From:	Craig Laubacher
To:	Squillace, Kristen M
Subject:	FW: IDEM OAQ Contact Information for Application No. 035-47764-00078 for Spartech, LLC
Date:	Monday, May 20, 2024 9:57:55 AM
Attachments:	image001.png image002.png image003.png image004.png image005.png image006.png image007.png image008.png

**** This is an EXTERNAL email. Exercise caution. DO NOT open attachments or click links from unknown senders or unexpected email. ****

Kristen,

Good morning. Nice to be introduced to you. I am assisting Spartech with their permit application, and I wanted to check in with you to see if you had any questions regarding the integral determination (which to my knowledge is the one remaining open item within the application). Please let me know if you have any questions and if our responses have been sufficient.

Thank you so much for your help,

Craig Laubacher
Regional Director
Environmental Compliance & Engineering
Mobile **512-635-4324**
Email claubacher@e-c-e.org

From: Alaoui, Hachem I <HIAlaoui@idem.IN.gov>
Sent: Monday, May 20, 2024 8:48 AM
To: Craig Laubacher <claubacher@e-c-e.org>
Cc: Squillace, Kristen M <KSquilla@idem.IN.gov>
Subject: RE: IDEM OAQ Contact Information for Application No. 035-47764-00078 for Spartech, LLC

Hi Craig,

I will be leaving for a vacation at the end of this week. Our permit writer, Kristen Squillace, copied in this email, will be in charge of your permit application No. 035-47764- 00078 for Spartech LLC The Jordan Company. Please coordinate with her for any questions you may have.

Thank you,

Indiana Department of Environmental Management
Hachem Ismaili Alaoui
Senior Environmental Manager 1
• (317) 232-2827 • Hialaoui@idem.IN.gov

Protecting Hoosiers and Our Environment

| | | | | www.idem.IN.gov

Help us improve!
IDEM values your feedback

From: Craig Laubacher <claubacher@e-c-e.org>
Sent: Monday, May 20, 2024 7:41 AM
To: Alaoui, Hachem I <HIAlaoui@idem.IN.gov>
Subject: RE: IDEM OAQ Contact Information for Application No. 035-47764-00078 for Spartech, LLC

**** This is an EXTERNAL email. Exercise caution. DO NOT open attachments or click links from unknown senders or unexpected email. ****

Hachem,

Good Monday to you. I wanted to check with you to see if you have all the information you require for the integral determination discussion below. If you'd like to discuss, I'm available today if that works for you.

Thank you for all of your help,

Craig Laubacher
Regional Director
Environmental Compliance & Engineering
Mobile **512-635-4324**
Email claubacher@e-c-e.org

From: Alaoui, Hachem I <HIAlaoui@idem.IN.gov>
Sent: Wednesday, May 8, 2024 10:15 AM
To: Collins, Jack <Jack.Collins@spartech.com>
Cc: Straitiff, Jessica <Jessica.Straitiff@spartech.com>; tlaubacher e-c-e.org <tlaubacher@e-c-e.org>; Craig Laubacher <claubacher@e-c-e.org>; Hood, Randy <Randy.Hood@spartech.com>; Power, Joshua <Joshua.Power@spartech.com>
Subject: RE: IDEM OAQ Contact Information for Application No. 035-47764-00078 for Spartech, LLC

Hi Jack,

Attached is an example of an integral determination for a different process that was submitted to IDEM-OAQ for evaluation. You can use it as a guide. You justification will be different since you have conveyors and the example is for power coating.

You can do soothing that looks like this example and send it to me.

Thank you,

Indiana Department of Environmental Management
Hachem Ismaili Alaoui
Senior Environmental Manager 1
• (317) 232-2827 • Hialaoui@idem.IN.gov

Protecting Hoosiers and Our

Environment

| www.idem.IN.gov

Help us improve!
IDEM values your feedback

From: Collins, Jack <Jack.Collins@spartech.com>
Sent: Tuesday, May 7, 2024 3:54 PM
To: Alaoui, Hachem I <HIAlaoui@idem.IN.gov>
Cc: Straitiff, Jessica <Jessica.Straitiff@spartech.com>; tlaubacher e-c-e.org <tlaubacher@e-c-e.org>; Craig Laubacher <claubacher@e-c-e.org>; Hood, Randy <Randy.Hood@spartech.com>; Power, Joshua <Joshua.Power@spartech.com>
Subject: RE: IDEM OAQ Contact Information for Application No. 035-47764-00078 for Spartech, LLC

**** This is an EXTERNAL email. Exercise caution. DO NOT open attachments or click links from unknown senders or unexpected email. ****

Here are our answers to the questions you had. Please let me know if you need anything else.
Thank you

1. One of the main reasons for the bin filters is to keep foreign material (contamination) from getting into the raw material being conveyed to the machinery
2. Not applicable
3. Yes, it is integral to the process.

From: Alaoui, Hachem I <HIAlaoui@idem.IN.gov>
Sent: Monday, May 6, 2024 12:51 PM
To: Collins, Jack <Jack.Collins@spartech.com>
Cc: Straitiff, Jessica <Jessica.Straitiff@spartech.com>
Subject: RE: IDEM OAQ Contact Information for Application No. 035-47764-00078 for Spartech, LLC

Jack,

Yes. Thank you.

Indiana Department of
Environmental Management
Hachem Ismaili Alaoui
Senior Environmental Manager 1
• (317) 232-2827 • Hialaoui@idem.IN.gov

Protecting Hoosiers and Our
Environment

| www.idem.IN.gov

Help us improve!
IDEM values your feedback

From: Collins, Jack <Jack.Collins@spartech.com>
Sent: Monday, May 6, 2024 12:24 PM
To: Alaoui, Hachem I <HIAlaoui@idem.IN.gov>
Cc: Straitiff, Jessica <Jessica.Straitiff@spartech.com>
Subject: RE: IDEM OAQ Contact Information for Application No. 035-47764-00078 for Spartech, LLC

**** This is an EXTERNAL email. Exercise caution. DO NOT open attachments or click links from unknown senders or unexpected email. ****

Good morning, is this the only response you are waiting on? I have sent a response to engineering to verify it is correct. As soon as I get a response, I will forward it to you. Thank you for your patience.

From: Alaoui, Hachem I <HIAlaoui@idem.IN.gov>
Sent: Thursday, May 2, 2024 10:49 AM
To: Collins, Jack <Jack.Collins@spartech.com>
Cc: Craig Laubacher <claubacher@e-c-e.org>; tlaubacher e-c-e.org <tlaubacher@e-c-e.org>; Straitiff, Jessica <Jessica.Straitiff@spartech.com>; Hood, Randy <Randy.Hood@spartech.com>
Subject: RE: IDEM OAQ Contact Information for Application No. 035-47764-00078 for Spartech, LLC

Hi Jack,

A control device integral request is a request from a source to IDEM-OAQ, in your case will be Spartech, LLC, to consider a control device be inherent or integral to a process. The source will provide the necessary information to IDEM-OAQ to justify why the control device should be integral to the process. In your case the control device will be bin vent and the process will be pneumatic conveyors. There are three questions that you need to address/answer and DEM-OAQ will evaluate your answers/information and decide if the bin vent filters should be considered integral or not. The three questions are:

1. Is the primary purpose of the equipment to control air pollution?
2. Where the equipment is recovering product, how do the cost savings from the product recovery compare to the cost of the equipment?
3. Would the equipment be installed if no air quality regulations are in place?

Section A.2(e) of your current permit has 23 pneumatic conveyors for transporting plastic pellets or regrind from the silos that have integral bin vent filters. This integral determination was done during permit renewal No. 30643, issued on November 2, 2011. I attached this permit for you in this email (see page 87 of this permit for integral determination justification provided at that time).

Regarding you second question. Normally, IDEM-OAQ looks at pollutant emissions from emission units before control to determine state rules applicability, the level of permitting, and the level of permit modification. However, if a control device was determined to be integral, IDEM-OAQ will look at the emissions after control for the state rules applicability, permit level determination, and permit modification levels.

In you case, the emissions from the pneumatic conveyors are very small and whether the bin vent filters are integral or not will not affect the current permit conditions.

Hopefully this answers your questions.

Please let me know if you have any other questions,

Thank you,

Indiana Department of
Environmental Management
Hachem Ismaili Alaoui
Senior Environmental Manager 1
• (317) 232-2827 • Hialaoui@idem.IN.gov

Protecting Hoosiers and Our
Environment

| | | | | www.idem.IN.gov
Help us improve!
IDEM values your feedback

From: Collins, Jack <Jack.Collins@spartech.com>
Sent: Thursday, May 2, 2024 9:42 AM
To: Alaoui, Hachem I <HIAlaoui@idem.IN.gov>
Cc: Craig Laubacher <claubacher@e-c-e.org>; tlaubacher e-c-e.org <tlaubacher@e-c-e.org>; Straitiff, Jessica <Jessica.Straitiff@spartech.com>; Hood, Randy <Randy.Hood@spartech.com>
Subject: FW: IDEM OAQ Contact Information for Application No. 035-47764-00078 for Spartech, LLC

Hachem would you please answer the below questions? Thank you

From: tlaubacher e-c-e.org <tlaubacher@e-c-e.org>
Sent: Tuesday, April 30, 2024 7:11 AM
To: Collins, Jack <Jack.Collins@spartech.com>; Craig Laubacher <claubacher@e-c-e.org>; Hood, Randy <Randy.Hood@spartech.com>
Cc: Straitiff, Jessica <Jessica.Straitiff@spartech.com>
Subject: RE: IDEM OAQ Contact Information for Application No. 035-47764-00078 for Spartech, LLC

Jack,

1. I don't know what an integral determination request is and what it consists of
2. I'm not sure of the ramifications if we decide not to pursue having them be integral to the emission unit. I think all that happens is the potential to emit for PM increases because we will not be able to take advantage of the filtering systems (control device) associated with the pneumatic conveyors

Tom Laubacher
330-807-9872 cell
ECE
Environmental Compliance & Engineering

From: Collins, Jack <Jack.Collins@spartech.com>
Sent: Monday, April 29, 2024 12:12 PM
To: Craig Laubacher <claubacher@e-c-e.org>; tlaubacher e-c-e.org <tlaubacher@e-c-e.org>; Hood, Randy <Randy.Hood@spartech.com>
Cc: Straitiff, Jessica <Jessica.Straitiff@spartech.com>
Subject: FW: IDEM OAQ Contact Information for Application No. 035-47764-00078 for Spartech, LLC

Any thoughts? Thank you

From: Alaoui, Hachem I <HIAlaoui@idem.IN.gov>
Sent: Monday, April 29, 2024 12:02 PM
To: Collins, Jack <Jack.Collins@spartech.com>
Subject: RE: IDEM OAQ Contact Information for Application No. 035-47764-00078 for Spartech, LLC

Hi Jack,

The current permit for Spartech, LLC has twenty-three (23) pneumatic conveyors for transporting plastic pellets or regrind from the silos, surge bins or containers to the coextruder input feed for processing with integral bin vent filters. In your application, you requested to add five (5) additional pneumatic conveyors. You will need to submit an integral determination request for these five (5) additional pneumatic conveyors in order to be evaluated to determine if the bin vent should be integral or not to those new 5 additional pneumatic conveyors.

If you are not interested, no integral determination request is need and IDEM-OAQ will consider the bin vent not integral to the new five (5) additional pneumatic conveyors.

Please let us know what you like to do for those five (5) new additional pneumatic conveyors.

Thank you,

Indiana Department of
Environmental Management
Hachem Ismaili Alaoui
Senior Environmental Manager 1
• (317) 232-2827 • Hialaoui@idem.IN.gov

Protecting Hoosiers and Our
Environment

| | www.idem.IN.gov

Help us improve!
IDEM values your feedback

From: Collins, Jack <Jack.Collins@spartech.com>
Sent: Friday, April 26, 2024 8:11 AM
To: Alaoui, Hachem I <HIAlaoui@idem.IN.gov>
Subject: Re: IDEM OAQ Contact Information for Application No. 035-47764-00078 for Spartech, LLC

**** This is an EXTERNAL email. Exercise caution. DO NOT open attachments or click links from unknown senders or unexpected email. ****

2671 sic code please. On both of out applications. Let me know if you have any questions.
Sent from my iPhone

On Apr 26, 2024, at 7:41 AM, Straitiff, Jessica <Jessica.Straitiff@spartech.com> wrote:

That works for me!

Thanks,
Jess

From: Collins, Jack <Jack.Collins@spartech.com>
Sent: Friday, April 26, 2024 7:24 AM
To: Straitiff, Jessica <Jessica.Straitiff@spartech.com>
Subject: Fwd: IDEM OAQ Contact Information for Application No. 035-47764-00078 for Spartech, LLC

2671 does look like a better fit in association to 326112.
Sent from my iPhone

Begin forwarded message:

From: "tlaubacher e-c-e.org" <tlaubacher@e-c-e.org>
Date: April 26, 2024 at 6:58:43 AM EDT
To: "Collins, Jack" <Jack.Collins@spartech.com>, Craig Laubacher <claubacher@e-c-e.org>
Subject: RE: IDEM OAQ Contact Information for Application No. 035-47764-00078 for Spartech, LLC

First of all, there is no right or wrong answer on choosing an SIC code. Its just that some might be a better description than others. And it is up to the owner to choose, not a regulator. Usually we use the SIC code or NAICS code that the facility is currently using for accounting purposes. Below is a quick analysis of the two codes. I like to couple the SIC code with its associated NAICS code, because the NAICS code descriptions are sometimes more detailed/refined. Remember, there could be (and usually are) more than one NAICS code associated with an SIC code.

325211	Plastics Material and Resin Manufacturing	**2821**	Plastics Materials, Synthetic and Resins, and Nonvulcanizable Elastomers
326112	Plastics Packaging Film and Sheet (including Laminated) Manufacturing	**2671**	Packaging Paper and Plastics Film, Coated and Laminated (single-web and multi-web plastics packaging film and sheet)
322221	Coated and Laminated Packaging Paper and Plastics Film Manufacturing	**2671**	Packaging Paper and Plastics Film, Coated and Laminated (except single-web and multi-web plastics packaging film and sheet)

Maybe there is a better one than these 2 choices. Attached is an excel spreadsheet that is a crosswalk between SIC code and NAICS code. Jack, ultimately I think it is up to you as a corporation to choose the SIC code that best describes your operations. Ultimately, it doesn't matter. There is no wrong answer.

Tom Laubacher
330-807-9872 cell
Environmental Compliance & Engineering

From: Collins, Jack <Jack.Collins@spartech.com>
Sent: Thursday, April 25, 2024 5:41 PM
To: tlaubacher e-c-e.org <tlaubacher@e-c-e.org>; Craig Laubacher <claubacher@e-c-e.org>
Subject: Fwd: IDEM OAQ Contact Information for Application No. 035-47764-00078 for Spartech, LLC

We make plastic roll stock are either of these sic codes correct?
Sent from my iPhone

Begin forwarded message:

From: "Alaoui, Hachem I" <HIAlaoui@idem.in.gov>
Date: April 25, 2024 at 10:27:23 AM EDT
To: "Collins, Jack" <Jack.Collins@spartech.com>
Subject: IDEM OAQ Contact Information for Application No. 035-47764-00078 for Spartech, LLC

CAUTION: This email originated from outside the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

You don't often get email from hialaoui@idem.in.gov. Learn why this is important

Dear Jack Collins,

I am the permit writer assigned to the current application No. 035-47764-00078 for Spartech, LLC. I would like to extend to you my contact information so that we may have continued communication until your new permit is issued. Please keep this information at hand. It is common for questions to arise, and oftentimes, further clarification is needed during the permit review process.

To expedite the review process, please e-mail me the electronic copy of your calculations in excel format.

Our database shows that the SIC code for Spartech, LLC is 2821 and the SIC code you provided is 2671. Also, the name we have in our database is Spartech, LLC The Jordan Company. Which name is correct? is it Spartech, LLC or Spartech, LLC **The Jordan Company.**

IDEM, OAQ will notify you when a draft permit has been submitted for public notice and/or when a final permit has been issued. As part of the notification, IDEM, OAQ will provide information on how to access the draft and/or final permit electronically on IDEM's website. If Spartech, LLC would prefer to receive paper copies of the entire draft and/or final permit, please let me know prior to the end of the applicant review period. If you prefer to receive paper copies of the entire permit, IDEM, OAQ will mail a paper copy of the draft permit and/or original signed final permit to the source contact. If you do not request to receive paper copies of the entire permit, IDEM, OAQ will only mail a paper copy of the original signed final permit signature page to the source contact.

Please feel free to contact me at any time if you have questions, concerns, or important information regarding your permit. For your convenience, my section chief (Ghassan Shalabi) may be contacted at 317-233-7622 or GShalabi@idem.IN.gov.

Thank you in advance for your time and assistance. I look forward to working with you.

Sincerely,

Indiana Department of Environmental Management
Hachem Ismaili Alaoui
Senior Environmental Manager 1
• (317) 232-2827 • Hialaoui@idem.IN.gov

Protecting Hoosiers and Our Environment

| www.idem.IN.gov

This email and any attachment(s) may contain confidential information. If you were not the intended recipient, please notify the Spartech LLC person who sent you this email and immediately delete the message and any attachments without copying them or disclosing them. Thank you.

This email and any attachment(s) may contain confidential information. If you were not the intended recipient, please notify the Spartech LLC person who sent you this email and immediately delete the message and any attachments without copying them or disclosing them. Thank you.

This email and any attachment(s) may contain confidential information. If you were not the intended recipient, please notify the Spartech LLC person who sent you this email and immediately delete the message and any attachments without copying them or disclosing them. Thank you.

This email and any attachment(s) may contain confidential information. If you were not the intended recipient, please notify the Spartech LLC person who sent you this email and immediately delete the message and any attachments without copying them or disclosing them. Thank you.

This email and any attachment(s) may contain confidential information. If you were not the intended recipient, please notify the Spartech LLC person who sent you this email and immediately delete the message and any attachments without copying them or disclosing them. Thank you.

From: Squillace, Kristen M
To: claubacher@e-c-e.org
Subject: IDEM OAQ Integral Determination Examples for Spartech App No. 035-47764-00078
Date: Monday, May 20, 2024 11:48:00 AM
Attachments: 30643integral determination.docx
image001.png
image002.png
image003.png
image004.png
image005.png
image006.png
image007.png
example integral determination.docx
example of integral determination2.docx

Hi Craig,

It was a pleasure speaking with you today. As we discussed, I'm attaching Spartech's first integral determination from permit 30643. I've also attached two examples of integral determinations that you can use as a reference on how to answer the questions for the determination.

1. Is the primary purpose of the equipment to control air pollution?
2. Where the equipment is recovering product, how do the cost savings from the product recovery compare to the cost of the equipment?
3. Would the equipment be installed if no air quality regulations are in place?

Let me know if the source would like go forward with the integral determination or if they are not interested in continuing with it.

Have a good day!

All the best,

Kristen

IDEM

Indiana Department of Environmental Management

Kristen Squillace
Environmental Manager
(317) 233-9327 • KSquilla@idem.IN.gov

Protecting Hoosiers and Our Environment

| | | | | | www.idem.IN.gov

Help us improve!
IDEM values your feedback

Air Pollution Control Justification as an Integral Part of the Process

The Permittee submitted the following justification such that the silo vent screens, bin vent filters, and vacuum pump filters controlling particulate emissions from Silos 1 through 12, the pneumatic conveyors, and the granulators be considered as an integral part of the manufacture of plastic sheeting process, as part of their MSOP application (Permit no.: M035-23122-00078, issued on April 18, 2007).

(a) During unloading, the raw materials for this plastic sheet manufacturing process (plastic pellets) are pneumatically conveyed from the railcar/truck unloading (RRUL) to the silos. Screened vents on the silo equalize pressure from the pneumatic transfer system. No bin vent filters are necessary as all materials handled are pelletized plastic, with negligible particulate emissions.

The Permittee did not provide data on cost and savings of these devices to show an "overwhelming economic benefit." IDEM, OAQ has evaluated the raw materials pneumatic conveying systems and has determined that the vent screens are not integral to the pneumatic conveying process. Therefore, the permitting level will be determined using the potential to emit before the screens.

(b) The plastic pellets are pneumatically conveyed from the silos, containers and surge bins to the coextruders. The pneumatic conveyors are fully enclosed vacuum pump systems that draw material from storage to the machine feed hoppers. Air is drawn through filters prior to entering the vacuum pump. The filters are required to protect the vacuum pump system. The use of the vacuum pump without the filter would result in pump failure, which in turn would result in off specification product and the shutdown of the production line. The pumps vent inside or outside the building, depending upon the process. The primary function of the filters on the pneumatic conveyance vacuum units is to prevent the failure of the vacuum pump system.

IDEM, OAQ has evaluated the vacuum pump pneumatic conveying systems and has determined that the filters perform a vital function and are integral to the vacuum conveying process. Therefore, the permitting level will be determined using the potential to emit after the filters.

(c) Waste from the coextruders, thermoformers, and Slitter/Trimmer/Rewinder is collected and ground in granulators for each process line, then pneumatically conveyed using pressure blowers to surge bins equipped with bin vent filters. The bin vent filters serve to neutralize air pressure at the end of the transport train and separate raw materials from air prior to storage or further processing.

The Permittee did not provide data on cost and savings of these devices to show an "overwhelming economic benefit." IDEM, OAQ has evaluated these justifications and determined that the bin vent filters controlling particulate emissions from the granulators, the pressure blowers, and the surge bins are not integral parts of the plastics extrusion process. Therefore, the permitting level will be determined using the potential to emit before the bin vent filters.

On June 17, 2011, the Permittee submitted information requesting that the bin vent filter be considered integral to the process for the 23 pneumatic conveyors for transporting plastic pellets or regrind from the silos, surge bins or containers to the coextruders. IDEM, OAQ evaluated the justifications and agreed that the bin vent filter will be considered integral to the process. This evaluation and approval was discussed in MSOP, M035-23122-00078, issued on April 18, 2007.

“Integral Part of the Process” Determination

The source submitted the following information to justify why the two (2) recovery cyclones (GBBC-2 and GBBC-3) should be considered an integral part of the glass bead blasters (GBB-2 and GBB-3), and one (1) recovery cyclone (SABC-1) should be considered an integral part of the soda ash blaster (SAB-1). Each of these units has add-on dust collectors, that not being examined for integral determination at this time.

(a) The Control Equipment Serves a Primary Purpose Other than Pollution Control

The two (2) glass bead blasters (GBB-2 and GBB-3) and one (1) soda ash blaster (SAB-1) are, each, manually operated batch process and is to be used offline on a periodic as-needed basis for cleaning parts in the teardown area. Each of these blasters is equipped with a media recovery cyclone. The cyclones are integral to the design of the machine (built as an integral part of the system) and are tied into the abrasive supply line for the pneumatic spray gun. The primary purpose of the cyclones is to return media to the gun for reuse in the abrasive cleaning process. Each of the cyclones is attached to the blaster via an exhaust tube located at the top of the blaster. Cyclones separate the collected materials that come through the exhaust tube. All recaptured blasting material is directed back into the media reservoir for reuse while the dust and particulate matter are directed into the add-on dust collectors that not being evaluated for integral determination.

(b) The Process Can Not Operate Without the Control Equipment

These material recovery cyclones are, each, physically part of the blast cabinets and connected via an exahust tube located at the top of the blasters. The cyclones are internal to the blasters and help produce a vacuum for the glass beads and soda ash to be fired through as well as providing a place for them to be captured. Removal of the cyclones would render these blaster units inoperable. Without the cyclones, the abrasive media would immediately exit the machine and the machines would quickly cease to operate (run out of media).

(c) The Control Equipment Has an Overwhelming Positive Net Economic Effect

Without the integral cyclone, the media consumption rate would be prohibitively high, and the unit would be extremely expensive (in both labor and material cost) to operate. Glass bead media is \$1.32 per pound, while soda ash is \$1.50 per pound. At the maximum rate of operation, the media consumption rates for blasting units GBB-2, GBB-3 and SAB-1 are 240, 50 and 100 pounds per hour respectively, corresponding to hourly media cost of \$317, \$65 and \$150 per hour of operation. With the integral cyclones in use, recovering is over 99% of the 100 sieve sized media for reuse, the total media costs are reduced from \$532 per hour to \$5.32 per hour, total. Furthermore, because each of the units hold less than 50 pounds of abrasive media each, there would be extensive manual labor and downtime necessary to resupply the unit with media every several minutes of operation.

"Integral Part of the Process" Determination

The source submitted the following information to justify why the dust collectors should be considered an integral part of the abrasive blasters:

(a) **Is the primary purpose of the equipment to control air pollution?**
No. The process cannot operate without the control equipment. The cyclones are integral to the blasting process by functioning as the media recycling and separation process, and ensuring fine particles from the blasting process and broken down media are not recirculated for quality purposes. The cyclone reclamation systems prevent the blasters from blasting the parts with contaminated media which would flaw the surface of the parts which would prevent the implants from meeting special design requirements for orthopedic industry QA/QC standards for surface finish requirements for implanting into the body. Additionally, without the cyclone and dust collector removing the fine dust from the blast cabinet, a dust cloud would exist that would not allow the operator to adequately see the parts and debris would build up in the blast cabinets.

Each blasting cabinet also has its own dedicated cyclone. The primary function of the cyclones is to facilitate the transfer of usable blasting media back into the blasting process. The cyclones will also provide particulate matter control. The cyclones will not operate without the dust collector. Limiting factors in this process include the time it takes an operator to prepare and load parts to be blasted, unload, and inspect blasted parts, and production needs as the source is a custom shop and does not always use the blasters.

Total PTE from the nine blasters with integral cyclone is 2.29 tons per year based on operating the blasters 8,760 hours/yr.

(b) **Where the equipment is recovering product, how do the cost savings from the product recovery compare to the cost of the equipment?**

Affected Process:		Cyclone 0663
Initial Investment		
Initial cost of DC 0663	$	$12,626
Anticipated life of unit	yrs	30 years
Total initial investment annualized over anticipate life of equipment	$/yr	$420.87
Operating Expense		
Price of electricity	/KWhr	16 cents
Estimated annual electricity usage	KWhr/yr	625
Cost of annual electrical usage	*$/yr*	*$99.99*
Price of labor*	$/hr	$21.00
Estimated amount of labor	hrs/yr	286
Cost of annual maintenance and labor	*$/yr*	*$6,006*
Total annualize operating costs	$/yr	$6,105.99
Product Recovery Savings		
Price per ton of WA-16-WM-B50 - 16 White Alum Oxide	$/ton	$3,820
Product recovered per year	tons/yr	12.08
Total annualized savings from operation of Cyclone 0663	$/yr	$46,145.60
Total Savings (Annual savings- annual maintenance and labor- total initial investment)		**$39,618.74**

(c) **Would the equipment be installed if no air quality regulations are in place?**

Yes. The blasters are designed and set up to only operate with the cyclone reclamation system in-line and operating. The cyclone is integral to the blasting process by functioning as the media recycling and separation process, and ensures that the fine particles from the blasting process and broken down media are not recirculated as part of the process for quality purposes. Without the cyclones, the blasters could blast the parts with contaminated media which would flaw the surface of the parts, thereby not meeting industry QA/QC standards. In addition, without removing the fine dust from the blast cabinet a dust cloud would exist that would not allow the operator to adequately see the part.

From:	Craig Laubacher
To:	Squillace, Kristen M
Subject:	RE: IDEM OAQ Integral Determination Examples for Spartech App No. 035-47764-00078
Date:	Thursday, May 30, 2024 11:24:27 AM
Attachments:	image001.png image002.png image003.png image004.png image005.png image006.png image007.png 2024 Muncie Emissions Calculations - Rev 2.xlsx 30643integral determination - previous permit.docx integral determination - 2024 permit.docx

Kristen,

Great talking with you today. I have attached 3 documents for your review.

1. The original integral determination document
2. The revised integral determination document
3. The updated PTE spreadsheet with clearly defined integral and non-integral determination calculations as well as updated emission factors for all polymers

Please let me know if you have any questions. Thank you again for your help with all of this.

Craig Laubacher
Regional Director
Environmental Compliance & Engineering
Mobile **512-635-4324**
Email claubacher@e-c-e.org

From: Squillace, Kristen M <KSquilla@idem.IN.gov>
Sent: Monday, May 20, 2024 10:48 AM
To: Craig Laubacher <claubacher@e-c-e.org>
Subject: IDEM OAQ Integral Determination Examples for Spartech App No. 035-47764-00078

Hi Craig,

It was a pleasure speaking with you today. As we discussed, I'm attaching Spartech's first integral determination from permit 30643. I've also attached two examples of integral determinations that you can use as a reference on how to answer the questions for the determination.

1. Is the primary purpose of the equipment to control air pollution?
2. Where the equipment is recovering product, how do the cost savings from the product

recovery compare to the cost of the equipment?
3. Would the equipment be installed if no air quality regulations are in place?

Let me know if the source would like go forward with the integral determination or if they are not interested in continuing with it.

Have a good day!

All the best,

Kristen

Indiana Department of Environmental Management

Kristen Squillace

Environmental Manager

(317) 233-9327 • KSquilla@idem.IN.gov

Protecting Hoosiers and Our Environment

| | | | | www.idem.IN.gov

Help us improve!

IDEM values your feedback

Appendix A: Emission Calculations
Potentail to Emit (PTE) Summary

Company Name: Spartech, LLC
Address: 1401 East Memorial Drive, Muncie, Indiana 47302
MSOP Permit No.: M035-43766-00078
Reviewer:

		Potential to Emit Before Controls (tons/year)							
Emission Unit	**Emission Unit ID**	**PM**	**PM10**	**PM2.5**	**SO_2**	**NOx**	**VOC**	**CO**	**Total HAPs**
Railcar Unloading	RRUL1 - RRUL4	5.20	5.20	5.20	-	-	-	-	-
Silos	Silo A - Silo P	1.02	1.02	1.02	-	-	-	-	-
Pneumatic Conveyors	-	2.23	2.23	2.23	-	-	-	-	-
Modified Existing Coextruders	COEX1 - COEX6	4.00	4.00	4.00	-	-	13.7	-	0.00
New Coextruders	COEX7 - COEX8	0.84	0.84	0.84	-	-	2.2	-	0.00
Coextruder Granulators	COEXG1 - COEXG8	0.15	0.15	0.15	-	-	-	-	-
Roll Granulators	G1-G5	0.18	0.18	0.18	-	-	-	-	-
Thermoformer	F5-F8, F11	1.51	1.51	1.51	-	-	0.71	-	0.47
Thermoformer Granulators/Conveyors	various	0.20	0.20	0.20	-	-	-	-	-
Slitter/Trimmer/Rewinder	SR1	0.00	0.00	0.00	-	-	-	-	-
Natural Gas Combustion	various	0.06	0.24	0.24	0.02	3.16	0.17	2.66	0.06
Printers	P4	-	-	-	-	-	7.50E-05	-	-
Ink Roll Cleaner	Roll Cleaner	-	-	-	-	-	1.03	-	0.01
Diesel-fired Fire Pump Engine	Pump1	0.11	0.11	0.11	0.11	1.61	0.13	0.35	0.001
NG Emergency Generator	Generator1	2.52E-05	3.27E-03	3.27E-03	1.92E-04	1.34	0.04	0.10	0.023
	Total (excluding fugitives)	**15.50**	**15.69**	**15.69**	**0.13**	**6.11**	**17.93**	**3.11**	**0.56**
Paved Roads (fugitive)	-	0.93	0.19	0.05	-	-	-	-	-
Cooling Tower (fugitive)	-	2.33E-03	2.33E-03	2.33E-03	-	-	-	-	-
	Total (including fugitives)	**16.43**	**15.88**	**15.74**	**0.13**	**6.11**	**17.93**	**3.11**	**0.56**

VOC – Changed from 24.26 tons/year to 17.93 tons/year
PM/PM_{10} – Changed from 35.84 tons/year to 16.43 tons/year

Appendix A: Emission Calculations
Particulate Emissions From Railcar unloading RRUL, RRUL2, and Silos

Company Name: Spartech, LLC
Address: 1401 East Memorial Drive, Muncie, Indiana 47302
MSOP Permit No.: M035-43766-00078
Reviewer:

Emission Unit (ID#) *(Control Device)*	Maximum Throughput (tons/hour)	PM/PM10/PM2.5 Emission Factor (controlled) (lbs/ton)[1]	Assumed Control Device for Emission Factor	PTE of PM/PM10/PM2.5 before Control (lbs/hr)	PTE of PM/PM10/PM2.5 before Control (ton/yr)
Railcar Unloading (RRUL1)	10.00	2.90E-05	Screens at 99.9%	0.29	**1.27**
Railcar Unloading (RRUL2)	5.94	2.90E-05	Screens at 99.9%	0.17	**0.75**
Railcar Unloading (RRUL3)	15.00	2.90E-05	Screens at 99.9%	0.44	**1.91**
Railcar Unloading (RRUL4)	10.00	2.90E-05	Screens at 99.9%	0.29	**1.27**
				Total:	**5.20**

Silos (A - P)	8.00	2.90E-05	Screens at 99.9%	0.23	**1.02**
				Total:	**1.02**

Emission units are uncontrolled.

1. Emission factor for plastic pellets is from AP 42, Chapter 11.6, Table 11.6-4 "Limestone Transfer with Fabric Filter" (SCC 3-05-006-12)(1/95).
Assume all PM is equal to PM10 and PM2.5
Even though the RRUL is bottleneck by the Coextruders, PTE was still based on the maximum capacity of the RRUL.
2. Silo P was added during 2024
There are 16 silos, each with a max throughput capacity of 1,000 lbs/hr (0.5 tons/hour)
The filters associated with the silos are integral to the process

METHODOLOGY

Before Controls PM/PM10/PM2.5 PTE (lb/hour) = Maximum Process Rate (ton/hour) x Controlled Emission Factor (lbs/ton) /(1- Control Efficiency (%))

Before Controls PM/PM10/PM2.5 PTE (ton/year) = (lbs/hour PTE) x (8760 hours/1 year) x (1 ton/2000 lbs)

Controlled PM/PM10/PM2.5 PTE (ton/year) = Maximum Process Rate (ton/hour) x Controlled Emission Factor (lbs/ton) x (8760 hours/1 year) x (1 ton/2000 lbs)

Appendix A: Emission Calculations
Particulate Emissions From Pneumatic Conveyors

Company Name: Spartech, LLC
Address: 1401 East Memorial Drive, Muncie, Indiana 47302
MSOP Permit No.: M035-43766-00078
Reviewer:

Emission Unit (ID#)	**Single Unit** Maximum Throughput (tons/hour)	PM/PM10/PM2.5 Emission Factor (controlled) (lbs/ton)[1]	Control Efficiency	PTE of PM/PM10/PM2.5 Before Control of **Single Unit** (tons/year)	PTE of PM/PM10/PM2.5 After Control of **Single Unit** (tons/year)
Twenty-eight (28) Pneumatic Conveyors (Vaccuum Pumps) (Integral bin vent filters)	1.25	2.9E-05	99.9%	0.159	**0.0002**
Two (2) Pneumatic Conveyor (bin vent filters Not Integral)	1.25	2.9E-05	99.9%	**0.159**	0.0002
Six (6) Pneumatic Conveyor (bin vent filters Not Integral)	2.50	2.9E-05	99.9%	**0.318**	0.0003
Total for 30 Pneumatic Conveyors (with intergral control):					0.0044
Total for 2 Pneumatic Conveyors (without control):					0.32
Total for 6 Pneumatic Conveyors (without control):					1.91
Total PTE for all Pneumatic Conveyors:					**2.23**

(1)Controlled emission factor for plastic pellets and scrap is from AP 42, Chapter 11.6, Table 11.6-4 "Limestone Transfer with Fabric Filter" (SCC 3-05-006-12)(1/95).
Assume all PM is equal to PM10 and PM2.5.
Even though these conveyors are bottleneck by the Coextruders, the PTE for the conveyors was still based on the maximum capacity of the conveyors.

METHODOLOGY

Before Controls PM/PM10/PM2.5 PTE (ton/yr) = Max Throughput (ton/hour) x Controlled Emission Factor (lbs/ton) /(1- Control Efficiency (%)) x 8760 hrs/year x 1 ton/2000 lbs

Controlled PTE of PM/PM10/PM2.5 (tons/year) = Max Throughput (ton/hour) x Emission Factor (lbs/ton) x 8760 hrs/year x 1 ton/2000 lbs

Since the bin vents on the twenty-three conveyors are considered integral, permit level is based on the PTE after control. Control on other conveyors is not considered integral.

Recipe/Structure (only 1 structure can be processed at one time)	Material Type	Maximum Throughput Rate (lbs/hour)	VOC Emission Factor (lbs/MMlb)	PM/PM10 Emission Factor (lbs/MMlb)	Ethylbenzene Emission Factor (lbs/MMlb)	Styrene Emission Factor (lbs/MMlb)	PTE of VOC (tons/year)	PTE of PM/PM10 (tons/year)

PTE of Ethylbenzene (tons/year)	PTE of Styrene (tons/year)

Recipe/Structure (only 1 structure can be processed at one time)	Material Type	Maximum Throughput Rate (lbs/hour)	VOC Emission Factor (lbs/MMlb)	PM/PM10 Emission Factor (lbs/MMlb)	Ethylbenzene Emission Factor (lbs/MMlb)	Styrene Emission Factor (lbs/MMlb)	PTE of VOC (tons/year)	PTE of PM/PM10 (tons/year)
1	Polypropylene	2,595	653.0	819.0	0.0	0.0	7.42	9.31
	EVOH/HDPE	118	30.7	26.6	0.0	0.0	0.02	0.01
	Glue/EVA	87.0	0.8	61.5	0.0	0.0	0.00	0.02
							7.44	9.35
1	Polypropylene	2,600	177.0	68.4	0.0	0.0	2.02	0.78
	Ethylene Vinyl Alcohol (EVOH)	250	0.0	0.0	0.0	0.0	0.00	0.00
	Glue/Ethylene Vinyl Acetate (EVA)	87	128.2	1.0	0.0	0.0	0.05	0.00
2	High Density Polyethylene (HDPE)	2,200	0.0	0.0	0.0	0	0.00	0.00
3	High Impact Polystyrene (HIPS)	3,800	190.0	53.3	0.0	0.0	3.16	0.89
	EVOH	250	0.0	0.0	0.0	0.0	0.00	0.00
	Glue/EVA	87	128.2	1.0	0.0	0.0	0.05	0.00
							3.21	0.89
							-4.23	**-8.46**
1	Polypropylene	2,781	177	68	0	0.0	2.16	0.83
	EVOH/HDPE	126	0.0	0.0	0.0	0.0	0.00	0.00
	Glue/EVA	93.0	128.2	1.0	0.0	0.0	0.05	0.00
							2.21	0.83
1	Polypropylene	2,700	177.0	68.4	0.00	0	2.09	0.81
	EVOH	250	0.0	0.0	0.00	0	0.00	0.00
	Glue/EVA	87	128.2	1.0	0.00	0	0.05	0.00
2	HIPS	3,000	190.0	53.3	0.0	0.0	2.50	0.70
3	HDPE	2,500	0.0	0.0	0.0	0.0	0.00	0.00
	LDPE	400	35.3	30.9	0.0	0.0	0.06	0.05
							2.50	0.81
							0.29	**-0.02**
1	RPET	2,400	157.4	242.0	0.0	44.3	1.65	2.54
							1.65	2.54
1	Polypropylene	2,200	177.0	68.4	0.0	0.0	1.71	0.66
	EVOH	150	0.0	0.0	0.0	0.0	0.00	0.00
	Glue/EVA	90	128.2	1.0	0.0	0.0	0.05	0.00
2	Polyethylene Terephthalate (PET)	2,400	0.3	0.0	0.0	0.0	0.00	0.00
3	HIPS	2,400	190.0	53.3	0.0	0.0	2.00	0.56
	EVOH	150	0.0	0.0	0.0	0.0	0.00	0.00
	Glue/EVA	90	128.2	1.0	0.0	0.0	0.05	0.00

	HDPE	150	35.3	30.9	0.0	0.0	0.02	0.02
							2.07	0.66
							0.42	**-1.88**
1	Polystyrene	3000	53.3	0.0	6.1	0.0	0.70	0.00
							0.70	0.00
1	Polypropylene	2,700	177.0	68.4	0.00	0	2.09	0.81
2	HIPS	3,000	190.0	53.3	0.00	0.0	2.50	0.70
3	HDPE	2,500	0.0	0.0	0.0	0.0	0.00	0.00
4	PET	3,000	0.3	0.0	0.0	0.0	0.00	0.00
							2.50	0.81
							1.80	**0.81**
1	Polystyrene	3,353	53.3	0.0	6.1	0.0	0.78	0.00
	EVOH/HDPE	107	30.7	26.6	0.0	0.0	0.01	0.01
	Glue/EVA	194	117.2	61.5	0.0	0.0	0.10	0.05
	LDPE	35	157.4	242.2	0.0	0.0	0.02	0.04
2	PET	4,500	0.3	0.0	0.0	0.0	0.01	0.00
	Polystyrene	4,500	53.3	0.0	6.1	0.0	1.05	0.00
							0.92	0.10
1	Polypropylene	2,700	177.0	68.4	0.0	0.0	2.09	0.81
	EVOH	150	0.0	0.0	0.0	0.0	0.00	0.00
	Glue/EVA	90	128.2	1.0	0.0	0.0	0.05	0.00

PTE of Ethylbenzene (tons/year)	PTE of Styrene (tons/year)
0.00	0.00
0.00	0.00
0.00	0.00
0.00	0.00
0.00	0.00
0.00	0.00
0.00	0.00
0.00	0.00
0.00	0.00
0.00	0.00
0.00	0.00
0.00	0.00
0.00	**0.00**
0.00	0.00
0.00	0.00
0.00	0.00
0.00	0.00
0.00	0.00
0.00	0.00
0.00	0.00
0.00	0.00
0.00	0.00
0.00	0.00
0.00	0.00
0.00	**0.00**
0.00	0.47
0.00	0.47
0.00	0.00
0.00	0.00
0.00	0.00
0.00	0.00
0.00	0.00
0.00	0.00
0.00	0.00

0.00	0.00
0.00	0.00
0.00	**-0.47**
0.08	0.00
0.08	0.00
0.00	0.00
0.00	0.00
0.00	0.00
0.00	0.00
0.00	0.00
-0.08	**0.00**
0.09	0.00
0.00	0.00
0.00	0.00
0.00	0.00
0.00	0.00
0.12	0.00
0.09	0.00
0.00	0.00
0.00	0.00
0.00	0.00

Appendix A: Emission Calculations
Particulate Emissions From Coextruder Granulators and Roll Granulators

Company Name: **Spartech, LLC**
Address: **1401 East Memorial Drive, Muncie, Indiana 47302**
MSOP Permit No.: **M035-43766-00078**
Reviewer:

Emission Unit (ID#) *(Control Device)*	Maximum Throughput (tons/hour)	PM/PM10/PM2.5 Emission Factor (controlled) (lbs/ton)[1]	Control Device	Control Efficiency (%)	PTE of PM/PM10/PM2.5 before Control (lbs/hr)	PTE of PM/PM10/PM2.5 After Control (lbs/hr)	PTE of PM/PM10/PM2.5 Before Control (tons/year)	PTE of PM/PM10/PM2.5 After Control (tons/year)
Coextruder Granulators/Conveyors (COEXG1) *(Bin Vent Filters)*	0.19	2.9E-05	Fabric filter	99.9%	5.51E-03	5.5E-06	0.024	2.41E-05
Coextruder Granulators/Conveyors (COEXG2) *(Bin Vent Filters)*	0.15	2.9E-05	Fabric filter	99.9%	4.35E-03	4.4E-06	0.019	1.91E-05
Coextruder Granulators/Conveyors (COEXG3) *(Bin Vent Filters)*	0.12	2.9E-05	Fabric filter	99.9%	3.48E-03	3.5E-06	0.015	1.52E-05
Coextruder Granulators/Conveyors (COEXG4) *(Bin Vent Filters)*	0.15	2.9E-05	Fabric filter	99.9%	4.35E-03	4.4E-06	0.019	1.91E-05
Coextruder Granulators/Conveyors (COEXG5) *(Bin Vent Filters)*	0.24	2.9E-05	Fabric filter	99.9%	6.82E-03	6.8E-06	0.030	2.99E-05
Coextruder Granulators/Conveyors (COEXG6) *(Bin Vent Filters)*	0.18	2.9E-05	Fabric filter	99.9%	5.08E-03	5.1E-06	0.022	2.22E-05
Coextruder Granulators/Conveyors (COEXG7) *(Bin Vent Filters)*	0.05	2.9E-05	Fabric filter	99.9%	1.45E-03	1.5E-06	0.006	6.35E-06
Coextruder Granulators/Conveyors (COEXG8) *(Bin Vent Filters)*	0.12	2.9E-05	Fabric filter	99.9%	3.34E-03	3.3E-06	0.015	1.46E-05
						Totals	**0.151**	**0.000**

Roll Granulator (G1) *(No Controls)*	1.25	2.9E-05	no control	NA	3.63E-03	3.6E-03	0.016	0.016
Roll Granulator (G2) *(Bin Vent Filters)*	1.00	2.9E-05	Fabric filter	99.9%	2.90E-02	2.9E-05	0.127	1.27E-04
Roll Granulator (G3) *(No Controls)*	1.25	2.9E-05	no control	NA	3.63E-03	3.6E-03	0.016	0.016
Roll Granulator (G4) *(No Controls)*	1.25	2.9E-05	no control	NA	3.63E-03	3.6E-03	0.016	0.016
Roll Granulator (G5) *(No Controls)*	0.50	2.9E-05	no control	NA	1.45E-03	1.5E-03	0.006	0.006
						Totals	**0.181**	**0.054**

1. Controlled emission factor for plastic pellets and scrap is from AP 42, Chapter 11.6, Table 11.6-4 "Limestone Transfer with Fabric Filter" (SCC 3-05-006-12)(1/95).
Assume all PM is equal to PM10 and PM2.5

METHODOLOGY

Controlled PTE of PM/PM10/PM2.5 (lbs/hour) = Maximum Process Rate (lbs/hour) x Emission Factor (lbs/ton)

Controlled PTE of PM/PM10/PM2.5 (tons/year) = Maximum Process Rate (lbs/hour) * Emission Factor (lbs/ton) * 8760 hrs/year *1 ton/2000 lbs

Uncontrolled PTE PM/PM10/PM2.5 (lb/hour) = Maximum Process Rate (lbs/hour) x Emission Factor (lbs/ton)/(1-Control Eff. (%)

Uncontrolled PTE PM/PM10/PM2.5 (ton/year) = Maximum Process Rate (lbs/hour) * Emission Factor (lbs/ton) * 8760 hrs/year *1 ton/2000 lbs / (1-Control Eff. (%)

Appendix A: Emission Calculations
Emissions From Thermoformers

Company Name: **Spartech, LLC**
Address: **1401 East Memorial Drive, Muncie, Indiana 47302**
MSOP Permit No.: **M035-43766-00078**
Reviewer:

Emission Unit (ID#) *(Uses electric heating elements to soften and re-form plastic products, using no controls and venting inside the building.)*	Material(s) Processed on Former	EF For Worst Case Material, (lbs/ton) (VOC)	EF For Worst Case Material (lbs/ton) (PM)	EF For Worst Case Material (lbs/ton) (HAP)	Maximum Throughput (tons/hour)	Maximum Throughput (tons/yr)	Usage (%)	**PTE Tons/Year (VOC)**	**PTE Tons/Year (PM)**	**PTE Tons/Year (HAP)**
Thermoformer 5 (F5)	Polypropylene	0.0614	0.1302	0.00284	0.15	1274.58	100.0%	0.0391	0.0830	0.0018
Thermoformer 6 (F6)	Polypropylene	0.0614	0.1302	0.00284	0.56	4927.50	80.0%	0.1210	0.2566	0.0056
Thermoformer 7 (F7)	Polypropylene	0.0614	0.1302	0.00284	0.56	4927.50	85.0%	0.1286	0.2727	0.0059
Thermoformer 8 (F8)	RPET	0.0614	0.1302	0.0052	0.70	6145.14	85.0%	0.1604	0.3400	0.0136
Thermoformer 11 (F11)	Polystyrene	0.0614	0.1302	0.10286	1.40	12264.00	70.0%	0.2636	0.5589	0.4415
							Totals (ton/yr)	**0.71**	**1.51**	**0.47**

Assume all PM is equal to PM10 and PM2.5
Usage % = Percentage of time formers are running.

METHODOLOGY

Potential Emission= Emission Factor * Material Rate * 8760 / 2000

Sources for Plastics Emission Factors:

Resin Type	Citation
Polypropylene (PP)	"Development of Emission Factors for Polypropylene Processing", Adams et al, J. Journal of Air and Waste Management Association, 49:49-56, 1999
Polyethylene, Polypropylene, Polyvinyl Chloride, Polystyrene (PE/PP/PVC/PS)	Patel, S.H. and Xanthos, M., Advances in Polymer Technology, Vol 14, No 1, 67-77 (1995).
Ethylene Vinyl Acetate (EVA), Ethylene-Methyl Acrylate (EMA), Polyethylene - low density (LDPE)	Barlow et al, J. Air & Waste Manage. Assoc., 47:1111-1118, 1997
Polyamide(PA) (Nylon)	Kriek et al, J. Air & Waste Manage. Assoc., 51:1001-1008, 2001
Polycarbonate (PC)	Rhodes et al, J. Air & Waste Manage. Assoc., 52:781-788, 2002
Acrylonitrile Butadiene Styrene (ABS)	Contos et al, J. Air & Waste Manage. Assoc., 45:686-694, 1995
Polyvinyl Chloride (PVC)	Ernes, D.A. and Griffin, J.P, J. Vinyl & Additive Technology, Sept 1996, Vol 2, No. 3, 180-183.

Appendix A: Emission Calculations
Particulate Emissions From Thermoformer Granulators/Conveyors

Company Name: **Spartech, LLC**
Address: **1401 East Memorial Drive, Muncie, Indiana 47302**
MSOP Permit No.: **M035-43766-00078**
Reviewer:

Emission Unit (ID#) *(Control Device)*	Maximum Throughput (tons/hour)	PM/PM10/PM2.5 Controlled Emission Factor (lbs/ton)[1]	Control Device	Control Efficiency (%)	PTE of PM/PM10/PM2.5 before Control (lbs/hr)	PTE of PM/PM10/PM2.5 After Control (lbs/hr)	**PTE of PM/PM10/PM2.5 Before Control (tons/year)**	PTE of PM/PM10/PM2.5 After Control (tons/year)
Thermoformer Granulators/Conveyors (FG5) *(Bin Vent Filters)*	0.13	2.9E-05	Fabric filter	99.9%	3.63E-03	3.6E-06	0.016	1.59E-05
Thermoformer Granulators/Conveyors (FG6A) *(Bin Vent Filters)**	0.25	2.9E-05	Fabric filter	99.9%	7.28E-03	7.3E-06	0.032	3.19E-05
Thermoformer Granulators/Conveyors (FG7) *(Bin Vent Filters)*	0.25	2.9E-05	Fabric filter	99.9%	7.28E-03	7.3E-06	0.032	3.19E-05
Thermoformer Granulators/Conveyors (FG8A) *(Bin Vent Filters)*	0.25	2.9E-05	Fabric filter	99.9%	7.28E-03	7.3E-06	0.032	3.19E-05
Thermoformer Granulators/Conveyors (FG11A) *(Bin Vent Filters)*	0.35	2.9E-05	Fabric filter	99.9%	1.02E-02	1.0E-05	0.044	4.45E-05
Thermoformer Granulators/Conveyors (FG11B) *(Bin Vent Filters)*	0.35	2.9E-05	Fabric filter	99.9%	1.02E-02	1.0E-05	0.044	4.45E-05
						Totals (ton/yr)	**0.20**	2.00E-04

* Thermoformer Granulators/Conveyors FG11A and FG11B do not operate simultaneously, one or the other is used depending on the product produced by Thermoformer F6

1. Emission factor for plastic pellets and scrap is from AP 42, Chapter 11.6, Table 11.6-4 "Limestone Transfer with Fabric Filter" (SCC 3-05-006-12)(1/95).

Assume all PM is equal to PM10 and PM2.5

METHODOLOGY

Controlled PTE of PM/PM10/PM2.5 (lbs/hour) = Maximum Process Rate (lbs/hour) x Emission Factor (lbs/ton)

Controlled PTE of PM/PM10/PM2.5 (tons/year) = Maximum Process Rate (lbs/hour) * Emission Factor (lbs/ton) * 8760 hrs/year *1 ton/2000 lbs

Uncontrolled PTE PM/PM10/PM2.5 (lb/hour) = Maximum Process Rate (lbs/hour) x Emission Factor (lbs/ton)/(1-Control Eff. (%)

Uncontrolled PTE PM/PM10/PM2.5 (ton/year) = Maximum Process Rate (lbs/hour) * Emission Factor (lbs/ton) * 8760 hrs/year *1 ton/2000 lbs / (1-Control Eff. (%)

Appendix A: Emission Calculations
Particulate Emissions From Slitter (SR1) and Granulators (G1-G4)

Company Name: Spartech, LLC
Address: 1401 East Memorial Drive, Muncie, Indiana 47302
MSOP Permit No.: M035-43766-00078
Reviewer:

Emission Unit (ID#) *(Control Device)*	Maximum Throughput (tons/hour)	PM/PM10/PM2.5 Emission Factor (controlled) (lbs/ton)	Control Device	Control Efficiency (%)	PTE of PM/PM10/PM2.5 before Control (lbs/hr)	**PTE of PM/PM10/PM2.5 Before Control (tons/year)**
Slitter/Trimmer/Rewinder/Conveyor (SR1)[1]	0.50	0.0	NA	NA	0.0	0.0
					Totals:	**0.0**

1. The Slitter was replaced in 2022. The new Slitter does not have an associated Granulator. See Granulator tab for Roll Granulator emissions

Appendix A: Emissions Calculations
Natural Gas Combustion Emission Unit List
MM BTU/HR <100

Company Name: Spartech, LLC
Address: 1401 East Memorial Drive, Muncie, Indiana 47302
MSOP Permit No.: M035-43766-00078
Reviewer:

3.06	18 Natural Gas-Fired Heaters, 1A, 4A-8A, 10A-13A, 1B-3B, 10B-14B @ 0.170 MMBtu/hr, each
0.15	3 Natural Gas-Fired tube heaters with heat input capacity 0.05 MMBtu/hr each
1.60	2 Natural Gas-Fired Heaters with heat input capacity of 0.80 MMBtu each
0.12	3 Natural Gas-Fired Heaters with heat input capacity of 0.04 MMBtu each
0.16	2 Natural Gas-Fired Heaters with heat input capacity of 0.08 MMBtu each
0.12	1 Natural Gas-Fired Heaters with heat input capacity of 0.12 MMBtu
0.597	CR1 natural gas-fired crystallizer unit with a maximum capacity of 0.597 MMBtu/hr
0.895	CR2 natural gas-fired crystallizer unit maximum capacity of 0.895 MMBtu/hr
0.331	DR6 natural gas-fired dryer unit with a maximum capacity of 0.331 MMBtu/hr
0.331	DR15 natural gas-fired dryer unit with a maximum capacity of 0.331 MMBtu/hr
7.4	**Total (MMBtu/hr)**

Appendix A: Emissions Calculations
Natural Gas Combustion Only
MM BTU/HR <100
Company Name: Spartech, LLC
Address: 1401 East Memorial Drive, Muncie, Indiana 47302
MSOP Permit No.: M035-43766-00078
Reviewer:

Heat Input Capacity MMBtu/hr	HHV mmBtu/mmscf	Potential Throughput MMCF/yr
7.4	1020	63.2

	Pollutant						
	PM*	PM10*	direct PM2.5*	SO2	NOx	VOC	CO
Emission Factor in lb/MMCF	1.9	7.6	7.6	0.6	100 **see below	5.5	84
Potential Emission in tons/yr	0.06	0.24	0.24	0.02	3.16	0.17	2.66

*PM emission factor is filterable PM only. PM10 emission factor is filterable and condensable PM10 combined.
PM2.5 emission factor is filterable and condensable PM2.5 combined.
**Emission Factors for NOx: Uncontrolled = 100, Low NOx Burner = 50, Low NOx Burners/Flue gas recirculation = 32

Methodology

All emission factors are based on normal firing.
MMBtu = 1,000,000 Btu
MMCF = 1,000,000 Cubic Feet of Gas
Emission Factors are from AP 42, Chapter 1.4, Tables 1.4-1, 1.4-2, 1.4-3, SCC #1-02-006-02, 1-01-006-02, 1-03-006-02, and 1-03-006-03
Potential Throughput (MMCF) = Heat Input Capacity (MMBtu/hr) x 8,760 hrs/yr x 1 MMCF/1,000 MMBtu
Emission (tons/yr) = Throughput (MMCF/yr) x Emission Factor (lb/MMCF)/2,000 lb/ton

	HAPs - Organics				
	Benzene	Dichlorobenzene	Formaldehyde	Hexane	Toluene
Emission Factor in lb/MMcf	2.1E-03	1.2E-03	7.5E-02	1.8E+00	3.4E-03
Potential Emission in tons/yr	6.641E-05	3.795E-05	2.37E-03	5.692E-02	1.075E-04

	HAPs - Metals				
	Lead	Cadmium	Chromium	Manganese	Nickel
Emission Factor in lb/MMcf	5.0E-04	1.1E-03	1.4E-03	3.8E-04	2.1E-03
Potential Emission in tons/yr	1.581E-05	3.478E-05	4.427E-05	1.202E-05	6.641E-05

Total (ton/yr)	0.060	
Highest Single (ton/yr)	0.057	hexane

Methodology is the same as the page before

The five highest organic and metal HAPs emission factors are provided above.
Additional HAPs emission factors are available in AP-42, Chapter 1.4.

Appendix A: Emission Calculations
VOC and HAP Emissions From the Printer Ink and Printer Cleaners

Company Name: Spartech, LLC
Address: 1401 East Memorial Drive, Muncie, Indiana 47302
MSOP Permit No.: M035-43766-00078
Reviewer:

Emissions Unit ID	Maximum Process Rate (parts/hour)	Usage Rate (lb of ink/part)	Weight % VOC in Ink	PTE VOC (lbs/hr)	PTE of VOC (tons/year)
Printer P4	25,200	6.8E-07	0.10%	1.71E-05	7.50E-05
			Total	**1.71E-05**	**7.50E-05**

Inks are cured with UV light.

METHODOLOGY
PTE of VOC (tons/year) = Maximum Process Rate (parts/hour) x Usage Rate (lb of ink/part) x Weight % VOC x 8760 hours/year x 1 ton/2000 lbs

Emission unit	Material	Density (lbs/gal)	Weight % VOC	Weight % Ethyl Acetate	Weight % Methyl Alcohol (HAP)	Weight % Methyl Isobutyl Ketone (HAP)	Maximum Usage (gal/year)	PTE of VOC (tons/year)	PTE of Ethyl Acetate (tons/year)	PTE of Methyl Alcohol (HAP) (tons/year)	PTE of Methyl Isobutyl Ketone (HAP) (tons/year)	Total HAP (ton/yr)
Ink Roll Hand Cleaning	Ethyl Acetate	7.51	100%	100%	0%	0%	220	0.83	0.83	0.00	0.00	0.01
	Denatured Ethyl Alcohol	8.34	100%	0%	3%	2%	50	0.21	0.00	0.007	0.004	

METHODOLOGY
PTE of VOC/HAP (tons/year) = Density (lbs/gal) x Weight % VOC/HAP x Maximum Usage (gal/year) x 1 ton/2000 lbs

Appendix A: Emission Calculations
Generator1
Reciprocating Internal Combustion Engines - Natural Gas
4-Stroke Lean-Burn (4SLB) Engines

Company Name: Spartech, LLC
Source Address: 1401 East Memorial Drive, Muncie, Indiana 47302
MSOP Permit No.: M035-43766-00078
Reviewer:

Maximum Output Horsepower Rating (hp)	187
Brake Specific Fuel Consumption (BSFC) (Btu/hp-hr)	7000
Maximum Hours Operated per Year (hr/yr)	500
Potential Fuel Usage (MMBtu/yr)	655
High Heat Value (MMBtu/MMscf)	1020
Potential Fuel Usage (MMcf/yr)	0.64

	Pollutant						
Criteria Pollutants	PM*	PM10*	PM2.5*	SO2	NOx	VOC	CO
Emission Factor (lb/MMBtu)	7.71E-05	9.99E-03	9.99E-03	5.88E-04	4.08E+00	1.18E-01	3.17E-01
Potential Emissions (tons/yr)	2.52E-05	3.27E-03	3.27E-03	1.92E-04	1.34	0.04	0.10

*PM emission factor is for filterable PM-10. PM10 emission factor is filterable PM10 + condensable PM.
PM2.5 emission factor is filterable PM2.5 + condensable PM.

Hazardous Air Pollutants (HAPs)

Pollutant	Emission Factor (lb/MMBtu)	Potential Emissions (tons/yr)
Acetaldehyde	8.36E-03	0.003
Acrolein	5.14E-03	0.002
Benzene	4.40E-04	0.000
Biphenyl	2.12E-04	0.000
1,3-Butadiene	2.67E-04	0.000
Formaldehyde	5.28E-02	**0.017**
Methanol	2.50E-03	0.001
Hexane	1.10E-03	0.000
Toluene	4.08E-04	0.000
2,2,4-Trimethylpentane	2.50E-04	0.000
Xylene	1.84E-04	0.000
	Total	**0.02**

HAP pollutants consist of the eleven highest HAPs included in AP-42 Table 3.2-2.

Methodology
Emission Factors are from AP-42 (Supplement F, July 2000), Table 3.2-2
Potential Fuel Usage (MMBtu/yr) = [Maximum Output Horsepower Rating (hp)] * [Brake Specific Fuel Consumption (Btu/hp-hr)] * [Maximum Hours Operated per Year (hr/yr)] / [1000000 Btu/MMBtu]
Potential Emissions (tons/yr) = [Potential Fuel Usage (MMBtu/yr)] * [Emission Factor (lb/MMBtu)] / [2000 lb/ton]

Appendix A: Emission Calculations
One (1) Fire Pump Engine
Reciprocating Internal Combustion Engines - Diesel Fuel
Output Rating (<=600 HP)
Maximum Input Rate (<=4.2 MMBtu/hr)

Company Name: **Spartech, LLC**
Source Address: **1401 East Memorial Drive, Muncie, Indiana 47302**
MSOP Permit No.: **M035-43766-00078**
Reviewer:

Emissions calculated based on output rating (hp)

The Fire Pump Engine is owned by Newell and is located on adjacent property across th
Spartech uses the fire water system with Newell

Output Horsepower Rating (hp)	208.0
Maximum Hours Operated per Year	500
Potential Throughput (hp-hr/yr)	104,000

	Pollutant						
	PM*	PM10*	direct PM2.5*	SO2	NOx	VOC	CO
Emission Factor in lb/hp-hr	0.0022	0.0022	0.0022	0.00205	0.0310	0.0025	0.00668
Potential Emission in tons/yr	0.11	0.11	0.11	0.11	1.61	0.13	0.35

*PM and PM2.5 emission factors are assumed to be equivalent to PM10 emission factors. No information was given regarding which method was used to determine the factor or the fraction of PM10 which is condensable.

Hazardous Air Pollutants (HAPs)

	Pollutant							
	Benzene	Toluene	Xylene	1,3-Butadiene	Formaldehyde	Acetaldehyde	Acrolein	Total PAH HAPs***
Emission Factor in lb/hp-hr****	6.53E-06	2.86E-06	2.00E-06	2.74E-07	8.26E-06	5.37E-06	6.48E-07	1.18E-06
Potential Emission in tons/yr	3.40E-04	1.49E-04	1.04E-04	1.42E-05	4.30E-04	2.79E-04	3.37E-05	6.12E-05

***PAH = Polyaromatic Hydrocarbon (PAHs are considered HAPs, since they are considered Polycyclic Organic Matter)
****Emission factors in lb/hp-hr were calculated using emission factors in lb/MMBtu and a brake specific fuel consumption of 7,000 Btu / hp-hr (AP-42 Table 3.3-1).

Potential Emission of Total HAPs (tons/yr)	**1.41E-03**

Methodology

Emission Factors are from AP 42 (Supplement B 10/96) Tables 3.3-1 and 3.3-2.
Potential Throughput (hp-hr/yr) = [Output Horsepower Rating (hp)] * [Maximum Hours Operated per Year]
Potential Emission (tons/yr) = [Potential Throughput (hp-hr/yr)] * [Emission Factor (lb/hp-hr)] / [2,000 lb/ton]

Appendix A: Emission Calculations
Fugitive Dust Emissions - Paved Roads

Company Name: **Spartech, LLC**
Source Address: **1401 East Memorial Drive, Muncie, Indiana 47302**
MSOP Permit No.: **M035-43766-00078**
Reviewer:

Paved Roads at Industrial Site
The following calculations determine the amount of emissions created by paved roads, based on 8,760 hours of use and AP-42, Ch 13.2.1 (1/2011).

Vehicle Informtation (provided by source)

Type	Maximum number of vehicles per day	Number of one-way trips per day per vehicle	Maximum trips per day (trip/day)	Maximum Weight Loaded (tons/trip)	Total Weight driven per day (ton/day)	Maximum one-way distance (feet/trip)	Maximum one-way distance (mi/trip)	Maximum one-way miles (miles/day)	Maximum one-way miles (miles/yr)
Semi Trailer (entering plant) (one-way trip)	15.0	1.0	15.0	35.0	525.0	528	0.100	1.5	547.5
Semi Trailer (leaving plant) (one-way trip)	15.0	1.0	15.0	5.0	75.0	528	0.100	1.5	547.5
Private Vehicle (entering plant) (one-way trip)	1.0	1.0	1.0	1.0	1.0	528	0.100	0.1	36.5
Private Vehicle (entering plant) (one-way trip)	1.0	1.0	1.0	1.0	1.0	528	0.100	0.1	36.5
		Total	**32.0**		**602.0**			**3.2**	**1168.0**

Average Vehicle Weight Per Trip = 18.8 tons/trip
Average Miles Per Trip = 0.10 miles/trip

Update to reflect 15 trucks entering and exiting each day
cells b13 and b14

Unmitigated Emission Factor, Ef = [k * (sL)^0.91 * (W)^1.02] (Equation 1 from AP-42 13.2.1)

	PM	PM10	PM2.5	
where k =	0.011	0.0022	0.00054	lb/VMT = particle size multiplier (AP-42 Table 13.2.1-1)
W =	18.8	18.8	18.8	tons = average vehicle weight (provided by source)
sL =	9.7	9.7	9.7	g/m^2 = silt loading value for paved roads at iron and steel production facilities - Table 13.2.1-3)

Taking natural mitigation due to precipitation into consideration, Mitigated Emission Factor, Eext = E * [1 - (p/4N)] (Equation 2 from AP-42 13.2.1)
Mitigated Emission Factor, Eext = Ef * [1 - (p/4N)]
where p = 125 days of rain greater than or equal to 0.01 inches (see Fig. 13.2.1-2)
N = 365 days per year

	PM	PM10	PM2.5	
Unmitigated Emission Factor, Ef =	1.735	0.347	0.0852	lb/mile
Mitigated Emission Factor, Eext =	1.586	0.317	0.0779	lb/mile

Process	Unmitigated PTE of PM (tons/yr)	Unmitigated PTE of PM10 (tons/yr)	Unmitigated PTE of PM2.5 (tons/yr)	Mitigated PTE of PM (tons/yr)	Mitigated PTE of PM10 (tons/yr)	Mitigated PTE of PM2.5 (tons/yr)
Semi Trailer (entering plant) (one-way trip)	0.47	0.09	0.02	0.43	0.09	0.02
Semi Trailer (leaving plant) (one-way trip)	0.47	0.09	0.02	0.43	0.09	0.02
Private Vehicle (entering plant) (one-way trip)	0.03	0.01	0.00	0.03	0.01	0.00
Private Vehicle (entering plant) (one-way trip)	0.03	0.01	0.00	0.03	0.01	0.00
	1.01	**0.20**	**0.05**	**0.93**	**0.19**	**0.05**

Methodology

Total Weight driven per day (ton/day)	= [Maximum Weight Loaded (tons/trip)] * [Maximum trips per day (trip/day)]
Maximum one-way distance (mi/trip)	= [Maximum one-way distance (feet/trip) / [5280 ft/mile]
Maximum one-way miles (miles/day)	= [Maximum trips per year (trip/day)] * [Maximum one-way distance (mi/trip)]
Average Vehicle Weight Per Trip (ton/trip)	= SUM[Total Weight driven per day (ton/day)] / SUM[Maximum trips per day (trip/day)]
Average Miles Per Trip (miles/trip)	= SUM[Maximum one-way miles (miles/day)] / SUM[Maximum trips per year (trip/day)]
Unmitigated PTE (tons/yr)	= [Maximum one-way miles (miles/yr)] * [Unmitigated Emission Factor (lb/mile)] * (ton/2000 lbs)
Mitigated PTE (tons/yr)	= [Maximum one-way miles (miles/yr)] * [Mitigated Emission Factor (lb/mile)] * (ton/2000 lbs)
Controlled PTE (tons/yr)	= [Mitigated PTE (tons/yr)] * [1 - Dust Control Efficiency]

Appendix A: Emission Calculations
Cooling Tower - Fugitive Particulate PTE

Company Name: **Spartech, LLC**
Source Address: **1401 East Memorial Drive, Muncie, Indiana 47302**
MSOP Permit No.: **M035-43766-00078**
Reviewer:

UNIT ID	Maximum Cooling Tower Water Circulation Rate (gal/hr)	Operating Hours (hours/year)	Maximum Total Dissolved Solids Content (PPM)	Maximum PM / PM10 / PM2.5 PTE (tons/yr)
Cooling Tower	4,800	8,760	700	0.002
			Total PM Emissions (tpy)	**0.002**

METHODOLOGY
PM/PM10 Emissions (tons/yr) = Recirculating Flow Rate (gal/hr) x E.F. (lb PM-PM10/10,000 gal) x Maximum Total Dissolved Solids (ppm/12000 ppm) x (Operating hours (hrs/yr)) x (1 ton/2000 lbs)
Emission Factor from AP-42, Table 13.4-1, 1/1995 version.
Lb/Drift per 10,000 gallons recirculated = 1.7
Lb PM/PM10 per 10,000 gallons recirculated = 0.019
From AP-42, Table 13.4-1, Footnote c, (1/1995 version), implied content of TDS in circulating water is 12,000 parts per million (ppm).

Air Pollution Control Justification as an Integral Part of the Process

The Permittee submitted the following justification such that the silo vent screens, bin vent filters, and vacuum pump filters controlling particulate emissions from Silos 1 through 12, the pneumatic conveyors, and the granulators be considered as an integral part of the manufacture of plastic sheeting process, as part of their MSOP application (Permit no.: M035-23122-00078, issued on April 18, 2007).

(a) During unloading, the raw materials for this plastic sheet manufacturing process (plastic pellets) are pneumatically conveyed from the railcar/truck unloading (RRUL) to the silos. Screened vents on the silo equalize pressure from the pneumatic transfer system. No bin vent filters are necessary as all materials handled are pelletized plastic, with negligible particulate emissions.

The Permittee did not provide data on cost and savings of these devices to show an "overwhelming economic benefit." IDEM, OAQ has evaluated the raw materials pneumatic conveying systems and has determined that the vent screens are not integral to the pneumatic conveying process. Therefore, the permitting level will be determined using the potential to emit before the screens.

(b) The plastic pellets are pneumatically conveyed from the silos, containers and surge bins to the coextruders. The pneumatic conveyors are fully enclosed vacuum pump systems that draw material from storage to the machine feed hoppers. Air is drawn through filters prior to entering the vacuum pump. The filters are required to protect the vacuum pump system. The use of the vacuum pump without the filter would result in pump failure, which in turn would result in off specification product and the shutdown of the production line. The pumps vent inside or outside the building, depending upon the process. The primary function of the filters on the pneumatic conveyance vacuum units is to prevent the failure of the vacuum pump system.

IDEM, OAQ has evaluated the vacuum pump pneumatic conveying systems and has determined that the filters perform a vital function and are integral to the vacuum conveying process. Therefore, the permitting level will be determined using the potential to emit after the filters.

(c) Waste from the coextruders, thermoformers, and Slitter/Trimmer/Rewinder is collected and ground in granulators for each process line, then pneumatically conveyed using pressure blowers to surge bins equipped with bin vent filters. The bin vent filters serve to neutralize air pressure at the end of the transport train and separate raw materials from air prior to storage or further processing.

The Permittee did not provide data on cost and savings of these devices to show an "overwhelming economic benefit." IDEM, OAQ has evaluated these justifications and determined that the bin vent filters controlling particulate emissions from the granulators, the pressure blowers, and the surge bins are not integral parts of the plastics extrusion process. Therefore, the permitting level will be determined using the potential to emit before the bin vent filters.

On June 17, 2011, the Permittee submitted information requesting that the bin vent filter be considered integral to the process for the 23 pneumatic conveyors for transporting plastic pellets or regrind from the silos, surge bins or containers to the coextruders. IDEM, OAQ evaluated the justifications and agreed that the bin vent filter will be considered integral to the process. This evaluation and approval was discussed in MSOP, M035-23122-00078, issued on April 18, 2007.

Air Pollution Control Justification as an Integral Part of the Process

(a) During unloading, the raw materials for this plastic sheet manufacturing process (plastic pellets) are pneumatically conveyed from the railcar/truck unloading (RRUL) to the silos. Screened vents on the silo equalize pressure from the pneumatic transfer system. No bin vent filters are necessary as all materials handled are pelletized plastic, with negligible particulate emissions. The Permittee is NOT requesting that the filters be considered integral to the operation; therefore, the Potential to Emit calculations will be performed without controls. (This is consistent with the previous permit determination)

(b) The plastic pellets are pneumatically conveyed from the silos, containers and surge bins to the coextruders. The pneumatic conveyors are fully enclosed vacuum pump systems that draw material from storage to the machine feed hoppers. Air is drawn through filters prior to entering the vacuum pump. The filters are required to protect the vacuum pump system. The use of the vacuum pump without the filter would result in pump failure, which in turn would result in off specification product and the shutdown of the production line. The pumps vent inside or outside the building, depending upon the process. The primary function of the filters on the pneumatic conveyance vacuum units is to prevent the failure of the vacuum pump system. The Permittee is requesting that the vacuum pump system filters are considered integral to the system. (This is consistent with the previous permit determination)

(c) Waste from the coextruders, thermoformers, and Slitter/Trimmer/Rewinder is collected and ground in granulators for each process line, then pneumatically conveyed using pressure blowers to surge bins equipped with bin vent filters. The bin vent filters serve to neutralize air pressure at the end of the transport train and separate raw materials from air prior to storage or further processing. The Permittee is NOT requesting that these bin vent filters be considered integral to the operation; therefore, the Potential to Emit calculations will be performed without controls. (This is consistent with the previous permit determination)

From:	Squillace, Kristen M
To:	Craig Laubacher
Subject:	RE: IDEM OAQ Integral Determination Examples for Spartech App No. 035-47764-00078
Date:	Thursday, May 30, 2024 11:56:00 AM
Attachments:	image001.png image002.png image003.png image004.png image005.png image006.png image007.png

Hi Craig,

Thanks for sending this. I'll let you know if I have any questions or need anymore information.

All the best,

Kristen

Indiana Department of Environmental Management

Kristen Squillace

Environmental Manager

(317) 233-9327 • KSquilla@idem.IN.gov

Protecting Hoosiers and Our Environment

| | | | | www.idem.IN.gov

Help us improve!

IDEM values your feedback

From: Craig Laubacher <claubacher@e-c-e.org>
Sent: Thursday, May 30, 2024 11:23 AM
To: Squillace, Kristen M <KSquilla@idem.IN.gov>
Subject: RE: IDEM OAQ Integral Determination Examples for Spartech App No. 035-47764-00078

**** This is an EXTERNAL email. Exercise caution. DO NOT open attachments or click links from unknown senders or unexpected email. ****

Kristen,

Great talking with you today. I have attached 3 documents for your review.

1. The original integral determination document
2. The revised integral determination document
3. The updated PTE spreadsheet with clearly defined integral and non-integral determination calculations as well as updated emission factors for all polymers

Please let me know if you have any questions. Thank you again for your help with all of this.

Craig Laubacher
Regional Director
Environmental Compliance & Engineering
Mobile 512-635-4324
Email claubacher@e-c-e.org

From: Squillace, Kristen M <KSquilla@idem.IN.gov>
Sent: Monday, May 20, 2024 10:48 AM
To: Craig Laubacher <claubacher@e-c-e.org>
Subject: IDEM OAQ Integral Determination Examples for Spartech App No. 035-47764-00078

Hi Craig,

It was a pleasure speaking with you today. As we discussed, I'm attaching Spartech's first integral determination from permit 30643. I've also attached two examples of integral determinations that you can use as a reference on how to answer the questions for the determination.

1. Is the primary purpose of the equipment to control air pollution?
2. Where the equipment is recovering product, how do the cost savings from the product recovery compare to the cost of the equipment?
3. Would the equipment be installed if no air quality regulations are in place?

Let me know if the source would like go forward with the integral determination or if they are not interested in continuing with it.

Have a good day!

All the best,

Kristen

Indiana Department of Environmental Management

Kristen Squillace

Environmental Manager

(317) 233-9327 • KSquilla@idem.IN.gov

Protecting Hoosiers and Our Environment

| | | | | www.idem.IN.gov

Help us improve!

IDEM values your feedback

From: Jack Laubacher
To: Squillace, Kristen M
Cc: Craig Laubacher
Subject: Re: IDEM OAQ New Calculations for Spartech App No.:035-47764-00078
Date: Thursday, June 6, 2024 9:34:58 AM
Attachments: image001.png
image002.png
image003.png
image004.png
image005.png
image006.png
image007.png
Outlook-oao1ib0b.png
Development of Emission Factors for Ethylene-Vinyl Acetate and Ethylene-Methyl Acrylate Copolymer Processing.pdf
Development of Emission Factors for Polycarbonate Processing.pdf
Development of Emission Factors for Polyethylene Processing.pdf
Plastics Emission Factor data for Polypropylene Processing.pdf
Polystyrene emissions.pdf

Hi Kristen,

Craig is traveling this weekend, and asked me to send you some reference material.

Please see attached. Note that the tables are referenced in the spreadsheet and documents have relevant items highlighted.

Thanks
Jack Laubacher
Cell- 330-212-6310
ECE
Environmental Compliance & Engineering

From: "Squillace, Kristen M" <KSquilla@idem.in.gov>
Date: June 6, 2024 at 7:40:37 AM CDT
To: Craig Laubacher <claubacher@e-c-e.org>
Subject: IDEM OAQ New Calculations for Spartech App No.:035-47764-00078

Hi Craig,

For the new calculations of the coextruders, would you be able to send the documents you got the new VOC (lbs/MMlb) and PM/PM10 (lbs/MMlb) factors from? I'd appreciate it if you could provide page numbers in the documents for those numbers. We need to confirm the numbers before we can accept the calculations.

Thanks!,

Kristen

Indiana Department of Environmental Management

Kristen Squillace

Environmental Manager

(317) 233-9327 • KSquilla@idem.IN.gov

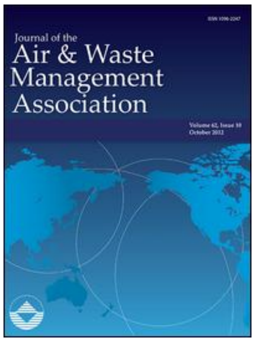
Protecting Hoosiers and Our Environment

| | | | |

www.idem.IN.gov

Help us improve!

IDEM values your feedback



Taylor & Francis
Taylor & Francis Group

Journal of the Air & Waste Management Association

ISSN: 1096-2247 (Print) 2162-2906 (Online) Journal homepage: www.tandfonline.com/journals/uawm20

Development of Emission Factors for Ethylene-Vinyl Acetate and Ethylene-Methyl Acrylate Copolymer Processing

Anthony Barlow, Pamela Moss, Earl Parker, Thomas Schroer, Mike Holdren & Kenneth Adams

ISSN 1047-3289 *J. Air & Waste Manage. Assoc.* **47**:1111-1118

Development of Emission Factors for Ethylene-Vinyl Acetate and Ethylene-Methyl Acrylate Copolymer Processing

Anthony Barlow
Quantum Chemical Corporation, Cincinnati, Ohio

Pamela Moss
AT Plastics, Brampton, Ontario

Earl Parker
Chevron Chemical Company, Orange, Texas

Thomas Schroer
E.I. du Pont de Nemours & Co., Wilmington, Delaware

Mike Holdren
Battelle, Columbus, Ohio

Kenneth Adams
The Society of the Plastics Industry, Inc., Washington, D.C.

ABSTRACT
Emission factors for selected volatile organic compounds (VOCs) and particulate emissions were developed over a range of temperatures during extrusion of three mixtures of ethylene-vinyl acetate (EVA) copolymers and two mixtures of ethylene-methyl acrylate (EMA) copolymers. A mixture of low-density polyethylene (LDPE) resins was used as a control. EVAs with 9, 18, and 28% vinyl acetate (VA) were used. The EMA mixtures were both 20% methyl acrylate. A small commercial extruder was used. Polymer melt temperatures were run at 340 °F for LDPE and both 18 and 28% EVAs. The 9% EVA mixture was extruded at 435 °F melt temperature. The EMA mixtures were extruded at 350 and 565 °F melt temperatures.

An emission rate for each substance was calculated, measured, and reported as pounds released to the atmosphere per million pounds of polymer processed [ppm (wt/wt)]. Based on production volumes, these emission factors can be used by processors to estimate emission quantities from EVA and EMA extrusion operations that are similar to the resins and the conditions used in this study.

IMPLICATIONS
This study provides quantitative emissions data collected during extrusion of ethylene-vinyl acetate (EVA) and ethylene-methyl acrylate (EMA) copolymers under specific operating conditions. These data can be used by processors as a point of reference to estimate emissions from similar EVA/EMA extrusion equipment based on production volumes.

INTRODUCTION
Industry is faced with a new challenge. Pursuant to the Clean Air Act Amendments (CAAA) of 1990, which mandated the reduction of various pollutants released to the atmosphere, companies are being faced with the daunting task of establishing "emission inventories" for the chemicals used in their processes. The chemicals targeted are those that produce either volatile organic compounds (VOCs) or compounds that are on the list of 189 hazardous air pollutants (HAPs). Title V of the amended Clean Air Act established a permit program for emission sources to ensure an eventual reduction in emissions. When applying for a state operating permit, processing companies are first required to establish a baseline of their potential emissions.[1]

In response to the needs of the plastics industry, the Society of the Plastics Industry, Inc. (SPI) organized a study to determine the emission factors for ethylene-vinyl acetate (EVA) and ethylene-methyl acrylate (EMA) extrusion. Sponsored by four major resin producers, the study was performed at Battelle, an independent research laboratory. This work follows two previous SPI–Battelle studies on the emissions of polyethylene[2] and polypropylene.[3]

A review of the literature shows that, while there are some qualitative and quantitative data available on polyethylene thermal emissions, there are fewer studies that mention EVA and EMA. The primary concern about previous polyethylene emissions data is that they were generated using static, small-scale,[4] or otherwise unspecified procedures.[5,6]

In the design stages of this and previous SPI–Battelle studies, considerable attention was given to whether the model used accurately reflected real processing conditions. The major contributing factors to the rate of emissions in an extrusion process were considered to be temperature, exposure to oxygen, and residence time. The goal was to reflect the actual on-line processing conditions rather than a static situation. In most extruders, the polymer melt continuously flows through the system, effectively limiting the residence time in any particular heated zone. If a static set-up were studied, the polymer may be exposed to the equivalent temperatures but for a longer period of time. This would effectively exaggerate the thermal exposure of the polymer. In a similar way, the concern over oxygen in the industrial extrusion process is minimized as the extruder screw design forces entrapped air back along the barrel during the initial compression and melting process. The air then exits the system through the hopper. Therefore, the hot polymer is exposed to air only when it is actually extruded through the die. In some of the static testing that has been reported, the hot polymer may have been exposed to air for extended periods of time.

The ideal would seem to be to measure the emissions directly from each individual process. In extrusion, for example, the type and quantity of emissions are known to be influenced by a number of operational parameters, including extruder size and type, extrusion temperature and rate, the air-exposed surface-to-volume ratio of the extrudate, the cooling rate of the extrudate, and the shear effect from the extruder screw. All of these would have to be specified and controlled.

Table 1. Average additive concentration (ppm) in polymer mixtures.

	SLIP	ANTI-BLOCK	ANTIOXIDANT
EVA			
18% VA	0	0	138
28% VA	0	0	263
9% VA	300	1500	145
EMA			
20% MA/3 MI	0	0	250
20% MA/6 MI	0	0	250
LDPE			
	156	300	340

The objective of the SPI–Battelle study was to take representative EVA/EMA resins from a number of suppliers and, using the same equipment used to study both polyethylene and polypropylene, provide baseline emission data. The test conditions used will provide reasonable reference data for processors involved in similar extrusion operations. In some cases the emission factors determined in this study may overestimate or underestimate emissions from a particular process. For example, a recent 2-year study[7] found, as would be expected, that a lower level of fume was generated by injection molding compared to extrusion-based processes in which the hot polymer is exposed to air. Therefore, professional judgment and conservative measures must be exercised when using the data for estimating emissions.

The samples used were mixtures of commercial copolymers from the sponsoring companies. The EVA mixtures, covering a range of 9 to 28% vinyl acetate, were composed of copolymers typically used in film forming, lamination, and hot-melt adhesive applications. The EMA mixtures containing 20% methyl acrylate were comprised of copolymers typically used in blown-film and extrusion coating applications. It should be noted that there are several variables related directly to the material being extruded that may influence the emissions. These variables include the age and type of resin, the additive package, and any additional materials added to the resin prior to extrusion. If a particular processor uses recycled materials, their thermal history is also an important factor. The test matrix used was designed to provide emissions data as a function of resin type and in some cases as a function of the operating temperature of the diehead assembly of the extruder. All of the EVA, LDPE, and EMA resins used were commercial grades. The average additive levels of the mixtures are shown in Table 1.

The equipment used was a small commercial extruder equipped with a 1.5-in. screw and fitted with an 8-strand die. The emissions were measured over a 30-minute period and were related to the weight of resin extruded. The emission factor for each substance measured was reported as pounds evolved to the atmosphere per million pounds of polymer processed [ppm(wt/wt)]. Processors using similar equipment can use these emission factors as reference points to assist in estimating emissions from their specific EVA–EMA application.

The 14 substances targeted for monitoring included particulate matter, total VOCs, light hydrocarbons (ethane, ethylene, and propylene), esters (vinyl acetate, and methyl acrylate), aldehydes (formaldehyde, acrolein, acetaldehyde, and propionaldehyde), ketones (acetone, and methylethyl ketone), and organic acids (formic, acetic, and acrylic acid). These are the analytes of interest, either because they are on the HAPs list, as stated earlier,

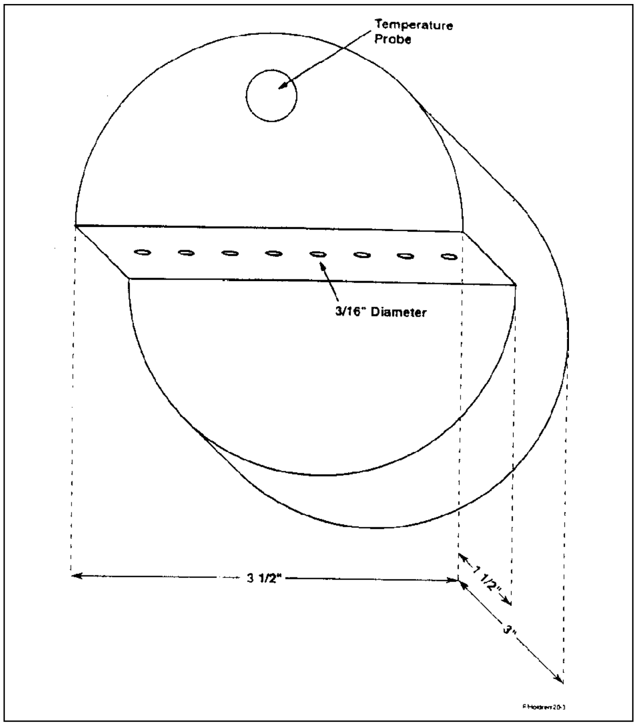


Figure 1. Extruder strand diehead used in EVA–EMA emissions testing program.

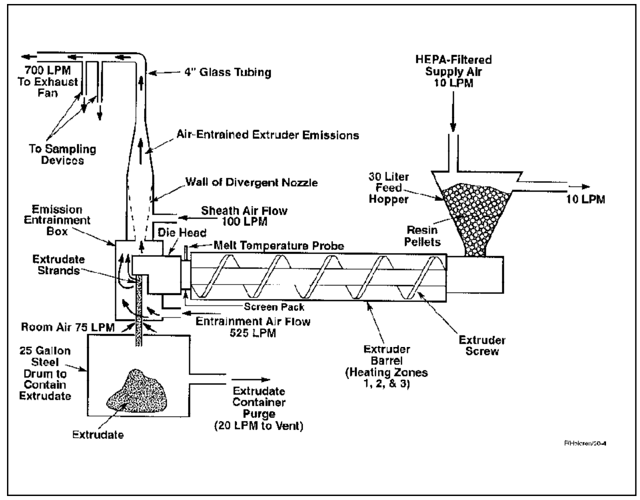


Figure 2. View of the extruder system and the various sampling locations.

or they are the expected thermal breakdown products of the polymers tested.

EXPERIMENTAL PROCEDURES

Experimental Process Conditions

An HPM Corporation 15-horsepower unvented extruder was used to process the EVA and EMA test sample mixtures at Battelle. The extruder was equipped with a 1.5-in. single screw (L/D ratio of 30:1) and fitted with an 8-strand die (Figures 1 and 2). Extruded resin strands were allowed to flow into a stainless steel drum located directly under the

Table 2. Resin throughput and key flow parameters during the EVA and EMA extrusion runs.

TEST RUN NO.	1A	1B	2	3	4	5	6
RESIN TYPE	Low-Density Polyethylene	Low-Density Polyethylene	EVA 18% VA	EVA 28% VA	EVA 9% VA	EMA 20% MA	EMA 20% MA
EXTRUDER CONDITIONS							
Melt Flow Rate	2	2	2	6	2	2	7
Average Diehead Melt Temperature, °F	340	340	340	340	435	350	565
Zone 3 Temperature, °F	292	301	301	301	415	300	547
Zone 2 Temperature, °F	296	297	297	297	365	300	449
Zone 1 Temperature, °F	275	274	275	274	275	275	275
Pressure, psig	1300	1500	1000	750	600	1750	<50
Resin Throughput [(lb/hr) (g/min)]	28.4/215	26.9/204	34.0/257	35.7/270	34.8/263	32.8/248	35.1/265
Rotor Speed, rpm	75	75	75	75	90	75	83
Run Duration, min	30	30	30	30	30	30	30
AIR FLOWS							
Total Manifold Flow, L/min	700	700	700	700	700	700	700
Flow Rate Into Sheath Area, L/min	100	100	100	100	100	100	100
Flow Rate Into Entrainment Area, L/min	525	525	525	525	525	525	525
Flow Rate Through Hopper, L/min		10	10	10	10	10	10 10
Flow Through Tubes for Carbonyls, L/min	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Flow Through Tubes for Organic Acids, L/min	5	5	5	5	5	5	5
Flow Into Canisters, L/min	0.16	0.16	0.16	0.16	0.16	0.16	0.16
Flow Through 402 THC Analyzer, L/min	1	1	1	1	1	1	1
Flow Through Filter Holder, L/min	15	15	15	15	15	15	15

Table 3. Order of EVA and EMA emissions test runs.

Run No. Sequence	Resin Type	% MA or VA	Melt Index (°F)	Melt Temp	Companies Contributing to Resin Mixture
1A	LDPE	0	2	340	Quantum NA 345 DuPont 20 AT 220 PE 5565 (Chevron)
1B	Use for spiking run				
2	EVA	18	2	340	Quantum UE631 ELVAX 3170 AT 1815
3	EVA	28	6	340	Quantum UE634 ELVAX 3175 AT 2810 M
4	EVA	9	2	435	Quantum UE637 ELVAX 3128 AT 1070 PE 5280 (Chevron)
Use LDPE mixture while cooling to 350 °F					
5	EMA	20	2	350	Quantum EMTR 003 SP 2205 (Chevron)
6	EMA	20	7	565	Quantum EMTR 010 SP 2207 (Chevron)

LDPE resin mixture was used to clean extruder during cool down. Extruder was purged of EMA before final shutdown to avoid corrosion.

die-head (Figure 2). Processing conditions, shown in Table 2, were selected to be representative of several commercial processing applications. The order of the EVA–EMA Emissions test runs is listed in Table 3.

Capture and Collection of Emissions

Emissions released at the diehead were collected separately for 30 minutes during the extrusion runs. Emissions from the hopper were excluded from analysis because previous emission studies showed their contribution to be insignificant (less than 2% of the total).[2] Table 4 shows the sampling strategy and the overall analytical scheme employed for the EVA and EMA test runs. Details of the analytical procedures are provided in the paper "Development of Emission Factors for Polyethylene Processing."[2]

Diehead Emissions

Emissions released at the diehead during extrusion were captured at the point of release in a continuous flow of clean air. A portion of this airflow was subsequently sampled downstream, as described below. The emissions were initially captured in a stainless-steel enclosure surrounding the diehead (Figure 3). The air stream was immediately drawn through a divergent nozzle entrainment cone, which provided a sheath of clean air between the diehead emission flow and the walls of the carrier duct. This minimized interaction of the hot exhaust with the cooler duct walls.

The total airflow employed for capturing diehead emissions was set at 700 L/min. This was composed of the diehead entrainment flow at 525 L/min, the sheath flow at 100 L/min, and 75 L/min of residual airflow, which was made up from room air drawn into the open bottom of the stainless-steel diehead enclosure. This residual airflow was used to facilitate effective capture of emissions from the polymer. These flows are depicted in Figures 2 and 3.

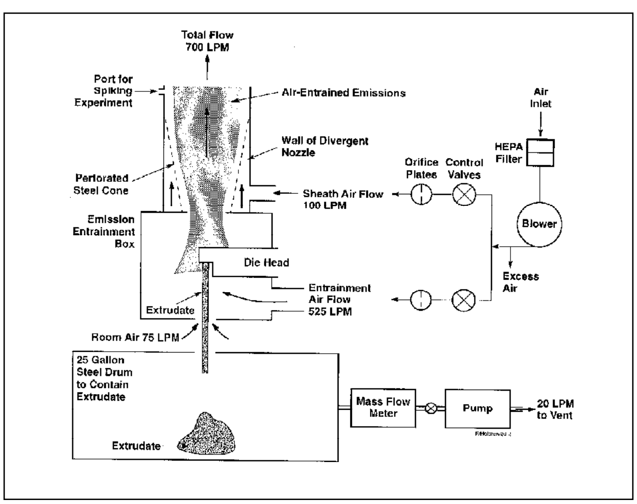


Figure 3. View of emission entrainment area.

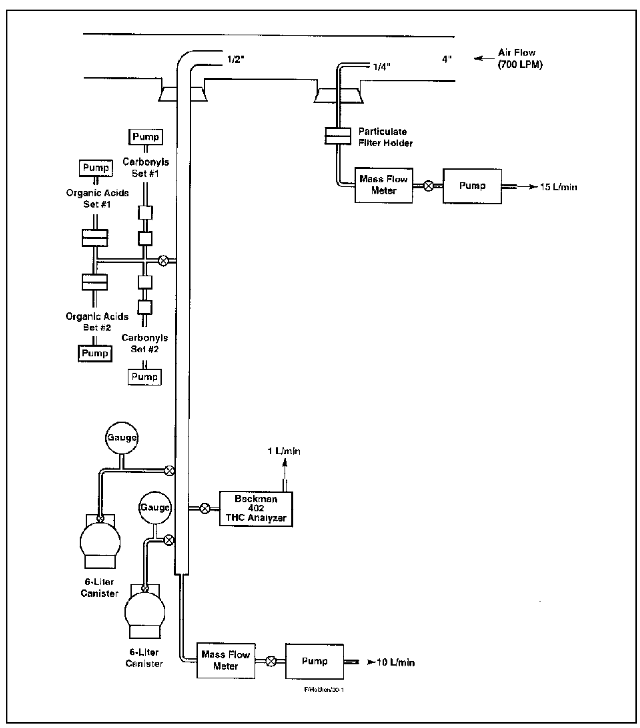


Figure 4. Sampling manifolds for emissions generated in diehead.

Table 4. Sample collection scheme for EVA and EMA test runs.

SUBSTANCES MONITORED		Organic Acids	Aldehydes/ Ketones	Particulate	VOCs		
					HHC		LHC
COLLECTION MEDIA		KOH Impregnated Filter	DNPH Tube	Glass Fiber Filter	SUMMA Canister		
ANALYTICAL METHOD		Desorption with Dilute H_2O_4 and Analysis by Ion Exclusion Chromatography/UV	Desorption with Acetonitrile and Analysis by HPLC	Gravimetric	Modified TO-14		
					HP-1 Fused Silica Capillary Column		Al_2O_3/Na_2SO_4 Capillary Column
					GC/MS	GC/FID	GC/FID
SAMPLING LOCATION				Manifold			
Melt Temp (°F)	Run No.			Number of Samples Analyzed			
340	1A	2	2	1	1	2	1
340	1B	2	2	1	1	2	1
340	2	2	2	1	1	2	1
340	3	2	2	1	1	2	1
435	4	2	2	1	1	2	1
350	5	2	2	1	1	2	1
565	7	2	2	1	1	2	1

Note: No processing aids were used.

Diehead emissions were transported by the 700-L/min airflow to a sampling point 10 ft. downstream of the diehead using 4-inch-diameter glass tubing. The location for this sampling point (Figure 2) was based on previous studies performed at Battelle that involved design, engineering, implementation, and proof-of-principle stages for the pilot plant system.[2]

Two separate sampling manifolds were used at the sampling location: one for collecting gases and vapors and the other for collecting particulates (Figure 4). For gases and vapors, a 10-L/min substream was diverted from the main emission entrainment stream using a 0.5-in. stainless steel tube (0.425-in. i.d.) wrapped with heating tape and maintained at 50 °C. VOCs and oxygenates were sampled from this manifold. Similarly, particulates were sampled from a separate 15-L/min substream using a 0.25-in. stainless unheated steel probe (0.1375-in. i.d.).

This study did not include any measurements of emissions from the drum collection area, as all commercial extrusion processes quench the molten resin shortly after it exits the die. Emissions from the extrudate in the collection drum were prevented from entering the diehead entrainment area by drawing air from the drum at 20 L/min and venting to the exhaust duct.

Table 5. Results from spiking experiments.

ANALYTE	**METHOD**	**SPIKE LEVEL μg/L**	**RECOVERY μg/L** *Set 1*	**RECOVERY μg/L** *Set 2*	**AVERAGE PERCENT RECOVERED***
			FIRST EXPERIMENT [a]		
Formic Acid	KOH filters	0.71	0.987	0.733	122±18
Acetic Acid	KOH filters	0.77	1.023	0.640	121±12
Acrylic Acid	KOH filters	0.59	0.687	0.567	107±11
Formaldehyde	DNPH Cartridge	1.63	2.20	2.03	130±5
Benzene-d_6	Canister	0.092	0.088	0.086	95±2
			SECOND EXPERIMENT [b]		
Benzene-d_6	Canister	0.24	0.27	0.25	108±4
Benzene	Canister	0.22	0.22	0.22	100
Methyl Acrylate-d_3	Canister	0.25	0.26	0.24	100±4
Methyl Acrylate	Canister	0.25	0.25	0.23	95±4
Vinyl Acetate	Canister	0.24	0.28	0.25	110±6

*Relative error is the relative percent difference: the absolute difference in the two samples multiplied by 100 and then divided by their average.

[a] Reference 2; [b] Reference 3

VALIDATION OF THE ANALYTICAL METHOD

The purpose of the manifold spiking experiments was to determine the collection and recovery efficiencies of the canister, acid, and carbonyl collection methods. During the first spiking experiment, all three collection methods were evaluated. Results are reported in detail elsewhere.[2] During the second

Table 6. Summary of EVA and EMA thermal process emissions for generic resin grades (µg/g).

TEST RUN NO.	1A	1B	2	3	4	5	6
Resin Type	Low-Density Polyethylene	Low-Density Polyethylene	EVA 18% VA	EVA 28% VA	EVA 9% VA	EMA 20% MA 3 MI	EMA 20% MA 6 MI
Die Melt Temperature (°F)	340	340	340	340	435	350	565
Particulate Matter	<1	1.5	<1	<1	<1	4.1	61.5
VOLATILE ORGANIC COMPOUNDS							
Beckman 402-THC*	106.7	106.9	128.2	123.4	99.7	45.7	117.2
Heavy Hydrocarbons (HHC)	86.0	83.0	108.3	109.9	86.4	44.2	90.0
LIGHT HYDROCARBONS (LHC)							
Ethane	0.02	0.02	0.01	0.01	0.03	0.02	0.49
Ethylene	0.01	0.01	0.01	0.01	0.02	0.02	0.36
Propylene	0.01	0.01	0.01	0.01	0.01	0.01	0.14
ESTERS							
Vinyl Acetate	<0.01	<0.01	<0.01	6.22	<0.01	<0.01	<0.01
Methyl Acrylate	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
ALDEHYDES							
Formaldehyde†	0.42	0.28	0.08	0.08	0.13	0.09	1.07
Acrolein†	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.10
Acetaldehyde†	0.09	0.07	0.04	0.03	0.10	0.03	0.77
Propionaldehyde†	0.02	0.01	0.01	0.01	0.02	<0.01	0.31
Butyraldehyde	0.02	0.02	0.01	0.01	0.04	0.02	0.49
Benzaldehyde	0.02	0.02	0.03	0.05	0.05	0.03	0.23
KETONES							
Acetone	0.15	0.13	0.10	0.10	0.13	0.10	0.34
Methyl Ethyl Ketone†	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
ORGANIC ACIDS							
Formic Acid	0.27	0.22	3.85	3.11	6.05	4.40	4.66
Acetic Acid	0.44	0.44	7.40	2.89	5.32	2.06	3.23
Acrylic Acid†	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02

Note: No processing aids were used.

* THC = Total hydrocarbons minus methane.

† Hazardous air pollutants (HAPs).

spiking experiment, collection and recovery efficiencies were determined only for the canister sampling method. The results from the two spiking experiments are summarized in Table 5. The analytes measured by the spiking experiments are listed in Column 1. Column 3 shows the calculated concentrations of the spiked compounds in the air stream of the manifold. The concentrations found from duplicate sampling and analyses, and corrected for background levels, are shown in the next two columns. Finally, the average percent recovered is given in the last column.

The results from the first experiment are summarized as follows: all three collection methods showed very good recoveries of the manifold spiked compounds; the three organic acids were spiked at a nominal air concentration of about 0.6 to 0.8 µg/L; recoveries using the KOH-coated filters ranged from 107 to 122%; formaldehyde (1.63 µ/L) served as the surrogate for the aldehyde–ketone species and the DNPH cartridge method showed a recovery of 130%; deuterated benzene (0.092 µg/L) served as the representative compound for the canister collection method; and the amount recovered was 95%.

During the second experiment, additional recovery data points were obtained for the canister method using an expanded list of compounds. The additional compounds

Table 7. Coefficient for equations predicting EMA emission levels, Y = MT + C, where T is extrusion temperature (°F) and Y is emission quantity in lbs per million lbs of resin.

EMA (20% Copolymer)	Temperature Range	M Slope	C (y intercept)
VOC (402 method)	350 - 565°F	0.33	-70.7
Particulates	350 - 565°F	0.27	-89.3
Formaldehyde	350 - 565°F	0.0046	-1.15
Acetaldehyde	350 - 565°F	0.0034	-1.17
Formic Acid	350 - 565°F	0.0012	3.98
Acetic Acid	350 - 565°F	0.0054	0.16

Other hydrocarbons and acids were detected, but were below the 0.75 ppm cut-off point.

included deuterated benzene for comparison with the first experiment, as well as benzene, methyl acrylate, deuterated methyl acrylate, and vinyl acetate. The expected spike level of these five species was nominally 0.24 µ/L. As the results indicate, excellent recoveries were obtained for all compounds. Mass ions from the mass spectrometric detector that were specific for each compound were used in calculating recovery efficiencies because the five species were not well resolved with the analytical column (e.g., the two methyl acrylates were seen as one peak when monitoring the flame ionization detector).

EMISSION FACTOR RESULTS

Ethylene Vinyl Acetate Copolymers

The emission results are presented in Table 6. Overall, VOCs and particulates for all three EVA test resins had much higher emission rates than the oxygenates. VOC emissions ranged from 100 to 130 ppm (wt/wt), while particulates were less than 1 ppm. The higher test temperature produced higher levels of aldehydes, but lower overall VOCs. However, this result is confounded because different EVA resins were used.

As discussed in the experimental section, two different methods were used to measure VOC emissions. One was the Beckman 402 Hydrocarbon Analyzer which continually analyzed the air emission stream throughout the run and provided a direct reading of all VOC substances responding to the flame ionization detector. The other method used an evacuated canister for sample collection and gas chromatography for analysis. With this method, total VOCs were determined by summing the Heavy Hydrocarbon (HHC) and Light Hydrocarbon (LHC) results.

As can be seen in Table 6, the Beckman 402 results are consistently higher than the HHC and LHC results. There are a number of possible explanations for these discrepancies, as the techniques are inherently different, but that discussion is beyond the scope of this paper. However, as a conservative measure, it is recommended that the higher result be used when estimating emission quantities.

One advantage of the canister method is that it can provide emission data on total VOCs as well as individual compounds. Based on visual observation of the VOC chromatograms, the VOC measurements were due to the additive response of many individual compounds. The majority of individual VOCs were well below 1 ppm (wt/wt). The exceptions were the organic acids, which were in the range of 6 to 12 ppm total. Variations in the amounts of organic acids evolved did not follow either the die-melt temperature or the percent bound vinyl acetate. This may have been simply a reflection of the variability of the method, or the effect of different samples being used at different temperatures. Organic acid emissions were, however, significantly higher than those observed in an earlier study on LDPE resins.[2]

Vinyl acetate was detected in only one of the test runs, that of the high vinyl acetate copolymer in Run #3. It is thought that this may have been an artifact of the test apparatus in which fewer VOCs may have adhered to the canister wall during sample storage and were not completely released during sample analysis.

Ethylene-Methyl Acrylate Copolymers

The emission factor results for the EMA copolymers are presented in Table 6. Extrusions were performed at 350 and 565 °F, corresponding to blown film and extrusion coating temperatures, respectively. Overall, the VOCs for the test resins had higher emission rates than the oxygenates. VOC emissions ranged from 45 to 117 ppm (wt/wt) and the particulates from 4 to 61 ppm (wt/wt). As expected, the higher test temperatures generally produced the higher emission factors. Even at the highest test temperature, the majority of individual VOCs were below 1 ppm (wt/wt) and no single VOC compound exceeded 5 ppm (wt/wt). Those that exceeded 1 ppm were aliphatic hydrocarbons in the C_{10} to C_{16} range.

Oxygenated VOCs were present in the emissions at both temperatures, but generally at values <1 ppm (wt/wt). The exceptions were formic acid, and acetic acid detected at levels of < 5 ppm at both extrusion temperatures, and formaldehyde, detected at a level of approximately 1 ppm at 565 °F extrusion temperature. From the structure of the ethylene-methyl acrylate copolymer shown below, it was thought that methanol would be generated during extrusion at the highest temperature.

H H H H
½ ½ ½ ½
-C-C-C-C-
½ ½ ½ ½
H H ½H
C = 0
½
0
½
CH_3

However, specific evaluation of the GC–MS runs for methanol showed this compound to be absent in runs made at both extrusion temperatures. The oxygenated compounds on the HAPs list are designated as such in Table 6.

Predicting Emissions within Experimental Temperature Range

The data in Table 6 were reduced to the following equation for EMA that predicts the level of emissions at a specific extrusion temperature:

$$Y = (M \times T) + C \tag{1}$$

where Y = emissions in pounds per million pounds of processed resin, and T = melt temperature in °F. M and C constants are shown in Table 7 for each analyte.

Inserting the melt temperature (°F) into the equation will provide an estimate of the number of pounds of emissions per one million pounds of processed polymer. This equation is only valid within the temperature ranges and conditions used in this study and is not recommended for predicting emissions for temperatures outside this range. A similar equation was not derived for EVA because of the limitations of test temperatures.

CONCLUSION

Significance of Emission Factors from SPI Study

This study provides published emission rate data collected during extrusion of EVA and EMA under specific operating conditions.

The significance of this data becomes apparent when placed into context of the 1990 Clean Air Amendment's definition of a "major" source for VOC emissions. Categorization of an emission source as a "major" source subjects it to more stringent permitting requirements. The definition of a "major" source varies with the severity of the ozone nonattainment situation of the area where the source is located. The current VOC emission limits are 10 tons per year for a source in the severe classification, and 50 tons per year for a source in the serious classification. Currently, the only extreme nonattainment area in the United States is the Los Angeles, California area.

The utility of this data can be illustrated in the following example. Based on the emissions data and equations developed in this effort, a processor with equipment and conditions similar to those in this study can extrude up to 156 million pounds of EVA or 171 million pounds of EMA, and using the maximum emissions discovered in this study without exceeding the 10-ton-per-year limit for an extreme ozone nonattainment area. However, before using the data in this paper to estimate emissions, one must consider a number of other parameters, such as increased additive levels, which may impact the type and quantity of emissions as discussed in the Introduction.

These results cannot be used for industrial hygiene purposes.

REFERENCES

1. Sherman, L. M. "Clean-air rules challenge processors," *Plastics Technology* **1995**, *41: 2*, 83-86.
2. Barlow, A.; Contos, D.; Holdren, M.; Garrison, P.; Harris, L.; Janke, B. "Development of emission factors for polyethylene processing," *J. Air & Waste Manage. Assoc.* **1996**, *46*, 569-580.
3. Battelle Final Report to the Society of the Plastics Industry, "Sampling and analysis of emissions evolved during thermal processing of polypropylene resin composites," March 1995.
4. Hoff, A.; Jacobsson, S. "Thermo-oxidative degradation of low density polyethylene close to industrial processing conditions," *J. Applied Polymer Science* **1981**, *26*, 3409-3423.
5. Hughes, T. W.; Boland, R. F.; Rinaldi, G. M. *Source Assessment: Plastics Processing, State of the Art*, EPA-600/2-78-004C, pp. 27-28, 1978.
6. *Air Facility Subsystem Source Classification Codes and Emission Factor Listing for Criteria Air Pollutants*, U.S Environmental Protection Agency, 1990, EPA 450/4-90-003.
7. Forrest, M. J.; Jolly, A. M.; Holding, S. R.; Richards, S. J. "Emissions from processing thermoplastics," *Annals of Occupational Hygiene* **1995**, 39: 1, 35-53.

About the Authors

Anthony Barlow, Ph.D., is a retired product steward for Quantum Chemical Company. Pamela Moss is the laboratory and support services manager for AT Plastics, Inc. Earl Parker is retired product compliance manager for Chevron Chemical Company. Thomas Schroer is regulatory affairs consultant for E.I. du Pont de Nemours & Co. Mike Holdren is a senior research scientist at Battelle Memorial Institute. Kenneth Adams (corresponding author) is the assistant technical director with The Society of the Plastics Industry, Inc., 1801 K Street NW, Suite 600K, Washington, D.C. 20006-1301.

Journal of the Air & Waste Management Association

ISSN: 1096-2247 (Print) 2162-2906 (Online) Journal homepage: www.tandfonline.com/journals/uawm20

Development of Emission Factors for Polycarbonate Processing

Verne L. Rhodes, George Kriek, Nelson Lazear, Jean Kasakevich, Marie Martinko, R.P. Heggs, M.W. Holdren, A.S. Wisbith, G.W. Keigley, J.D. Williams, J.C. Chuang & J.R. Satola

TECHNICAL PAPER

ISSN 1047-3289 *J. Air & Waste Manage. Assoc.* **52**:781-788

Development of Emission Factors for Polycarbonate Processing

Verne L. Rhodes
Product Regulatory Services, Inc., Gulf Breeze, Florida

George Kriek and Nelson Lazear
Bayer Corporation, Pittsburgh, Pennsylvania

Jean Kasakevich
The Dow Chemical Company, Midland, Michigan

Marie Martinko
The Society of the Plastics Industry, Inc., Washington, DC

R.P. Heggs, M.W. Holdren, A.S. Wisbith, G.W. Keigley, J.D. Williams, J.C. Chuang, and J.R. Satola
Battelle, Columbus, Ohio

ABSTRACT

Emission factors for selected volatile organic compounds (VOCs) and particulate emissions were developed while processing eight commercial grades of polycarbonate (PC) and one grade of a PC/acrylonitrile-butadiene-styrene (ABS) blend. A small commercial-type extruder was used, and the extrusion temperature was held constant at 304 °C. An emission factor was calculated for each substance measured and is reported as pounds released to the atmosphere/million pounds of polymer resin processed [ppm (wt/wt)]. Scaled to production volumes, these emission factors can be used by processors to estimate emission quantities from similar PC processing operations.

IMPLICATIONS

This study provides quantitative emission data collected while processing nine types of PC-based resins. These data are directly related to production throughput and can be used as reference points to estimate emissions from similar PC resins processed on similar equipment.

INTRODUCTION

The Clean Air Act Amendments of 1990 (CAAA) mandated the reduction of various pollutants released to the atmosphere. As a result, companies are faced with the task of establishing an "emissions inventory" for the chemicals generated and released by their production processes. The chemicals targeted are those considered volatile organic compounds (VOCs) and those that are on the U.S. Environmental Protection Agency's (EPA) current list of 188 hazardous air pollutants. Title V of the CAAA establishes a permit program for emission sources to ensure an eventual reduction in these chemical emissions. When applying for a state operating permit, processing companies are required to establish a baseline of their potential emissions.[1]

In response to the needs of the plastics industry, the Society of the Plastics Industry, Inc. (SPI) organized a study to determine the emission factors for extruding polycarbonate (PC) homopolymers, copolymers, and blends. Sponsored by two major resin producers, the study was performed at Battelle. This work follows previous SPI/Battelle studies on the emissions from acrylonitrile-butadiene-styrene (ABS),[2] polyethylene,[3] ethylene-vinyl acrylate and ethylene-methyl acrylate copolymers,[4] polypropylene,[5] and polyamide.[6]

There are limited literature references about emissions from PC, but most of these use static, small-scale procedures and were intended to predict emissions from either a fire scenario or worker exposure.[7,8] These procedures do not accurately simulate the temperature profile and oxygen exposure conditions typical of extrusion processing. Static testing usually exposes the resin to temperatures outside (both greater than and less than) typical extrusion temperature ranges and to atmospheric oxygen for extended periods of time. During commercial processing, the resin is molten for a few minutes at most, and the equipment is designed to force air out of contact with the melt in the barrel. Hot resin is in contact with oxygen only briefly as it exits the die. In light of these differences, the data obtained from static tests are of limited use in predicting emissions from commercial processing.

Greater accuracy would, of course, be possible by measuring emissions from actual production equipment. Because operating parameters can influence the type and quantity of emissions, the greatest accuracy can be achieved by studying each process. Parameters that can influence emissions include extruder/injection molder size and type, melt temperature, processing rate, the ratio of air-exposed surface to the volume of the product, and shear effects caused by screw design. Variables associated with the material being processed that can also affect emissions include resin type, age of the resin, additive packages, and heat history of any recycled resin. It would be a daunting task to design and implement emission studies for all combinations of processing variables.

To strike a balance between the inapplicability of static tests and the complexity of measuring each process, SPI and major PC producers initiated work to develop baseline emission factors for PC processing under conditions that would provide reasonable reference data for similar processing operations. Extrusion was chosen as the preferred process because of its continuous nature and the ability to reach steady-state conditions for accurate measurement. Extrusion is also believed to have higher emission rates than other processes, such as injection molding operations,[9] and, therefore, should lead to more conservative extrapolations.

For the current study, three composites and six single resins were evaluated (see Table 1). The composites were a blend of Bayer Makrolon and Dow Calibre intended for food contact, compact discs, and UV-stabilized product markets. Bayer then tested three grades of Makrolon intended for radiation-stabilized, impact-modified, and ignition-resistant markets. Dow tested a radiation-stabilized grade, a branched PC, and a PC/ABS blend.

Sampling and analytical measurements were conducted to determine emission factors for the following:

- total particulate matter;
- total VOCs;
- eight targeted VOCs: methylmethacrylate, monochlorobenzene, carbon tetrachloride, methylene chloride, *p/m*-xylene, styrene, *o*-xylene, and toluene; and
- four targeted semi-volatile organic compounds (SVOCs): diphenylcarbonate, bisphenol A, phenol, and *p*-cumyl phenol.

The targeted organic species were chosen based on their known or expected presence as thermal and thermal oxidative breakdown products of the polymers selected for study.

EXPERIMENTAL

Resin Blending Procedure

For runs 1–3, equal portions of each contributed resin were homogeneously mixed in 10-gal metal cans to form a composite blend immediately before the test run. Each container was filled to approximately two-thirds of capacity and then thoroughly blended by rotation on an automated can-rolling device. Each resin (runs 4–9) or resin mixture (runs 1–3) was placed in a drying hopper and dried at 126.7 °C for 6 hr to a dew point of –28.9 °C.

Extruder Operating Procedures

The HPM Corp. 1.5-in., single-screw, 30:1 L/D (length-to-diameter ratio), 15-hp plastic extruder was thoroughly cleaned before the PC experiments. The extruder is capable of ~27.2 kg/hr throughput and 426.7 °C (maximum) barrel temperatures for the three heat zones. A specially constructed screw used on a previous polyamide study[6] was used and is shown in Figure 1. An eight-strand die head used in previous SPI-sponsored emission studies was used for this study and is shown in Figure 2. The die head was cleaned and inspected, the holes were reamed to a 3/16-in. diameter, and the surface was polished before the start of experimental work.

Each PC resin or mixture was initially extruded for 10–20 min before the actual test run to ensure stable process conditions. During this time, the total VOCs were monitored by online instrumentation to indicate equilibration of the exhaust effluent. A check of operating parameters was recorded initially and at 5-min intervals during each 20-min test run. These parameters included

Table 1. Test runs for PC resins program.

Run No.	Resin	Sample Description Applications	Bayer MAKROLON	Dow CALIBRE	Extruding Temperature
1	Composite[a]	Food contact	3108	201	304 °C
2	Composite[a]	Compact discs	MAS-140 and CD2005	XU 73109.OIL	304 °C
3	Composite[a]	UV stabilized	3103	302	304 °C
4	Single	Radiation stabilized	RX-2530		304 °C
5	Single	Impact modified	T-7855		304 °C
6	Single	Flame retarded	6485		304 °C
7	Single	Radiation stabilized		2081	304 °C
8	Single	Branched		603-3	304 °C
9	Single	PC/ABS blend		Pulse 830	304 °C

[a]Equal weights of resins dry blended.

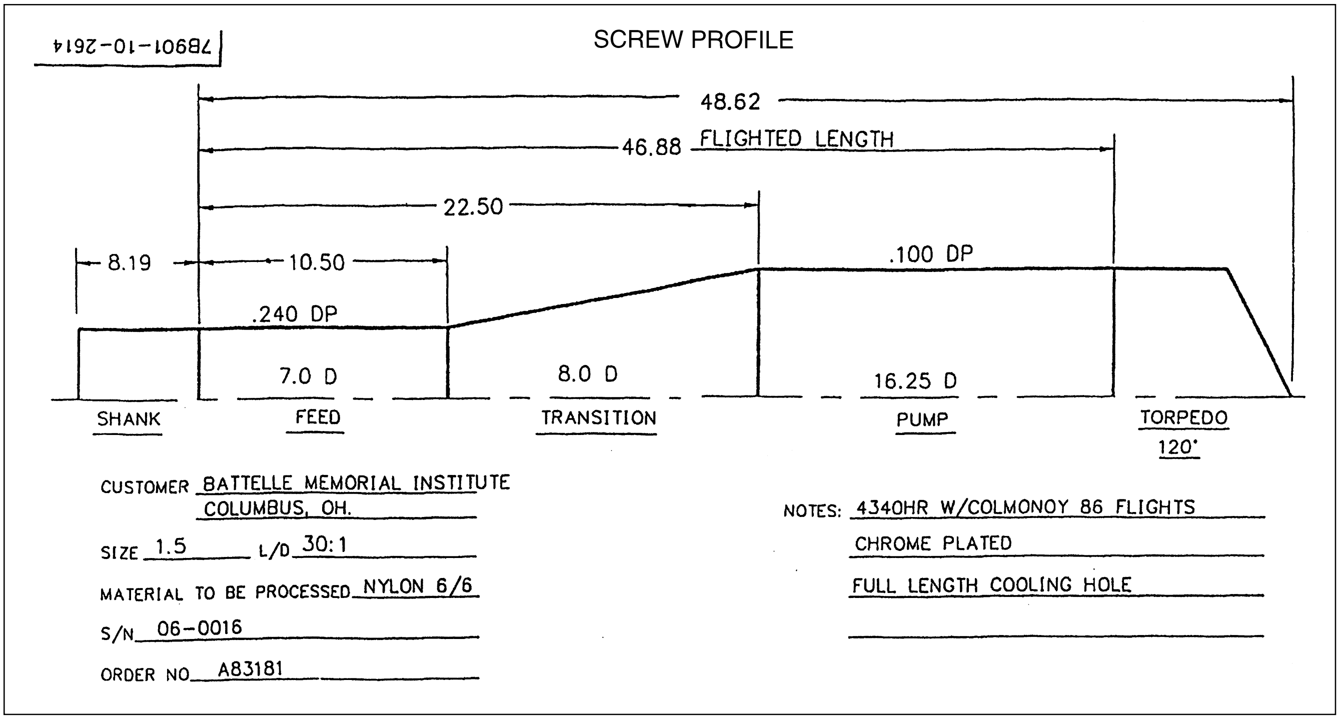


Figure 1. Screw profile (HPM Corporation).

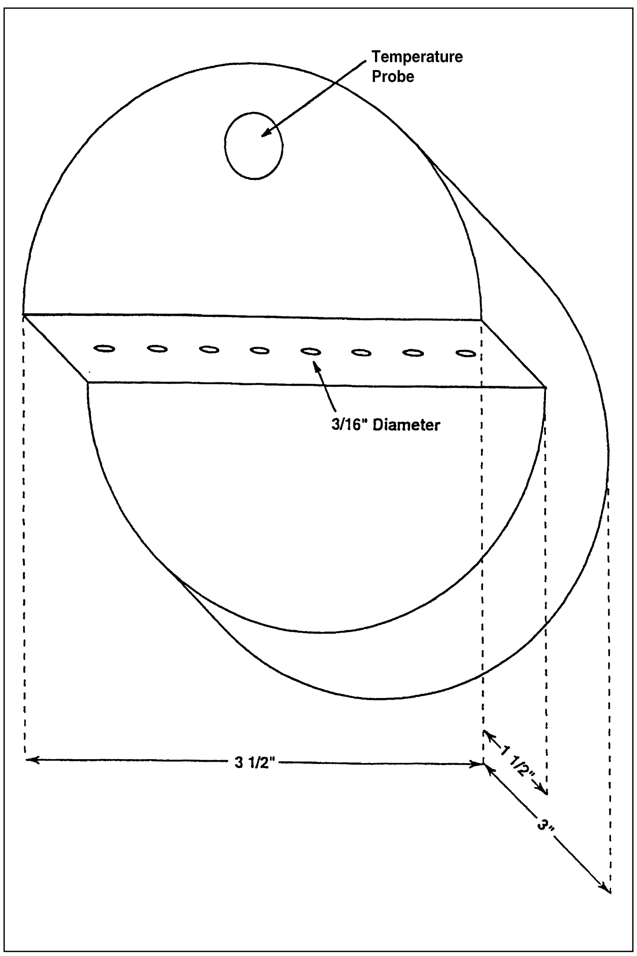


Figure 2. Extruder strand die head used in polyamide emissions testing program.

- check that the temperature at the die head had reached target and was stable;
- check that the RPM setting was at 60% (60 RPM);
- check of the extruder cooling water flow (in and out);
- check of manifold airflow rates; and
- check of the flow settings for all sampling equipment.

For each test run, a second repetitive run was carried out immediately after completion of the first run using the same operating conditions. Duplicate runs were conducted to allow better assessment of sampling and analytical precision.

Die Head Emission Collection

The stainless-steel emission-sampling manifold is shown in Figure 3. Emissions were entrained in pre-conditioned air (i.e., purified through a charcoal filter). Incoming filtered air was preset at a flow of 400 L/min using the variable flow blower and were maintained at this rate for all test runs. This flow was directed through the laminar flow head assembly and across the extrusion die head. The variable flow blower on the receiving side of the manifold system was adjusted to match the 400-L/min inlet flow. Additional flow from the sampling equipment resulted in ~10% greater flow into the receiving end of the sampling manifold. Smoke tubes were used during the test runs to confirm efficient transfer of the emissions.

The manifold was equipped with multiple ports for connecting the various sampling devices. Each port was 0.25-in. o.d. and protruded 1 in. into the airstream. The

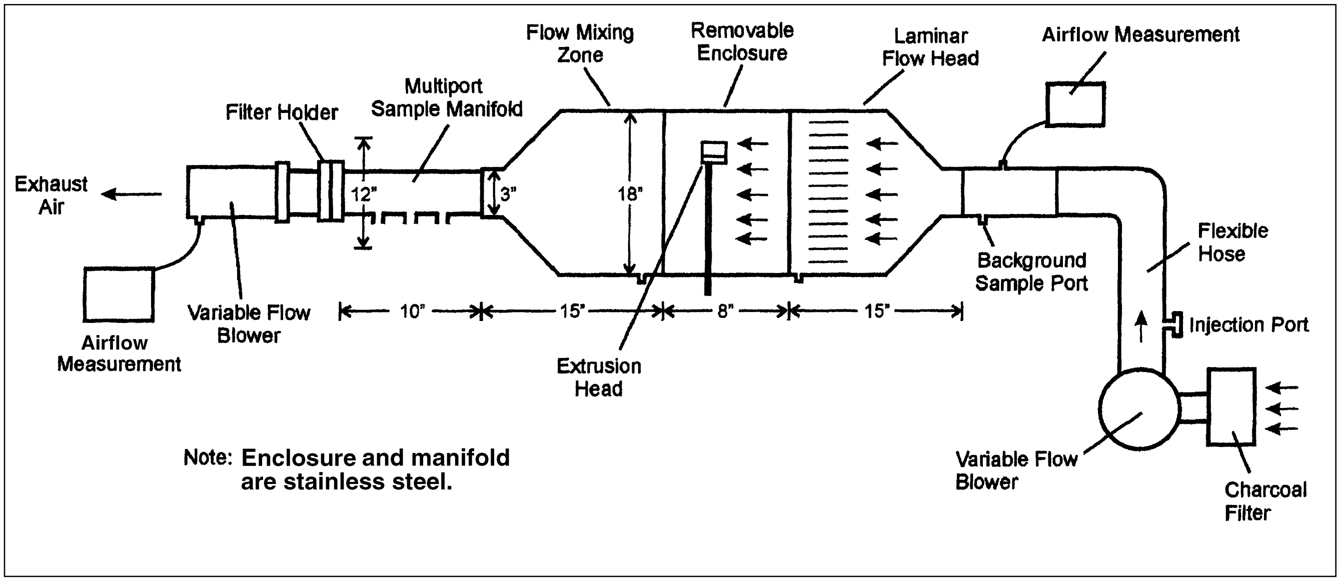


Figure 3. Emission enclosure apparatus.

manifold was also equipped with a 4-in. filter holder assembly and an in-line stainless steel probe (0.25-in. o.d.) connected to a 47-mm filter pack.

Sampling and Analysis Methods

The methods employed for characterizing the emissions from the resin extrusion process are summarized in Table 2. Detailed information is provided in the following sections.

Target VOCs. The collection and analysis of target VOCs followed EPA Method TO-14A guidelines. Evacuated and polished SUMMA 6-L canisters (100 mtorr) were used to collect whole air samples. The 6-L canisters were initially cleaned by placing them in a 50 °C oven and using a five-step sequence of evacuating to less than 1 torr (1 mm of mercury vacuum) and filling to ~4 psig (lb/in.^{2} gauge) using humidified ultra-zero air. A final canister vacuum of 100 mtorr was achieved with an oil-free mechanical pump. Each canister was connected to the sampling manifold, and a 20-min integrated sample was obtained during the collection period. After collection, the canister pressure was recorded, and the canister was filled to 5.0 psig with ultra-zero air to facilitate repeated analyses of air from the canister.

Table 2. Sample collection and analysis methods for polycarbonate test runs.

Substances Monitored	Collection Media	Analytical Method
Total VOCs	Real-time monitoring	Continuous FID
Target SVOCs	XAD-2 adsorbent	GC/MS
Particulate matter	Glass fiber filter	Gravimetric weighing
Target VOCs	SUMMA canister	GC/parallel FID and MSD

A Fisons MD 800 gas chromatographic (GC) system equipped with parallel flame ionization detectors (FID) and mass spectrometric detectors (MSD) was used to analyze the target VOCs present in the canister samples. The GC contained a cryogenic preconcentration trap. The trap was a 1/8- × 8-in. coiled stainless steel tube packed with 60/80 mesh glass beads. The trap was maintained at –185 °C during sample collection and at 150 °C during sample desorption. A six-port valve was used to control sample collection and injection. Analytes were chromatographically resolved on a Restek Rtx-1, 60 m × 0.5 mm i.d. fused silica capillary column (1 μm film thickness). Optimal analytical results were achieved by temperature-programming the GC oven from –50 to 220 °C at 8 °C/ min. The column exit flow was split to direct one-third of the flow to the MSD and the remaining flow to the FID. The mass spectrometer (MS) was operated in the total ionization mode so that all masses were scanned between 30 and 300 amu at a rate of 1 scan/0.4 sec. Identification of VOCs was performed by matching the mass spectra acquired from the samples to the mass spectral library from the National Institute of Standards and Technology (NIST). The sample volume was 60 cm^3. With this sample volume, the FID detection level was 1.0 ppb. Detector calibration was based on instrument response to known concentrations of dilute calibration gas containing the target VOCs (traceable to NIST calibration cylinders). The calibration range extended from 0.1 to 1000 μg/L.

Target SVOCs. XAD-2 adsorbent tubes were used to collect SVOC emissions. Analyses were carried out using a GC/MS system. The adsorbent cleaning, sampling, and analytical procedures are described in the next paragraphs.

The sampling module consisted of an inlet jet equipped with a quartz fiber filter (Pallflex) and a glass cartridge packed with precleaned XAD-2 (Supelco). The filters were purged in an oven (450 ºC) overnight before use. The XAD-2 cartridge assembly was sealed at both ends, wrapped with aluminum foil, and labeled with a sample code.

Single XAD cartridge sampling was conducted over a 20-min collection period using nominal flow rates of 4 L/min. An SKC sampling pump was used to draw the sample into the cartridge assembly. A mass flow meter (0–5 L/min) was used during the sampling period to measure actual flow rate. After sampling, the XAD-2 assembly was capped and stored in a refrigerator. For runs 1A, 2A, and 5B, a known amount of bisphenol-A (deuterated, d_6) was spiked onto the XAD-2 cartridge just before sampling.

The filter/XAD-2 samples from each run were extracted separately with dichloromethane for 16 hr. The extracts were concentrated by evaporation with a Kuderna-Danish (K-D) apparatus to a final volume of 10 mL. The concentrated extracts were analyzed by GC/MS to determine SVOC concentrations.

A Hewlett Packard Model 5973 GC/MS, operated in the electron impact mode, was used. Sample extracts were analyzed by GC/MS in the full mass scan mode to determine SVOC levels. A fused silica capillary DB-5 column, 60 m × 0.32 mm i.d. (0.25 µm film thickness), was used for analyte resolution. The initial GC oven temperature was 70 ºC. After 2 min, the temperature was programmed to 150 ºC at 15 ºC/min and then to 290 ºC at 6 ºC/min. Helium was used as the carrier gas. The MS was set to scan from m/z 35 to 500 amu at 3 scans/sec. Identification of the target analyte was based on a comparison of mass spectra and retention times relative to the corresponding internal standards (naphthalene-d_8 and phenanthrene-d_{10}). Tentative identification of nontarget compounds was accomplished by manual interpretation of background-corrected spectra together with an online library search.

Total Particulate Material. The concentration of particulate emissions was determined by passing a sample of the exhaust effluent through a pre-weighed filter and then conducting a gravimetric analysis of the sampled filter. The pre-weighed filter (8 × 10 in.) and holder were inserted into the exhaust port of the sampling manifold. The sample volume was determined from a calibrated orifice and Magnehelic gauge located on the sample manifold blower. A flow rate of 200 L/min was used during the 20-min test runs. Gravimetric analyses of the filter before and after sampling were carried out in a controlled environmental facility (temperature 21 ± 1 ºC, relative humidity 50 ± 5%). The filters were preconditioned to the controlled environment for 24 hr and then weighed.

Total VOCs. A VIG Industries Model 20 total hydrocarbon analyzer equipped with a hydrogen flame ionization

Table 3. Total manifold exhaust flow and resin throughput rates for generic PC resin grades.

Test Run No.	Resin Type	Orifice (inches of water)	Blower @140 °F or 60 °C (L/min)	Blower @ 75 °F or 24 °C (L/min)	Total VOC Analyzer (L/min)	XAD-2 Sampler (L/min)	Canister Sampler (L/min)	Total Manifold Flow (L/min)	Resin Throughput (g/min)
1A	Food contact	4	417	393	2	4.0	0.2	399.2	354
1B		4	417	393	2	4.0	0.2	399.2	333
2A	Compact discs	4	417	393	2	4.0	0.2	399.2	370
2B		4	417	393	2	4.0	0.2	399.2	368
3A	UV stabilized	4	417	393	2	3.9	0.2	399.1	341
3B		4	417	393	2	3.9	0.2	399.1	322
4A	Radiation stabilized	4	417	393	2	4.0	0.2	399.2	356
4B		4	417	393	2	3.9	0.2	399.1	359
5A	Impact modified	4	417	393	2	3.9	0.2	399.1	309
5B		4	417	393	2	3.9	0.2	399.1	310
6A	Ignition resistant	4	417	393	2	3.9	0.2	399.1	344
6B		4	417	393	2	3.9	0.2	399.1	351
7A	Radiation stabilized	4	417	393	2	4.0	0.2	399.2	348
7B		4	417	393	2	4.0	0.2	399.2	346
8A	Branched	4	417	393	2	4.0	0.2	399.2	325
8B		4	417	393	2	4.0	0.2	399.2	323
9A	PC/ABS blend	4	417	393	2	4.0	0.2	399.2	285
9B		4	417	393	2	4.0	0.2	399.2	287

Table 4. Summary of extrusion emissions of target chemicals from generic polycarbonate resin grades (μg/L).[a]

Test Run No.	Resin Type	Particulate Matter	Total VOCs	Speciated VOCs (total)	Methyl-methacrylate	Monochloro-benzene	Carbon Tetrachloride	Methylene Chloride	*p,m*-Xylene	Styrene	*o*-Xylene	Toluene	Target SVOCs	Diphenyl-carbonate	Bis-phenol A	Phenol	*p*-Cumyl Phenol
1A	Food contact	7.52	34.20	28.23	<0.01	26.22	<0.01	<0.01	0.02	0.02	<0.01	0.03		1.14	0.34	0.84	<0.01
1B		7.54	30.60	31.87	<0.01	26.10	<0.01	<0.01	0.02	0.02	<0.01	0.03		1.32	0.30	0.89	<0.01
2A	Compact discs	12.12	19.80	21.68	<0.01	20.38	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		0.49	0.49	0.49	0.49
2B		11.80	21.60	22.43	<0.01	21.52	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01		0.37	0.28	0.28	<0.01
3A	UV stabilized	24.77	32.40	39.43	<0.01	36.07	<0.01	0.29	0.08	0.02	0.02	0.03		1.91	0.28	0.43	<0.01
3B		24.89	32.40	42.89	<0.01	38.20	<0.01	0.29	0.08	0.02	0.02	0.03		2.21	0.27	0.98	<0.01
4A	Radiation stabilized	7.15	63.00	78.64	<0.01	50.61	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		3.48	0.23	1.05	<0.01
4B		5.34	55.80	76.83	<0.01	51.14	<0.01	0.14	<0.01	0.02	0.02	<0.01		4.21	0.17	1.07	<0.01
5A	Impact modified	16.12	90.00	114.5	58.26	28.58	<0.01	<0.01	0.02	<0.01	<0.01	0.02		4.68	0.23	1.43	<0.01
5B		13.85	84.60	108.6	57.61	29.92	<0.01	<0.01	<0.01	<0.01	<0.01	0.02		4.94	0.30	1.59	<0.01
6A	Ignition resistant	8.01	16.20	6.56	0.03	5.25	<0.01	0.14	<0.01	<0.01	<0.01	0.02		1.56	0.10	0.59	<0.01
6B		8.49	18.00	8.43	<0.01	7.63	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		1.62	0.10	0.57	<0.01
7A	Radiation stabilized	19.85	12.60	6.06	<0.01	0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		2.51	0.36	0.35	<0.01
7B		19.64	12.60	6.43	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	0.02		1.19	0.30	0.47	<0.01
8A	Branched	25.34	9.00	1.13	<0.01	0.07	0.18	<0.01	0.08	<0.01	0.02	0.02		0.55	0.24	0.21	<0.01
8B		26.58	9.00	1.41	<0.01	0.05	0.16	<0.01	0.09	<0.01	0.02	0.02		0.17	0.21	0.25	<0.01
9A	PC/ABS blend	98.96	84.60	135.9	<0.01	<0.01	<0.01	<0.01	49.05	47.81	0.31	1.25		0.25	0.47	0.92	<0.01
9B		99.56	82.80	118.8	<0.01	<0.01	<0.01	<0.01	43.30	39.57	0.26	1.14		0.14	0.44	0.82	<0.01

[a]Micrograms of target chemical per liter of manifold exhaust flow.

detector (HFID) was used to continuously monitor the VOC content of the exhaust effluent. A heated sample line (149 °C) was connected to the extruder sample manifold, and the sample flow was maintained at 2 L/min. The analyzer was calibrated at the beginning of each test day against a NIST-traceable reference cylinder containing a mixture of propane in 42-μg/L ultrazero air (minimal total hydrocarbons, water, CO_2, CO, or other impurities). Linearity was demonstrated by challenging the analyzer calibration standards of 3, 46, 280, and 4480 μg/L of methane.

Total Manifold Flow

The total manifold exhaust flow for the individual test runs was needed for the eventual calculation of emission factors. Table 3 lists the total flows for each test run. The orifice ΔP value is the observed reading for each run. From the experimentally derived regression equation, flow = 74.223(ΔP) + 119.77 (R^2 = 0.9943), a flow rate (typically expressed as L/min) through the blower can be determined using this ΔP value. However, the flow across the orifice was originally calibrated at 75 °F (23.8 °C). The Rankine temperature (°R) is commonly employed (°R = °F + 459.67). To correct the flow to the manifold operating temperature of 140 °F (60 °C), the following flow orifice equation was used:

$$Q_2 = Q_1 \left[\frac{T_2}{T_1}\right]^{1/2} \quad (1)$$

where Q_1 was the flow rate during test runs, Q_2 was the flow rate at 75 °F (535 °R), T_1 was the temperature of the exhaust air (°R), and T_2 was the temperature at calibration (535 °R).

A temperature correction factor of 0.944 was applied to the flow rate during the test runs to determine the flow rate at 75 °F. In addition, the flow rates from the individual sampling components were needed to obtain a total manifold flow. The total manifold flow is shown in the last row of Table 3. For all test runs, the total manifold flow was balanced at the preset incoming flow rate of 400 L/min.

Table 5. Summary of extrusion emissions of target chemicals from generic polycarbonate resin grades (μg/g).[a]

Test Run No.	Resin Type	Particulate Matter	Total VOCs	Speciated VOCs (total)	Methyl-methacrylate	Monochloro-benzene	Carbon Tetrachloride	Methylene Chloride	*p,m*-Xylene	Styrene	*o*-Xylene	Toluene	Target SVOCs			
													Diphenyl-carbonate	Bis-phenol A	Phenol	*p*-Cumyl Phenol
1A	Food contact	8.48	38.57	31.83	<0.01	29.56	<0.01	<0.01	0.02	0.02	<0.01	0.04	1.28	0.39	0.95	<0.01
1B		9.04	36.68	38.20	<0.01	31.29	<0.01	<0.01	0.02	0.03	<0.01	0.04	1.59	0.36	1.07	<0.01
2A	Compact discs	13.07	21.36	23.40	<0.01	21.98	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	0.53	0.30	0.19	<0.01
2B		12.80	23.43	24.33	<0.01	23.35	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	0.40	0.22	0.16	<0.01
3A	UV stabilized	28.99	37.93	46.16	<0.01	42.23	<0.01	0.34	0.09	0.02	0.03	0.03	2.23	0.33	0.51	<0.01
3B		30.85	40.17	53.18	<0.01	47.36	<0.01	0.36	0.09	0.03	0.03	0.04	2.74	0.33	1.22	<0.01
4A	Radiation stabilized	8.02	70.64	88.19	<0.01	56.75	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	3.90	0.26	1.18	<0.01
4B		5.94	62.05	85.43	<0.01	56.87	<0.01	0.16	<0.01	0.02	0.02	<0.01	4.68	0.19	1.19	<0.01
5A	Impact modified	20.83	116.3	147.9	75.27	36.92	<0.01	<0.01	0.03	<0.01	<0.01	0.03	6.04	0.30	1.84	<0.01
5B		17.83	108.9	139.9	74.19	38.53	<0.01	<0.01	<0.01	<0.01	<.01	0.02	6.36	0.38	2.04	<0.01
6A	Ignition resistant	9.30	18.80	7.61	0.03	6.09	<0.01	0.16	<0.01	<0.01	<0.01	0.03	1.81	0.12	0.69	<0.01
6B		9.66	20.47	9.58	<0.01	8.68	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	1.84	0.11	0.65	<0.01
7A	Radiation stabilized	22.77	14.45	6.95	<0.01	0.06	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	2.88	0.41	0.41	<0.01
7B		22.66	14.54	7.42	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	1.38	0.35	0.54	<0.01
8A	Branched	31.12	11.05	1.39	<0.01	0.08	0.22	<0.01	0.10	<0.01	0.02	0.02	0.68	0.29	0.25	<0.01
8B		32.85	11.12	1.75	<0.01	0.06	0.19	<0.01	0.11	<0.01	0.03	0.02	0.21	0.26	0.31	<0.01
9A	PC/ABS blend	138.6	118.5	190.3	<0.01	<0.01	<0.01	<0.01	68.71	66.96	0.43	1.74	0.35	0.65	1.28	<0.01
9B		138.5	115.2	165.3	<0.01	<0.01	<0.01	<0.01	60.23	55.05	0.36	1.58	0.19	0.61	1.14	<0.01

[a]Micrograms of target chemical per gram of test material.

Emission Factors

Amounts of the target chemicals detected in the manifold exhaust flow are shown in Table 4 (μg/L). Emission factors for the amount of target chemicals detected for each resin tested (μg/G) were calculated from the measured emission levels in Table 4 using this formula:

$$E = (C \times F)/O \qquad (2)$$

where E was μg emissions/g processed resin, C was the measured concentration of emissions in μg/L, F was the total manifold flow rate in L/min, and O was the resin throughput in g/min. Emission factors (μg/G) are summarized in Table 5. Dimensional analysis shows that these emission factors can also be read as lb emissions/million lb resin processed.

Significance of Emission Factors

This study provides emission data collected during extrusion of various PC resins under specific operating conditions. The calculated emission factors can be used by processors to determine their expected annual emissions, which are used to categorize industrial sites under the 1990 CAAA. The most stringent current limitation is 10 t/year of VOC emissions within an extreme O_3 management area. A processor with equipment similar to that used in this study could extrude 100–800 million lb/year of PC, depending upon the product mix, before achieving maximum permit levels. In less restricted areas, where the VOC emissions can be up to 50 t/year, the processor could potentially process 5 times this amount.

RESULTS

The primary results of the study are shown in Table 5. Some specific observations are as follows:

(1) Overall emissions were low. Many grades indicated less than 100 lb emissions/million lb PC processed. Processing conditions differed from resin to resin, most notably by temperature, so emission data from different resins were not directly comparable.

(2) The PC/ABS blend produced the highest emissions. This was predicted by the previous SPI-sponsored ABS study.

(3) Impact-modified PC was the next highest emitter. Again, this was expected because this blend contained a toughener component.

Table 5 shows that very good precision was observed for the nine duplicate runs across all four measurement techniques. Calculated precision was 8% for particulate matter, 6% for VOCs, 14% for targeted VOCs, and 15% for SVOCs. Several of the targeted VOCs were either nondetectable or present at extremely low levels in all resins, particularly carbon tetrachloride, methylene chloride, *o*-xylene, and toluene. Others, such as *p,m*-xylene and styrene, were only present in the PC/ABS blend.

CONCLUSIONS

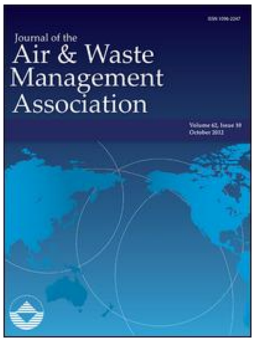
The data collected in this study provide processors with a baseline for estimating emissions generated by PC resins processed under similar conditions. Discrepancies between total VOCs (as measured by the total hydrocarbon analyzer) and total SVOCs (as measured by gas chromatography) are a result of differences in instrument calibrations. The larger value of the two should be used to ensure conservative estimates. The emission factors reported here may not represent those for other PC types or for other methods of processing. Professional judgment and conservative measures must be exercised as necessary when using these data for estimating emission quantities.

REFERENCES

1. Sherman, L.M. Clean-Air Rules Challenge Processors; *Plastics Technol.* **1995**, *41* (2), 83-86.
2. Contos, D.A.; Holdren, M.W.; Smith, D.L.; Brooke, R.C.; Rhodes, V.L.; Rainey, M.L. Sampling and Analysis of Volatile Organic Compounds Evolved during Thermal Processing of Acrylonitrile-Butadiene-Styrene Composite Resins; *J. Air & Waste Manage. Assoc.* **1995**, *45,* 686-694.
3. Barlow, A.; Contos, D.; Holdren, M.; Garrison, P.; Harris, L.; Janke, B. Development of Emission Factors for Polyethylene Processing; *J. Air & Waste Manage. Assoc.* **1996**, *46,* 569-580.
4. Barlow, A.; Moss, P.; Parker, E.; Schroer, T.; Holdren, M.; Adams, K. Development of Emission Factors for Ethylene-Vinyl Acetate and Ethylene-Methyl Acrylate Copolymer Processing; *J. Air & Waste Manage. Assoc.* **1997**, *47,* 1111-1118.
5. Adams, K.; Bankston, J.; Barlow, A.; Holdren, M.; Marchesani, V.; Meyer, J. Development of Emission Factors for Polypropylene Processing; *J. Air & Waste Manage. Assoc.* **1999**, *49,* 49-56.
6. Kriek, G.; Barnes, J.; Lazear, N.; Bollmeier, J.; Pietrezyk, D.; Rhodes, V.; Holdren, M. Development of Emission Factors for Polyamide Processing; *J. Air & Waste Manage. Assoc.* **2001**, *51*, 1001-1008.
7. Ball, G.L.; Boettner, E.A. Volatile Combustion Products of Polycarbonate and Polysulfone; *J. Appl. Polymer Sci.* **1972**, *16,* 855-863.
8. Edgerley, P.G. A Study of Fume Evolution at Polymer Processing Temperatures; *Plastics Rubber Process. Applic.* **1981**, *1* (1), 81-86.
9. Forrest, M.J.; Jolly, A.M.; Holding, S.R.; Richards, S.J. Emissions from Processing Thermoplastics; *Ann. Occup. Hygiene* **1995**, *39* (1), 35-53.

About the Authors

M.W. Holdren and J.C. Chuang are senior research scientists, J.D. Williams and G.W. Keigley are master research technicians, A.T. Wisbith is a principal research scientist, J.R. Satola is a researcher, and R.P. Heggs is a program manager, all at Battelle Memorial Institute. Jean Kasakevich is environmental health and safety manager at the Dow Chemical Company. George Kriek is an associate research and development scientist at Bayer. Nelson Lazear is manager, Environmental & Industry Issues, at Bayer. Verne Rhodes is president of Product Regulatory Services, Inc. Marie Martinko (corresponding author) is manager, Environmental and Health Projects, for SPI, Suite 600K, 1801 K St. NW, Washington, DC 20006; phone: (202) 974-5330; e-mail: mmartink@socplas.org.



Journal of the Air & Waste Management Association

ISSN: 1096-2247 (Print) 2162-2906 (Online) Journal homepage: www.tandfonline.com/journals/uawm20

Development of Emission Factors for Polyethylene Processing

Anthony Barlow, Demise A. Contos, Michael W. Holdren, Philip J. Garrison, Lynne R. Harris & Brian Janke

To cite this article: Anthony Barlow, Demise A. Contos, Michael W. Holdren, Philip J. Garrison, Lynne R. Harris & Brian Janke (1996) Development of Emission Factors for Polyethylene Processing, Journal of the Air & Waste Management Association, 46:6, 569-580, DOI: 10.1080/10473289.1996.10467493

To link to this article: https://doi.org/10.1080/10473289.1996.10467493

Published online: 09 Jan 2012.

ISSN 1047-3289 *J. Air & Waste Manage. Assoc.* **46**: 569-580

Development of Emission Factors for Polyethylene Processing

Anthony Barlow
Quantum Chemical Company, Allen Research Center, Cincinnati, Ohio

Denise A. Contos and Michael W. Holdren
Battelle, Columbus, Ohio

Philip J. Garrison
Lyondell Petrochemical Company, Lyondell Technical Center, Alvin, Texas

Lynne R. Harris
The Society of the Plastics Industry, Inc., Washington, D.C.

Brian Janke
Exxon Biomedical Sciences, Inc., East Millstone, New Jersey

ABSTRACT
Emission factors for selected volatile organic and particulate emissions were developed over a range of temperatures during extrusion of polyethylene resins. A pilot scale extruder was used. Polymer melt temperatures ranged from 500 °F to 600 °F for low density polyethylene (LDPE), 355 °F to 500 °F for linear low density polyethylene (LLDPE), and 380 °F to 430 °F for high density polyethylene (HDPE). An emission factor was calculated for each substance measured and reported as pounds released to the atmosphere per million pounds of polymer processed (ppm[wt/wt]). Based on production volumes, these emission factors can be used by processors to estimate emissions from polyethylene extrusion operations that are similar to the conditions used in this study.

INTRODUCTION
The Clean Air Act Amendments of 1990 (CAAA) mandated the reduction of various pollutants released to the atmosphere, such as volatile organic compounds (VOCs) and the U.S. Environmental Protection Agency's (EPA) list of 189 hazardous air pollutants (HAPs). Title V of the amended Clean Air Act establishes a permit program for emission sources to ensure a reduction in emissions. This program will radically impact tens of thousands of companies that will have to apply for state operating permits. In response to the needs of the industry, the Society of the Plastics Industry, Inc. (SPI) organized a study to measure emissions produced during polyethylene processing to assist processors in complying with the CAAA. Sponsored by nine major resin producers, the work was performed at Battelle, a not-for-profit research organization in Columbus, Ohio.

Prior to this study, a review of the literature revealed earlier polyethylene thermal emissions work that provided a wealth of qualitative data as well as some quantitative data on emissions. However, because of the concerns about the emission generation techniques used, the quantitative information is not deemed adequate for addressing the regulatory issues currently at hand.

The primary concern about previous emissions data is that they were generated using static, small-scale,[1] or otherwise unspecified procedures.[2,3] These techniques may not adequately simulate the temperature and oxygen exposure condition typically encountered in the extrusion process. That is, in most extruders, the polymer melt continuously flows through the system, limiting the residence time in the heated zones. This contrasts with static procedures where the polymer may be exposed to the equivalent temperature but for an effectively longer period of time, thus resulting in an exaggerated thermal exposure. In a similar way, the concern over oxygen in the industrial extrusion process is minimized as the extruder screw design forces entrapped air back along the barrel during the initial compression and melting process. The air exits the system via the hopper; consequently, hot polymer is only briefly in contact with oxygen

IMPLICATIONS
This study provides quantitative emissions data collected during extrusion of polyethylene under specific operating conditions. The emission factors developed in this study are two orders of magnitude lower than those reported in an earlier EPA document. These data can be used by processors as a point of reference to estimate emissions from similar polyethylene extrusion equipment based on production volumes.

when it is extruded through the die. Again, this is in contrast to static testing where hot polymer may be exposed to air for extended periods of time. In view of these concerns, it is apparent that the accuracy of data obtained from these techniques may be limited when used to predict emissions generated by polyethylene processors.

As an alternative to small-scale static technology, a better approach would be to measure emissions directly from the extrusion process. Since the type and quantity of emissions are often influenced by operational parameters, the ideal situation would be to study each process under the specific operating conditions of concern. Parameters that can alter the nature of the emissions include: extruder size and type, extrusion temperature and rate, the air-exposed surface to volume ratio of the extrudate, the cooling rate of the extrudate, and the shear effect from the extruder screw. Other variables related to the material(s) being extruded can also influence emissions. These include: resin type, age of the resin, additive package, and any additional materials added to the resin prior to extrusion. If a processor uses recycled materials, the thermal history is also an important factor.

In view of these variables, it is clear that it would be a considerable task to devise and conduct emission measurement studies for all major extrusion applications. Therefore, SPI's objective in this work was to develop baseline emission factors for polyethylene processing under conditions that would provide reasonable reference data for processors involved in similar extrusion operations.

A pilot-scale extruder equipped with a 1.5 inch screw and fitted with an eight-strand die was chosen to process resins associated with three major applications: extrusion coating, blown film, and blow molding. The resin types were respectively: low density polyethylene (LDPE), linear low density polyethylene (LLDPE), and high density polyethylene (HDPE).

The emissions were measured over a 30-minute period and were related to the weight of resin extruded. The emission factor for each substance measured was reported as pounds evolved to the atmosphere per million pounds of polymer processed (ppm[wt/wt]). Processors using similar equipment can use these emission factors as relative reference points to assist in estimating emissions from their specific polyethylene application.

EXPERIMENTAL

Test Resins

Resins were selected for this study to cover the main processing applications for each major type of polyethylene, i.e., LDPE, LLDPE, and HDPE. Where applicable, project sponsors submitted a fresh sample of their most common resin grade using their standard additive package for each application. Equal portions of the sponsor samples were mixed by Battelle to provide an aggregate test sample for each resin type. The additives in the final LLDPE blend were slip (900 ppm), antioxidants/stabilizers (1775 ppm), process aids (580 ppm), and antiblock (4750 ppm). The additives in the final HDPE blend were antioxidants/stabilizers (350 ppm), and process aids (200 ppm). None of the LDPE resins contained additives in their formulation. All resins were eight months old or less at the start of testing.

Experimental Process Conditions

A HPM Corporation 15 horsepower unvented extruder was used to process the polyethylene composite test samples at Battelle. The extruder was equipped with a 1.5 inch single screw (L/D ratio of 30) and fitted with an eight strand die.[4] Extruded resin strands were allowed to flow into a stainless steel drum located directly under the die head (see Figure 1). Process conditions were selected to be representative of several commercial processing applications. These are provided in Tables 1 and 2.

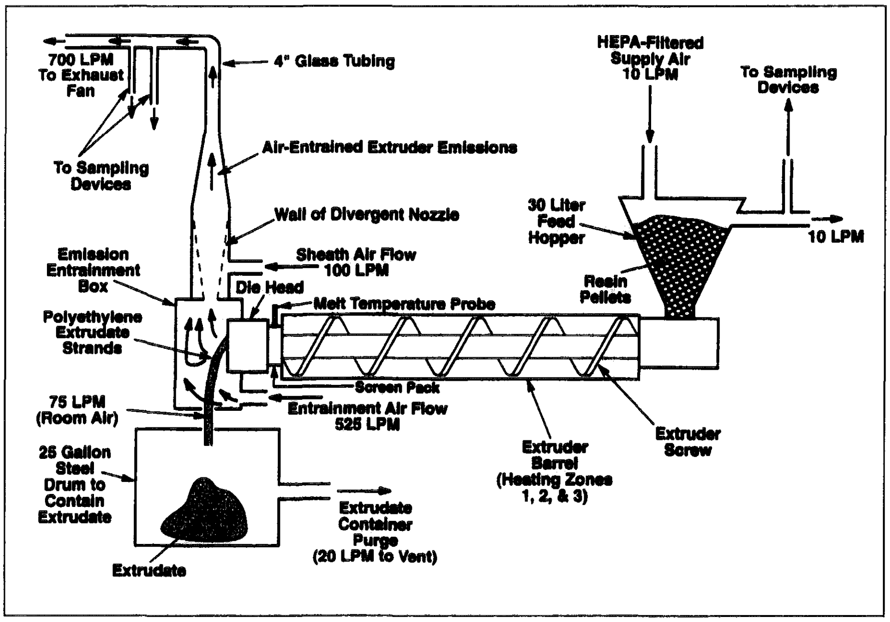


Figure 1. View of the extruder system and the various sampling locations.

Capture and Collection of Emissions

Emissions released at the die head and hopper areas were separately collected for 30 minutes during the extrusion runs. Table 3 shows the sampling strategy employed for the three types of polyethylene resins. Air sampling/collection rates for the various analytical samplers employed are provided in Table 4.

Die Head Emissions. Emissions released at the die head during extrusion were captured at the point of release in a continuous flow of clean

Table 1. Resin type characterization and extrusion temperatures.

Resin Grade	*Number of Resins in Composite*	*Use*	*Melt Index grams/ 10 minutes*	*Density g/cc*	*Extrusion Temperatures °F*
LDPE	5	Extrusion Coating	7	0.92	500, 600
LLDPE	6	Blown Film	1	0.92	355, 395 450, 500
HDPE	5	Blow Molding	0.2	0.95	380, 430

Table 2. Experimental process conditions.

	LDPE			*LLDPE*			*HDPE*	
Number of Extrusion Runs	2	2[a]	1	1	1	2[b]	1	2
Diehead Melt Temperature, °F	500	600	355[c]	395	450	500	380	430
Zone 3 Temperature, °F	487	610	310	335	425	485	355	415
Zone 2 Temperature, °F	485	590	310	335	400	475	335	375
Zone 1 Temperature, °F	411	450	300	325	350	400	325	325
Pressure, psig	NA[d]	NA[d]	2,000	3,000	1,000	800	1,750	1,500
Resin Throughput lb/hr [gm/min]	38.3/290	38.3/290	37.0/280	36.9/279	38.1/288	38.4/291	37.4/283	34.1/258
Rotor Speed, rpm	96	96	96	96	96	96	96	96
Run Duration, min	30	30	30	30	30	30	30	30

[a] In addition to the duplicate tests at 600 °F, a (third) spiking test was performed at this temperature for benzene-d_6.
[B] In addition to the duplicate tests at 500 °F, a (third) spiking test was performed at this temperature for formaldehyde and formic, acetic and acrylic acids.
[C] Screenpack was removed for 355 °F run with LLDPE to achieve target melt temperature at die head.
[D] NA = Not available.

air. A portion of this air flow was subsequently sampled downstream as described below. The emissions were initially captured in a stainless-steel enclosure surrounding the die head (see Figure 2). The air stream was immediately drawn through a divergent nozzle entrainment cone which provided a sheath of clean air between the die head emission flow and the walls of the carrier duct. This minimized interaction of the hot exhaust with the cooler duct walls.

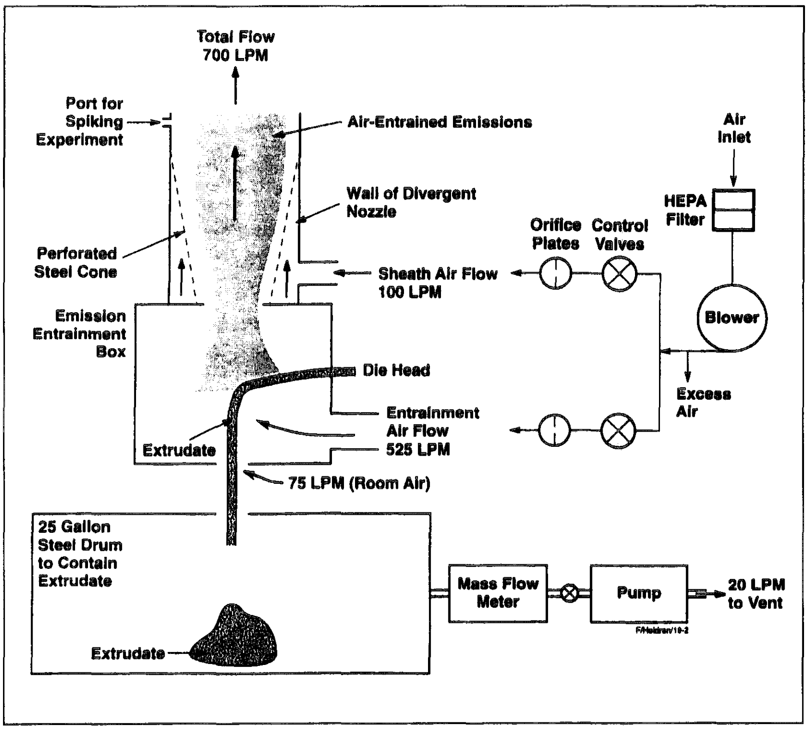


Figure 2. View of emission entrainment area.

The total air flow employed for capturing die head emissions was set at 700 liters per minute. This was comprised of the die head entrainment flow at 525 liters per minute, the sheath flow at 100 liters per minute, and 75 liters per minute of residual air flow which was made up from room air drawn into the open bottom of the stainless-steel die head enclosure. This residual air flow was used to facilitate effective capture of the polymer emissions. These flows are depicted in Figures 1 and 2.

Die head emissions were transported by the 700-liter per minute air flow to a sampling point 10 feet downstream of the die head using 4-inch diameter glass tubing. The location for this sampling point (see Figure 1) was based on previous studies performed at Battelle which involved design, engineering, implementation, and proof-of-principle stages for the laboratory system.[4]

Two separate sampling manifolds were used at the sampling location; one for collecting gases and vapors and the other for collecting particulates (see Figure 3). For gases and vapors, a 10-liter per minute substream was diverted from the main emission entrainment stream using a 1/2-inch stainless steel tube (0.425 inch i.d.) wrapped with heating tape

Table 3. Sample collection and analysis scheme.

Substances Monitored	Organic Acids	Aldehydes/ Ketones	Particulates	VOCs					
				HHC[a]		LHC[b]	HHC		LHC
Collection Media	KOH Impregnated Filter	DNPH Tube	Glass Fiber Filter	SUMMA Canister					
Analytical Method	Desorption with Dilute H_2SO_4 and Analysis by Ion Exclusion Chromatography/ UV	Desorption with Acetonitrile and Analysis by HPLC	Gravimetric	Modified TO-14					
				HP-1 Fused Silica Capillary Column		Al_2O_3/ Na_2SO_4 Capillary Column	HP-1 Fused Silica Capillary Column		Al_2O_3/ Na_2SO_4 Capillary Column
				GC/MS	GC/FID	GC/FID	GC/MS	GC/FID	GC/FID
Sampling Location	Manifold						Hopper		
	Number of Samples Analyzed Per Run								
	2	2	1	1	2	2	1	2	2

[a] HHC = Heavy hydrocarbons - includes C_4 to C_{16} compounds present in canister samples
[b] LHC = Light hydrocarbons - includes ethane, ethylene, propylene

and maintained at 50 °C. VOCs and oxygenates were sampled from this manifold. Similarly, particulates were sampled from a separate 15-liter per minute substream using a 1/4-inch stainless unheated steel probe (0.1375 inch i.d.).

This study did not include any emissions from the drum collection area as all commercial extrusion processes quench the molten resin shortly after exiting the die. Any emissions from the extrudate in the collection drum were prevented from entering the die head entrainment area by drawing air from the drum at 20 liters per minute and venting to the exhaust duct.

Hopper Emissions. One of the underlying objectives of this study was to determine if substances evolved from the hopper area had any substantial contribution to the overall emissions. Any such emissions would likely be released during the heating and homogenization of the resin pellets in the initial zones of the screw. Since the process temperatures used in this area were substantially lower than those encountered at the die head, the likelihood of generating oxidation products or particulates is low. Therefore, only VOCs were monitored in this area.

Emissions released from the extruder throat of the hopper area were captured using a 30-liter stainless steel enclosure. The enclosure was equipped with a specially designed air-tight lid that would also allow rapid delivery of additional resin material as needed. As shown in Figure 1, a 10-liter per minute air flow was drawn through the enclosure to entrain any emissions and remove them to a downstream location for analytical sampling. The sampling manifold was located 2 feet downstream of the hopper, and a portion of the 10-liter per minute flow was directed to the total VOC analyzer as well as to air sampling canisters (as shown in Figure 3).

Target Analytes

The chemicals measured in this study were selected by cross referencing the substances identified in the thermal emission literature[1] with the EPA's list of Hazardous Air Pollutants (HAPs). Many of these were oxygenated compounds, including acetaldehyde, acrolein, acrylic acid, formaldehyde, methyl ethyl ketone, and propionaldehyde. Although not on the HAPs list, acetic acid, acetone, and formic acid were added to the list of target analytes because they have been

Table 4. Air flow rates for capture and collection of emissions.

PARAMETER	*LDPE (L/min)*	*LLDPE/ HDPE (L/min)*
Total Manifold Flow	700	700
Flow Rate Into Sheath Area	100	100
Flow Rate Into Entrainment Area	525	525
Flow Rate Through Hopper	10	10
Flow Through Tubes for Aldehydes/Ketones	1	0.5
Flow Through Tubes for Organic Acids	10	5
Flow Into Canisters	0.16	0.16
Flow Through 402 THC Analyzer	1	1
Flow Through Filter Holder	15	15

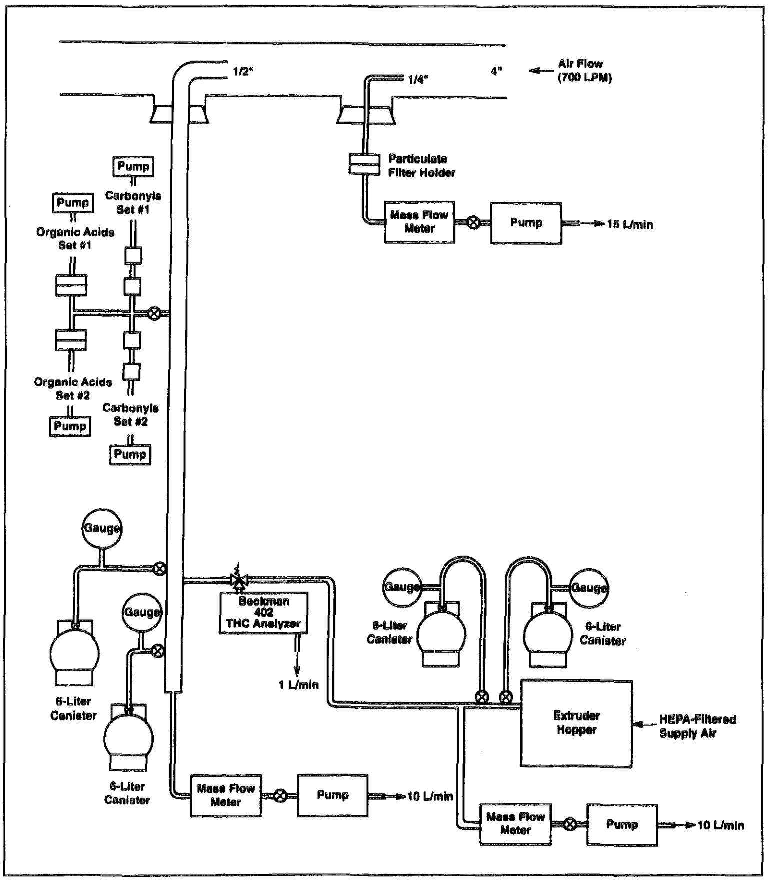


Figure 3. Sampling manifolds for emissions generated at die head and hopper.

commonly reported in the literature as thermal emission components, and they were easily included in the selected analytical protocol.

All gaseous and volatile hydrocarbons were grouped together and monitored as Volatile Organic Compounds (VOCs). This included compounds such as ethane, ethylene, propylene, butane, hexane, and octane. The analytical approach (discussed below) provided a collective measurement for a broad range of volatile hydrocarbons as well as the ability to speciate individual analytes, such as hexane, which is the only hydrocarbon on the HAPs list that is identified in the thermal emission literature associated with polyethylene.

Nonvolatile material (analyzed as "Particulates") was also included as a target substance as this material has been identified in some polyethylene thermal emissions by the study sponsors.

Measurement of Emissions

Emission samples were analyzed as outlined in Table 3. The following classes of materials were measured: volatile organic compounds (VOCs), specific organic acids, specific aldehydes and ketones, and particulates. The emissions from each run were collected over the course of the 30-minute extrusion run and analyzed using the methods described below. VOCs were also monitored in real-time using an on-line heated probe flame ionization detection system.

Volatile Organic Compounds (Time-integrated measurement). Evacuated SUMMA polished 6-liter canisters were used to collect whole air samples. The 6-liter canisters were initially cleaned by placing them in a 50 °C oven, and utilizing a five-step sequence of evacuating to less than 1 torr and filling to ~4 psig using humidified ultra-zero air. A final canister vacuum of 100 mtorr was achieved with an oil-free mechanical pump. Each canister was connected to an orifice/gauge assembly during sampling to assure that an integrated sample was obtained over the 30-minute collection time. The orifice was sized to deliver ~160 mL/min. Canister samples were collected in duplicate at the manifold and hopper locations. After collection, the canister pressure was recorded and the canister was pressurized to 5.0 psig with ultra-zero air to facilitate repeated sampling and analysis of the canister.

Analyses of canister samples were accomplished with two gas chromatographic (GC) systems. The light hydrocarbon (LHC) GC system was used for the analyses of the target compounds ethane, ethylene, and propylene. The GC system was a Varian 3 Model 3600 equipped with a flame ionization detector (FID) and a sample cryogenic preconcentration trap. The trap was a 1/8-inch by 8-inch coiled stainless steel tube packed with 60/80 mesh glass beads. The trap was maintained at -185 °C during sample collection and 100 °C during sample desorption. A six-port valve was used to control sample collection and injection. Analytes were chromatographically resolved with a Chrompack 50 meter by 0.32 mm i.d. Al_2O_3/Na_2SO_4 fused silica capillary column (5-µm film thickness). The column was operated isothermally at 50 °C to resolve the three target species and then ramped to 200 °C to purge the column of the remaining organic species. The sample size was 200 cc.

Propane was the detector calibration gas (traceable to NIST calibration cylinders). The calibration range extended from 0.5 to 1000 parts per billion carbon (ppbC). The ppbC unit is equivalent to part per billion by volume multiplied by the number of carbons in the compound. For the calibrant propane, 1 ppb by volume compound (or 3 ppb carbon) converts to 1.80 nanograms per liter of air (at 25 °C, 1 atm). For this study, an equal per carbon response was used for all hydrocarbon species (i.e., 1 ppbC of benzene will produce the same FID response as 1 ppbC of hexadecane). This procedure permits one calibrant to be used for calculating concentrations of all hydrocarbons species.[4]

A Hewlett Packard Model 5880 GC equipped with parallel flame ionization FID and mass spectrometric detectors MSD was used for the analyses of the heavier hydrocarbons which includes C_4 to C_{16} compounds present in the canister samples. For the heavy hydrocarbons (HHC) analysis, canisters were heated to 120°C to assure quantitative recovery of the C_6 to C_{16} organic compounds. The GC contained a similar cryogenic preconcentration trap as described earlier. Analytes were chromatographically resolved on a Hewlett Packard HP-1, 50 m by 0.32 i.d. fused silica capillary column (1 µm film thickness). Optimal analytical results were achieved by temperature programming the GC oven from -50 °C to 200 °C at 8°/min. The column exit flow was split to direct one-third of the flow to the MSD and the remaining flow to the FID. The mass spectrometer was operated in the total ionization mode so that all masses were scanned between 35 and 300 daltons at a rate of 1 scan per 0.6 seconds. Identification of major components were performed by matching the mass spectra acquired from the samples to the mass spectral library from the National Institute of Standards and Technology (NIST). Interpretation also included manual review of all mass spectral data. The sample size was 80cc. Detector calibration was based upon instrument response to known concentrations of dilute benzene calibration gas (traceable to NIST calibration cylinders). The calibration range extended from 1.0 to 1,000 ppbC.

Volatile Organic Compounds (Real-Time). The real-time VOC method involved the Beckman 402 analyzer as an on-line continuous instrument using a heated probe flame ionization detection (FID) system. This method has been frequently used by Battelle to determine total organic concentrations from emission sources[5,6] and is the method specified in the Code of Federal Regulations (CFR) for determining the total hydrocarbon content from automobile exhaust.[7] It is essentially equivalent to EPA method 25A.[8]

A Beckman 402 heated probe (150 °C) flame ionization detector (HFID) was calibrated against a NIST traceable reference cylinder containing 94 ppmC of propane. Challenges with NIST traceable standards have demonstrated instrument linearity from a detection level of 1 ppmC to 1,000 ppmC.

The analyzer was connected to the sampling manifold and the hopper via a three-way solenoid valve. The valve was manually switched during the test runs so that VOC levels could be determined at both hopper and manifold locations. The analyzer was also used to verify the extruder system stability prior to the beginning of each test run.

VOC emission factors were determined using the average of real-time data acquired over the course of the 30-minute run.

Organic Acids (Formic, Acetic, Acrylic). The method for monitoring organic acids was successfully demonstrated by Battelle on an earlier automotive exhaust study for the determination of formic acid.[9]

The target analytes were formic, acetic and acrylic acids. An all-Teflon, three stage, 47-mm diameter filter holder (Berghof/America) was used for sample collection. Potassium hydroxide impregnated filters were prepared by dipping 47-mm diameter Gelman A/E glass fiber filters in a solution of 0.05 N KOH in ethanol. After dipping, the filters were placed individually on a stainless steel rack in a drying oven (45 °C). The oven was continually purged with zero air. Filters were stored in covered petri dishes in a dry box that was also purged with zero air. Each filter holder was loaded with 3 filters. The loaded filter holder was connected to the sampling manifold and the exit side of the holder was connected to a mass flow controller and pump assembly. The flow was set to 10 liters per minute for the LDPE resin runs and to 5 liters per minute for the LLDPE and HDPE test runs. Manifold samplers were collected in duplicate for each test run.

For analyses, filters were taken out of the filter-pack and individually placed into wide mouth jars containing 5 mL of a 3 mM H_2SO_4 solution and 20 µL chloroform (to retard microbial losses). The jar was sonicated for 5 minutes and the solution was pipetted into a centrifuge tube. The tube was centrifuged to separate solid material from solution. A 200 µL aliquot was extracted and analyzed by ion exclusion chromatography with UV detection at 210 nm. A Bio-Rad Aminex HPX-87H HPLC column (7.8 mm i.d. by 300 mm length) was used to resolve the organic acids. The analytical method was shown to be linear for all three acids over a concentration range from the detection limit to 200 µg/mL. These concentrations are expressed in terms of the free organic acid in dilute sulfuric acid solution. The detection limits were 2 µg/mL for formic and acetic acid, and 0.2 µg/mL for acrylic acid. The standards were prepared with neat material (>99 % purity) diluted with a 3 mM H_2SO_4 solution.

Selected Aldehydes and Ketones. The analysis of selected, aldehydes and ketones followed procedures identified in U.S. EPA Method TO-11.[10] The target analytes included formaldehyde, acetaldehyde, acrolein, acetone, propionaldehyde, and methyl ethyl ketone (MEK). C_{18} Sep-Pak cartridges (Waters, Assoc.) coated with dinitrophenylhydrazine (DNPH) were used to collect carbonyl species. The stock reagent contained 0.2 grams of DNPH dissolved in 50 mL of acetonitrile. Orthophosphoric acid (50 µL) was added to provide an acidified solution. Each C_{18} cartridge was precleaned with 2 mL of the acetonitrile and then loaded with 400 µL of DNPH stock reagent. Clean nitrogen gas was used to "dry" the DNPH coated cartridge. The coated cartridges were sealed with polyethylene plugs, placed in 10 cc glass vials and refrigerated until needed. Sample collection was carried out with two cartridges in tandem and a flow control/pump assembly downstream of the cartridges. The flow was set to 1 liter per minute for the LDPE resin runs and to 0.5 liters per minute for the LLDPE and the HDPE test runs. Manifold samples were collected in duplicate for each test run.

For analyses, individual cartridges were backflushed with 2 mL acetonitrile. An aliquot (30 µL) of the extracted solution was analyzed with a Waters Model 600 high performance liquid chromatograph equipped with a UV detector

(360 nm). Carbonyl separations were achieved with two Zorbax ODX (4.6 mm i.d. by 25 cm) columns connected in series. The mobile phase was acetonitrile/water; the flow rate was 0.8 mL/min. The analytical method was shown to be linear for the carbonyl species over a concentration range from the detection limit of 0.1 to 20 μg/mL. These concentrations were expressed in terms of the underivatized aldehyde/ketone in acetonitrile solvent. Standards were prepared with weighed amounts of individual DNPH-derivatives in acetonitrile solution.

Particulate Matter. Particulate emissions were collected under isokinetic conditions on a single in-line 25-mm glass fiber filter (1 μm pore size). The filter was attached to a 0.4 inch i.d. stainless steel sampling probe that was positioned in the 4" glass manifold airstream approximately 12 inches in front of the organic sampling manifold. Gravimetric analyses of the filter before and after sampling were carried out to determine mass loading.

Verification of the Measurement System

The ability of the system to accurately measure emissions was insured in a number of ways including ongoing observation and documentation of system performance as well as manifold spiking tests to measure the recovery of substances released at the die head in known quantities. These are further described below.

Extruder Cleaning. The extruder was thoroughly purged and cleaned[4] prior to extrusion of the polyethylene test resins. The test resins were extruded in order of increasing melt viscosity to minimize cross-contamination.

Homogeneity of Emission Stream. Prior to collection of air samples the air-entrained emissions were verified to be homogeneous at the sampling location for die head emissions. A Beckman 402 hydrocarbon analyzer and a TSI-Aerodynamic Particle Sizer were used for real-time, cross-sectional measurements during the extrusion of LDPE.

Capture Efficiency. Prior to testing, the capture efficiency of the air entrainment system at the die head was visually confirmed with the aid of smoke tubes (Mine Safety Appliance, #458480-Lot 176) prior to testing. The 25-gallon collection drum was also tested to ensure that potential emissions from this area were excluded from the entrainment system.

System Equilibration. Each test resin was extruded for 30 minutes prior to collection of emissions. During this period, total VOCs were monitored by the on-line Beckman 402 Hydrocarbon Analyzer to confirm equilibration of the system.

Confirmation of Critical Operating Parameters. Operating parameters were recorded initially and at 5 minute intervals during the 30-minute test. These include: extruder temperatures, extruder cooling water flow, air flows for the total manifold, sheath and entrainment zones and hopper, and flow settings of all sampling equipment.

Manifold Spiking Tests. Spiking studies were conducted at the outset of the study to verify the recovery efficiencies for each type of target analyte. Compounds representing VOCs, organic acids, and aldehydes were spiked into the sampling manifold about 2 feet downstream of the die head during the extrusion. The spike conditions are provided in Table 5. Additional details about the spiking experiments are provided below.

VOCs (as benzene-d_6). Benzene-d_6 (deuterated benzene) was chosen to represent VOC recoveries in the spiking experiment because (1) its response on the GC/MSD is not prone to interferences from other expected VOC components, and (2) it is generally in the middle of the volatility range of the VOCs likely to be encountered.

A measured amount of benzene-d_6 was injected into a high pressure cylinder through a heated injection port and the cylinder was then filled with zero grade nitrogen to 1000 psig. The cylinder was equipped with a regulator and mass flow controller set at 10 liters per minute. The exit tube was

Table 5. Spike recovery data during extrusion.

Substance	*Test Run*	*Amount Spiked*	*Amount of Spiked Material Recovered*[a]	*Percent Recovery and Relative Error*[b]
	Pounds Released Per Million Pounds of Polymer Processed ppm(wt/wt)			
Benzene-d_6	LDPE @ 600 °F	0.22	0.21	95 ± 2
Formaldehyde	LLDPE @ 500 °F	3.93	5.10	130 ± 5
Formic Acid	LLDPE @ 500 °F	1.71	2.07	121 ± 18
Acetic Acid	LLDPE @ 500 °F	1.86	2.24	121 ± 12
Acrylic Acid	LLDPE @ 500 °F	1.42	1.51	106 ± 11

[a] The corresponding unspiked run showed a formaldehyde background level of 0.19 lb/million lb. The other species contained background levels less than the detection level.
[B] The relative error was determined as the difference in results from duplicate samples multiplied by 100 and then divided by the average amount.

inserted into the sampling manifold 2 feet downstream of the die head. The resulting manifold gaseous concentration was 0.092 µg/L. VOC samples were collected using a 6-liter evacuated canister to measure the "spiked" emission concentration as described under Measurement of Emissions.

Organic Acids and Formaldehyde. Aqueous solutions of the three organic acids and formaldehyde were mixed just before the spiking experiment commenced. The solution was dispensed at a rate of 0.57 mL/min using a CADD-PLUS infusion pump. The flow rate was digitally displayed and confirmed by measuring the weight loss of water after the experiment was completed. The water solution was directed through a heated injection system which was inserted into the manifold approximately 2 feet downstream of the die head. Complete evaporation of the water occurred at a temperature of 160 °C.

The spiking apparatus described above has been recently developed at Battelle[11] and has been successfully used for applications which require minimal temperature for the vaporization of liquid material. The vaporizer, shown in Figure 4, consists of a 21-cm length of thin wall 6.35-mm o.d. nickel chamber containing approximately 1 ml of water as the working fluid. A nickel capillary (0.60 mm o.d., 0.35 mm i.d.) coaxially traverses the length of the chamber. The outer surface of the capillary is in contact only with the vapor and liquid phase of the working fluid. The nickel chamber is heated with insulated resistance wire wrapped around and along the length of the chamber. A copper jacket between the resistance heater and the nickel chamber improves temperature uniformity of the chamber and provides additional thermal ballast for the working fluid. The generated gaseous concentrations in the manifold with the vaporizer were: formic acid, 0.60 µg/L; acetic acid, 0.71 µg/L; acrylic acid, 0.59 µg/L; and formaldehyde, 1.63 µg/L.

Calculation of Emission Factors

The emission concentrations in micrograms/L of air were converted to emission factors in micrograms/gram of

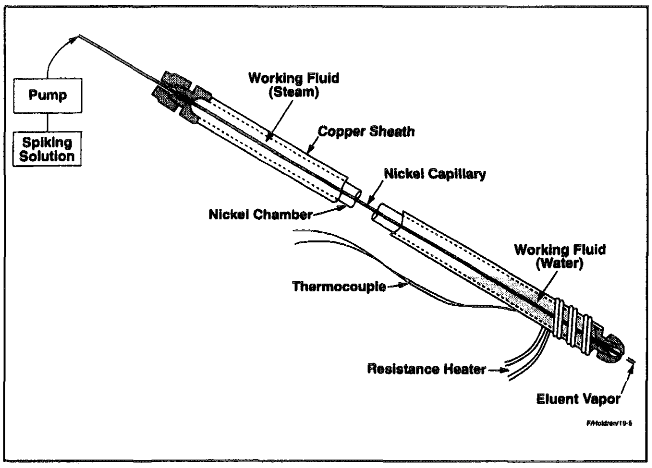


Figure 4. Battelle-developed water vaporizer.

processed resin using the following equation:

$$Y = C * F/O$$

where:

Y = micrograms of material per gram of processed resin
C = concentration of emissions material in the manifold air (micrograms/L)
F = delivery flow rate in liters per minute (700 liters per minute for manifold, 10 liters per minute for hopper)
O = resin throughput in grams/minute.

The emission factors in units of micrograms/gram (ppm[wt/wt]) are equivalent to pounds of emissions per million pounds of processed resin.

RESULTS AND DISCUSSION

Accuracy and Precision of Emission Measurements

The Manifold Spiking Tests (described earlier) provided a measure of accuracy for the emission factor data. Precision (or relative error) of the data was measured by calculating the relative percent difference (RPD) of the duplicate analysis results. Based on these evaluations, the emission factors generated in this project are, on a conservative basis, expected to be within ±30 percent of the actual values. The accuracy and precision results are further discussed below.

Accuracy. Benzene-d_6 served as the surrogate compound for the hydrocarbon method (i.e., canister sampling and GC/FID analysis). Formaldehyde represented the compounds analyzed with the carbonyl species method, whereas all three acids were used to validate the organic acid method. Spike recoveries for these substances range from 95% to 130% and are presented in Table 5.

Precision. By definition, the relative percent difference (RPD) for duplicate measurements is determined by calculating the absolute difference of the two results, multiplying by 100, and then dividing by the mean. For this study, duplicate samples were collected with the following sampling/analytical methods, light and heavy hydrocarbons (canisters), organic acids (KOH coated filters) and aldehydes/ketones (DNPH impregnated cartridges). Duplicate sampling was not carried out for particulates. Additionally, repeated extrusion runs at one or more of the target die head melt temperatures were carried out for all three types of resins. As a result, there are both within-run and between-run components of precisions.

The within-run precision was calculated as follows. For every analyte which contained duplicate values, a RPD was calculated. An average RPD was then calculated for all analytes within a method. Table 6 shows these within-run average RPD values for each method, along with the range of individual results.

The between-run precision was calculated as follows. For the repeated extrusion test runs, a RPD value was calculated for each analyte across each repeated extrusion run. An average RPD was then calculated for all analytes within a method. Table 6 shows these between-run average RPD values for each method, along with the range of the individual results.

Emission Factor Results

The emission factor results are presented in Table 7. Overall, VOCs and particulates for all three test resins had much higher emission factors than the oxygenates. VOC emissions for polyethylene ranged from 8 to 157 ppm (wt/wt), while particulates were as high as 242 ppm (wt/wt). The higher test temperatures generally produced higher emission factors, as illustrated for VOCs and particulates in Figures 5 and 6, respectively.

As discussed in the experimental section, two different methods were used to measure VOC emissions. One was the Beckman 402 Hydrocarbon Analyzer which continually analyzed the air emission stream throughout the run and provided a direct reading of all (VOC) substances responding to the flame ionization detector. The other method utilized an evacuated canister for sample collection and gas chromatography for analysis. With this method, total VOCs are determined by summing the Heavy Hydrocarbons and Light Hydrocarbons results.

As can be seen in Table 7, the results between the two methods do not always correlate. For LDPE, the Beckman 402 results are about twice as high as the sum of the HHC and LHC results. However, for LLDPE, the VOC emissions at 355 °F and 395 °F indicate the opposite situation. There are a number of possible explanations for these discrepancies as the techniques are inherently different, but that discussion is beyond the scope of this paper. However, as a conservative measure, it is recommended that the higher result of either VOC method be used when estimating emission quantities.

One advantage of the canister method is that it can provide emission data on total VOCs as well as individual compounds. Based on visual observation of the VOC chromatograms, the VOC measurements were due to the additive response of many individual compounds. Even at the highest test temperature used for each resin, the majority of individual VOCs were below 1 ppm (wt/wt), and no single VOC compound exceeded 6 ppm (wt/wt). Those that exceeded 1 ppm (wt/wt) were aliphatic hydrocarbons in the C_6 to C_{16} range. Hexane, which is listed as a Hazardous Air Pollutant, was present in some of the resin emissions, but never at levels exceeding 1 ppm (wt/wt).

In almost all cases, oxygenates were either present in the emission at levels less than 1 ppm (wt/wt), or they were not detected at all. The exception is LDPE processed at 600 °F. At this temperature, formic acid, formaldehyde, methyl ethyl ketone (or butyraldehyde), acetaldehyde, propionaldehyde, and acetic acid had emission factors of more than 1 ppm (wt/wt). Formic acid was the highest oxygenated compound detected at 12 ppm (wt/wt). The oxygenated compounds on the HAPs list are designated as such in Table 7.

Comparison of VOC Quantities from Hopper and Die Areas

VOCs were measured from both potential emission sources to determine "total" VOCs released during extrusion. The results of this study indicate that the die area of the extruder was the predominant source of VOC emissions. For all three test resins, the emissions collected in the hopper area represent less than 2% of the total VOCs. Hence, the contribution from the hopper area was not included in the calculation of emission factors.

Predicting Emissions Within Experimental Temperature Range

The data in Table 7 were reduced to the following equation that predicts the level of emissions at a specific extrusion temperature:

$$Y = (M * T) + C,$$

where:

Y = emissions in pounds per million pounds of processed resin

T = melt temperature in °F.

M and C constants are shown in Table 8 for each analyte.

Table 6. Within-run and between-run precision.

Method	Within-Run RPD[a] (%)	Range of Individual Results ppm		Between-Run RPD[a] (%)	Range of Individual Results ppm	
		Low	High		Low	High
Heavy Hydrocarbons	16.5 (n[b] = 57)	0.02	6.02	9.6 (n = 40)	0.08	5.94
Light Hydrocarbons	8.5 (n = 27)	0.01	1.66	13.0 (n = 12)	0.01	1.66
Organic Acids	26.9 (n = 5)	0.19	15.6	12.6 (n = 2)	2.0	14.7
Aldehydes/Ketones	14.9 (n = 59)	0.02	8.37	24.7 (n = 23)	0.01	8.32
Particulates	ND[c]	ND[c]	ND[c]	20.9 (n = 4)	22.5	245.1

[a] RPD = Relative percent difference
[b] n = Number of measurements.
[c] ND = Not determined.

Table 7. Summary of polyethylene emission factors by resin type (lbs/million lbs).

Resin Type	*LDPE Extrusion Coating*			*LLDPE Blown Film*			*HDPE Blow Molding*	
Melt Temperature (°F)	500	600	355	395	450	500	380	430
Particulates	30.9	242.2	2.4	21.7	24.7	59.9	19.6	26.6
Volatile Organic Compounds								
Beckman 402 - THC[a]	35.3	157.4	8.0	9.3	14.2	19.9	21.1	30.7
Heavy Hydrocarbons (HHC)[b]	17.0	76.6	13.9	15.3	15.4	21.3	25.0	38.5
Light Hydrocarbons (LHC)								
Ethane	0.09	1.21	0.02	0.03	0.03	0.04	0.02	0.02
Ethylene	0.05	1.58	0.01	0.03	0.01	0.02	0.02	0.01
Propylene	0.02	0.38	<0.01	0.01	<0.01	<0.01	0.01	<0.01
Aldehydes								
Formaldehyde[c]	0.10	8.11	0.09	0.04	0.14	0.20	0.06	0.06
Acrolein[c]	<0.01	0.07	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Acetaldehyde[c]	0.12	4.43	0.03	0.03	0.09	0.16	0.04	0.05
Propionaldehyde[c]	0.07	3.26	<0.02	<0.02	0.02	0.05	<0.02	0.02
Ketones								
Acetone	0.02	0.04	0.08	0.07	0.08	0.08	0.02	0.03
Methyl ethyl ketone[c]	0.10	5.25	<0.02	<0.02	0.02	0.04	0.05	0.02
Organic acids								
Formic acid	0.34	12.3	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17
Acetic acid	<0.17	2.00	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17
Acrylic acid[c]	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02

[a] THC = Total hydrocarbons.
[B] HHCs are predominantly comprised of C_4 - C_{16} alkanes and alkenes.
[c] Hazardous air pollutants under the Clean Air Act. Methyl ethyl ketone is indistinguishable from butyraldehyde in the HPLC analysis; therefore, any mass reported may be due to the presence of either or both substances.

These constants were calculated using the data for each run: in some cases duplicate runs were made at the same temperature (see Table 2). In those cases where duplicate runs were made the average analyte emissions are reported in Table 7.

Inserting the melt temperature (°F) into the equation will provide an estimate of the number of pounds of emissions per one million pounds of processed polymer. This equation is only valid within the temperature ranges used in this study and is not recommended for predicting emissions for temperatures outside this range.

Significance of Emission Factors from SPI Study

This study provides emission data collected during extrusion of polyethylene under specific operating conditions. The emission factors developed in this study are two orders of magnitude lower than those reported in an earlier EPA document.[2]

The significance of this data becomes apparent when placed in the context of the 1990 Clean Air Amendment's definition of "major" source for VOC emissions. Categorization of an emission source as a "major" source subjects it to more stringent permitting requirements. The definition of a "major" source varies with the severity of the ozone nonattainment situation of the area where the source is located. The current VOC emission limits are 10 tons/year for an emission source within an extreme ozone nonattainment classification, 25 tons/year for a source in the severe classification, and 50 tons/year for a source in the serious classification. Currently, the only extreme nonattainment area in the U.S. is the Los Angeles area.

The utility of this data can be illustrated in the following example. Based on the emissions data and equations developed in this effort, a processor with equipment similar to that used in this study can extrude up to 125 million pounds of LDPE, 950 million pounds of LLDPE, or 510 million pounds of HDPE using the maximum temperatures employed in this study without exceeding the 10-ton/year limit for an extreme ozone nonattainment area.

Although this information is clearly useful, the reader must realize that these emission factors reflect the quantities obtained from the specific resins and under the conditions and with the specific equipment used in this study. Before using the data in this paper to estimate emissions, one must consider a number of other parameters that may impact the type and quantity of emissions as discussed in the introduction section.

SUMMARY OF FINDINGS

- The emission entrainment, collection and analysis techniques employed in this study provided a representative, accurate and precise method for determining air emissions evolved from thermal extrusion of selected types of LDPE, LLDPE and HDPE on a pilot scale extruder with a 1.5 inch screw fitted with an eight-strand die.

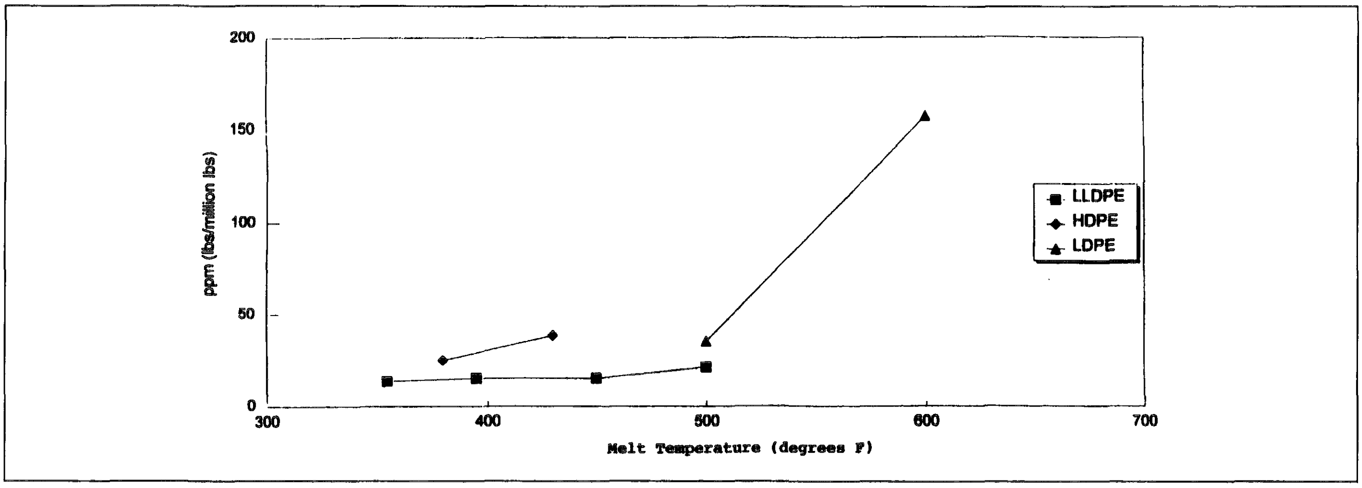


Figure 5. Emissions of VOCs from polyethylene resin composites versus temperature. Note: The equation has not been validated beyond the temperature ranges used in this study. Particular care should be taken when using the equation above the upper test temperature for each resin. Use of this equation to predict emissions above the upper range of this study is not recommended.

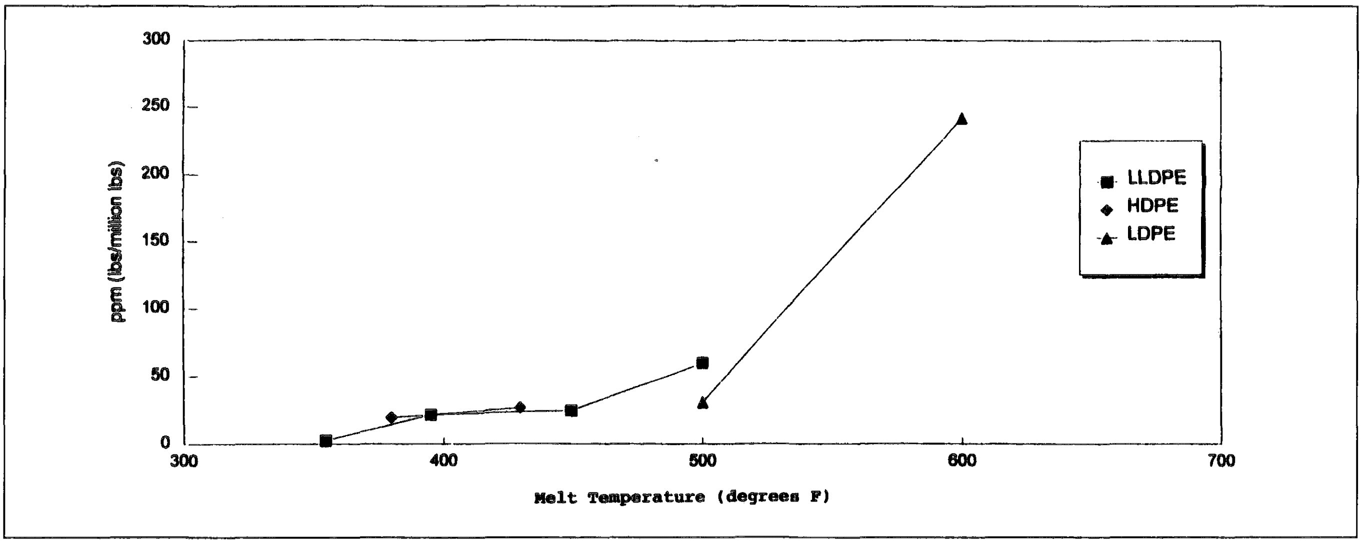


Figure 6. Particulate emissions from polyethylene resin composites versus temperature. Note: The equation has not been validated beyond the temperature ranges used in this study. Particular care should be taken when using the equation above the upper test temperature for each resin. Use of this equation to predict emissions above the upper range of this study is not recommended.

- For all three resins studied, the major emission components were particulate matter and VOCs. VOC emissions for polyethylene ranged from 8 to 157 ppm (wt/wt), which is equivalent to pounds of emissions per million pounds of processed resin. Particulates ranged as high as 242 ppm (wt/wt). Lower emission levels were measured for the specific aldehydes, ketones and organic acids monitored in this study. VOC emissions measured in this study from polyethylene are two orders of magnitude lower than estimates reported in a 1978 EPA report.
- According to The Clean Air Act Amendments of 1990, a major emission source of VOCs is one that has the potential to emit 10 tons per year of VOC emissions in an extreme ozone nonattainment area. If a processor were to process the same resins and use the same equipment and conditions employed in this study, a total of 125 million pounds of LDPE, 950 million pounds of LLDPE, or 510 million pounds of HDPE could be processed without exceeding the 10-ton/year limit. (Note that the processor must also account for emissions from all additional materials used in the operation and any other activities in the plant.)
- The predominant emission source for VOCs was the die head of the extruder. The emissions from the hopper area contributed 2% or less of the total emissions.
- In general, higher melt temperatures produced higher emissions factors for a given resin.
- Equations for predicting the emissions from LDPE, LLDPE and HDPE as a function of temperature were developed for total VOCs, particulates and the selected oxygenated compounds. Those using these equations must realize that they reflect the emissions generated for the specific resins and conditions. The equations

Table 8. Coefficients for equation predicting emission levels (y = mt+c, where "t" is extrusion temperature (°F) and "y" is emission quantity in lbs per million lbs of resin).

LDPE	Temperature Range	M (slope)	C (y Intercept)
VOCs (402 method)	500 - 600 °F	1.221	-575.2
Particulates	500 - 600 °F	2.112	-1025
Formaldehyde	500 - 600 °F	0.0801	-39.9
Acetaldehyde	500 - 600 °F	0.0433	-21.5
Propionaldehyde	500 - 600 °F	0.0323	-16.1
Methyl Ethyl Ketone	500 - 600 °F	0.0516	-25.7
Acetone	500 - 600 °F	0.00015	-0.055
Formic Acid	500 - 600 °F	0.132	-65.4
Crotonaldehyde was sometimes detected at a maximum of 0.2μg/gm. Compounds that were only detected at higher temperature: Acrolein and Acetic Acid			
LLDPE VOCs (speciation method)	355 - 500 °F	0.046	-3
Particulates	355 - 500 °F	0.3923	-136.9
Formaldehyde	355 - 500 °F	0.00096	-0.281
Acetaldehyde	355 - 500 °F	0.0010	-0.357
Compound that was constant over temperature range: Acetone. Compounds that were only detected at higher temperature: Propionaldehyde, Methyl Ethyl Ketone			
HDPE VOCs (speciation method)	380 - 430 °F	0.27	-77.6
Particulates	380 - 430 °F	0.141	-34.0
Compounds that were constant over temperature range: Formaldehyde, Acetaldehyde, Acetone, Methyl Ethyl Ketone			

Note: The equation has not been validated beyond the temperature ranges used in this study. Particular care should be taken when using the equation above the upper test temperature for each resin. Use of this equation to predict emissions above the upper range of this study is not recommended.

have not been validated beyond the temperature ranges used in this study and their use above these ranges is not recommended.

- In some cases the emission factors determined in this study may overestimate or under estimate emissions from a particular process. Professional judgment and conservative measures must be exercised as necessary when using the data for estimating emission quantities.

ACKNOWLEDGMENTS

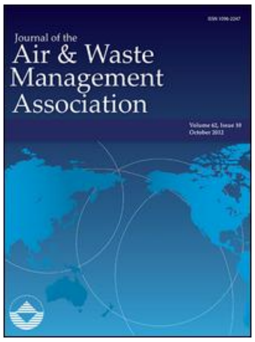
We gratefully acknowledge the technical assistance provided by D.L. Smith, R.N. Smith, G.W. Keigley, J. Frye, T.M. Vinci and M.J. Brooker. We are especially indebted to M.A. Roberts for her help in preparing the tables. Work was funded through The Society of the Plastics Industry, Inc. Companies providing financial support and resin materials are: Chevron Chemical Company, The Dow Chemical Company, DuPont Canada Inc., Exxon Chemical Company, Lyondell Technical Center, Mobil Chemical Company, Novacor Chemical LTD., Quantum Chemical Company, Union Carbide Corporation.

REFERENCES

1. Hoff, A.; Jacobsson, S. "Thermo-oxidative degradation of low density polyethylene close to industrial processing conditions," *Journal of Applied Polymer Science* **1981**, *26*, 3409-3423, 1981.
2. Hughes, T.W.; Boland, R.F.; Rinaldi, G.M. of Monsanto Research Corporation. "Source Assessment: Plastics Processing, State of the Art," EPA-600/2-78-004C, March 1978, pp. 27-28.
3. EPA Document EPA 450/4-90-003. "Airs Facility Subsystem Source Classification Codes and Emission Factor Listing for Criteria Air Pollutants," EPA, March 1990.
4. Battelle. Sampling and Analysis of Emissions Evolved During Thermal Processing of Polyethylene Resin Composites (LDPE, LLDPE, HDPE Resins); Final Report to the Society of the Plastics Industry, Inc., July 1994.
5. Spicer, C.W.; Holdren, M.W.; Miller, S.E.; Smith, D L.; Smith, R.N.; Kuhlman, M. R.; Hughes, D. P. Aircraft Emissions Characterization: TF41-A2, TF30-P103, TF30-P109 Engines. Report ESL-TR-87-27, Tyndall AFB, FL, March 1988.
6. Spicer, C.W.; Holdren, M.W.; Miller, S.E.; Smith, D L.; Smith, R.N.; Hughes, D.P. Aircraft Emissions Characterization. Report ESL-TR-87-63, Tyndall AFB, FL, March 1988.
7. *Code of Federal Regulations* (CFR), title 40, part 86, section 111, July 1, 1994.
8. *Code of Federal Regulations* (CFR), title 40, part 60, Appendix A, July, 1994.
9. Sampling and Measurement of Formic Acid in Methanol-Vehicle Exhaust, Battelle Final Report to Coordinating Research Council, November 1991. Available from NTIS as PB92-160100.
10. Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, U.S. Environmental Protection Agency, June 1988. Available from NTIS as PB90-127374.
11. Slivon, L.E.; Kenny, D.V.; Severance, R A. United States Patent #4,982,097, January 1991.

About the Authors

A. Barlow, Ph.D., is the Product Steward for Quantum Chemical Company; Philip J. Garrison, Ph.D., is a Research Scientist at Lyondell Technical Center; Michael W. Holdren is a Senior Research Scientist, and Denise A. Contos is a Program Manager, both at Battelle Memorial Institute; Brian Janke is presently an Industrial Hygienist at Exxon Research and Engineering Co.; and Lynne R. Harris (corresponding author) is Technical Director with the Society of the Plastics Industry, Inc., 1275 K Street, N.W., Suite 400, Washington, D.C. 20005.



Taylor & Francis
Taylor & Francis Group

Journal of the Air & Waste Management Association

ISSN: 1096-2247 (Print) 2162-2906 (Online) Journal homepage: www.tandfonline.com/journals/uawm20

Development of Emission Factors for Polypropylene Processing

Ken Adams, John Bankston, Anthony Barlow, Michael W. Holdren, Jeff Meyer & Vince J. Marchesani

TECHNICAL PAPER

ISSN 1047-3289 *J. Air & Waste Manage. Assoc.* **49**:49-56

Development of Emission Factors for Polypropylene Processing

Ken Adams
The Society of the Plastics Industry, Inc., Washington, District of Columbia

John Bankston
Aristech Chemical Corporation, Pittsburgh, Pennsylvania

Anthony Barlow
Quantum Chemical Company, Cincinnati, Ohio

Michael W. Holdren
Battelle, Columbus, Ohio

Jeff Meyer
Amoco Polymers, Inc., Alpharetta, Georgia

Vince J. Marchesani
Montell North America, Inc., Wilmington, Delaware

ABSTRACT
Emission factors for selected volatile organic compounds and particulate emissions were developed during extrusion of commercial grades of propylene homopolymers and copolymers with ethylene. A small commercial extruder was used. Polymer melt temperatures ranged from 400 to 605 °F. However, temperatures in excess of 510 °F for polypropylene are considered extreme. Temperatures as high as 605 °F are only used for very specialized applications, for example, melt-blown fibers. Therefore, use of this data should be matched with the resin manufacturers' recommendations.

An emission factor was calculated for each substance measured and reported as pounds released to the atmosphere per million pounds of polymer processed [ppm (wt/wt)]. Based on production volumes, these emission factors can be used by processors to estimate emission quantities from polypropylene extrusion operations that are similar to the resins and the conditions used in this study.

IMPLICATIONS
This study provides quantitative emissions data that were collected during extrusion of homopolymers and copolymers of propylene. These data are directly related to production volumes and can be used as reference points to estimate emissions from similar polypropylene resins extruded on similar equipment.

INTRODUCTION
The Clean Air Act Amendments of 1990 (CAAA90) mandated the reduction of various pollutants released to the atmosphere. Consequently, companies are being faced with the task of establishing an "emissions inventory" for the chemicals released or generated in their processes. The chemicals targeted are those that either produce volatile organic compounds (VOCs) and/or compounds that are on the U.S. Environmental Protection Agency's (EPA) list of 189 hazardous air pollutants (HAPs). Title V of the amended Clean Air Act establishes a permit program for emission sources to ensure an eventual reduction in emissions. When applying for a state operating permit, processing companies are first required to establish a baseline of their potential emissions.[1]

In response to the needs of the plastics industry, the Society of the Plastics Industry, Inc. (SPI) organized a study to determine the emission factors for extrusion of homopolymer and copolymer of polypropylene. Sponsored by ten major resin producers, the study was performed at Battelle, an independent research laboratory. This work follows a previous SPI/Battelle study on the emissions of polyethylene[2] and was performed in conjunction with emission studies on ethylene-vinyl acetate and ethylene-methyl acrylate copolymers.[3]

A review of the literature reveals that thermo-oxidation studies have been performed on polypropylene.[4,5] The primary concerns about these previous emissions data are that they were generated using static, small-scale,[6] or otherwise unspecified procedures.[7,8] These procedures may not adequately simulate the temperature and oxygen exposure conditions typically encountered in the extrusion process. That is, in most extruders, the polymer melt continuously flows through the system, limiting the residence time in the heated zones. This contrasts with static procedures, in which the polymer may be exposed to the equivalent temperature, but for an effectively longer period of time, thus resulting in an exaggerated thermal exposure. In a similar way, the concern over oxygen in the industrial extrusion process is minimized as the extruder screw design forces entrapped air back along the barrel during the initial compression and melting process. The air exits the system via the hopper; consequently, hot polymer is only briefly in contact with oxygen when it is extruded through the die. Again, this is in contrast to static testing, in which hot polymer may be exposed to air for extended periods of time. In view of these concerns, the accuracy of data obtained from these procedures may be limited when used to predict emissions generated by polypropylene processors.

As an alternative to small-scale static technology, a better approach is to measure emissions directly from the extrusion process. Since the type and quantity of emissions are often influenced by operational parameters, the ideal situation is to study each process under the specific operating conditions of concern. Parameters that can alter the nature of the emissions include extruder size and type, melt temperature and rate, the air-exposed surface to volume ratio of the extrudate, the cooling rate of the extrudate, and the shear effect from the extruder screw. Other variables related to the material(s) being extruded can also influence emissions. These include resin type, age of the resin, additive package, and any additional materials added to the resin prior to extrusion. If a processor uses recycled materials, the thermal history is also an important factor.

In view of these variables, a considerable task would be to devise and conduct emission measurement studies for all major extrusion applications. Therefore, SPI's objective in this work was to develop baseline emission factors for polypropylene processing under conditions that would provide reasonable reference data for processors involved in similar extrusion operations.

The five resin types evaluated were a reactor grade homopolymer, a controlled rheology homopolymer with and without antistat, a random copolymer, and a reactor impact copolymer. The samples used were mixtures of commercial resins from the sponsoring companies. The test matrix used was designed to provide emissions data as a function of their resin type and typical melt temperature(s). This information is provided in Table 1, together with the average additive content of the resin mixtures. These are typical additives normally found in polypropylene.

A small commercial extruder was equipped with a 1.5-in. screw and fitted with an eight-strand die. The emissions were measured over a 30-min. period and were related to the weight of resin extruded. The emission factor for each substance measured is reported as pounds evolved to the atmosphere per million pounds of polymer processed [ppm{wt/wt}]. Processors using similar equipment can use these emission factors as reference points to assist in estimating emissions for their specific process.

Table 1. Polypropylene emission test runs; resin characteristics additive concentration and melt temperature.

Run No. Sequence	Resin Type	Melt Flow Rate (g/10 min @ 230 °C)	Number of Resins in Composite	Melt Temp (°F)	Average Additive Concentration (ppm)
1 2 3	Controlled Rheology Homopolymer Non Antistat	30–35	6	400 510 605	Antioxidant 1,700 PA* 1,000
4	Controlled Rheology Homopolymer with Antistat	30–35	6	490	Antioxidant 1,700 AS** 3,400 PA* 2,500
5 6	Reactor Grade Homopolymer	3–7	7	490 570	Antioxidant 1,700 PA* 900
7	Reactor Impact Copolymer 15-20 wt % EPR	3–10	4	505	Antioxidant 2,500 PA* 1,500
8	Random Copolymer 3–6 wt % Ethylene	3–7	3	510	Antioxidant 2,000 PA* 2,200 Slip/AB 3,000

*Process aid
**Antistat

The substances targeted for monitoring included particulate matter, VOCs, light hydrocarbons (ethane, ethylene, and propylene), aldehydes (formaldehyde, acrolein, acetaldehyde, and propionaldehyde), ketones (acetone and methyl ethyl ketone), and organic acids (formic, acetic, and acrylic acid). These are the analytes of interest, either because they are on the HAPs list, as stated earlier, or they are the expected thermal and thermo-oxidative breakdown products of the polymers tested.

EXPERIMENTAL

In the following section, brief descriptions of the extruder, the entrainment zone, and sampling manifolds are provided. Details of the sampling methods, procedures, and analytical instrumentation are provided elsewhere.[2,12]

Experimental Process Conditions

An HPM Corporation 15-hp unvented extruder was used to process the polypropylene test sample mixtures at Battelle. The extruder was equipped with a 1.5-in. single screw (L/D ratio of 30:1) and fitted with an eight-strand die (Figures 1 and 2). Extruded resin strands were allowed to flow into a stainless steel drum located directly under the die head (Figure 2). Processing conditions, shown in Table 2, were selected to be representative of commercial processing applications. The order of the polypropylene emissions test runs is listed in Table 1.

Capture and Collection of Emissions

Emissions released at the die head were separately collected for 30 min. during the extrusion runs (Table 3). Emissions from the hopper were excluded from analysis since previous emission studies showed their contribution to be insignificant (less than 2% of the total).[2] Table 3 shows the sampling strategy and overall analytical scheme employed for the polypropylene test runs.

Die Head Emissions

Emissions released at the die head during extrusion were captured at the point of release in a continuous flow of clean air. A portion of this air flow was subsequently sampled downstream is described in the following paragraphs. The emissions were initially captured in a stainless steel enclosure surrounding the die head (Figure 3). The air stream was immediately drawn through a divergent nozzle entrainment cone, which provided a sheath of clean air between the die head emission flow and the walls of the carrier duct. This minimized interaction of the hot exhaust with the cooler duct walls.

The total air flow employed for capturing die head emissions was set at 700 L/min. This was composed of the die head entrainment flow at 525 L/min, the sheath flow at L/min, and 75 L/min of residual air flow that was made up from room air drawing into the open bottom of the stainless steel die head enclosure. This residual air flow was used to facilitate effective capture of emissions from

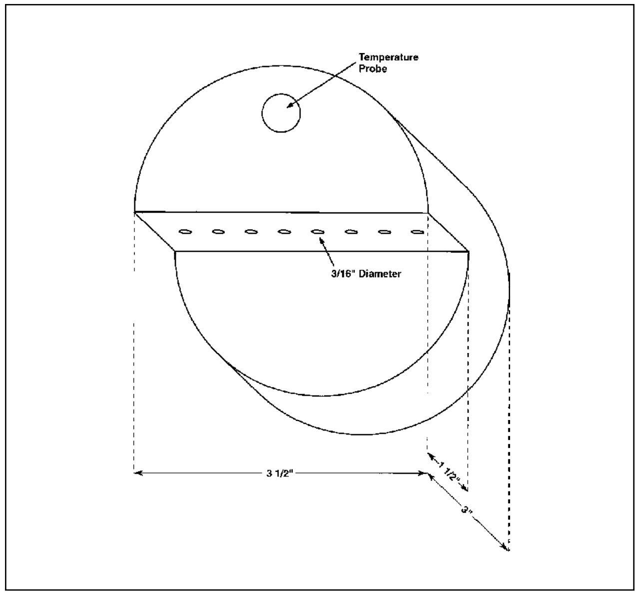


Figure 1. Extruder strand die head used in polypropylene emissions testing program.

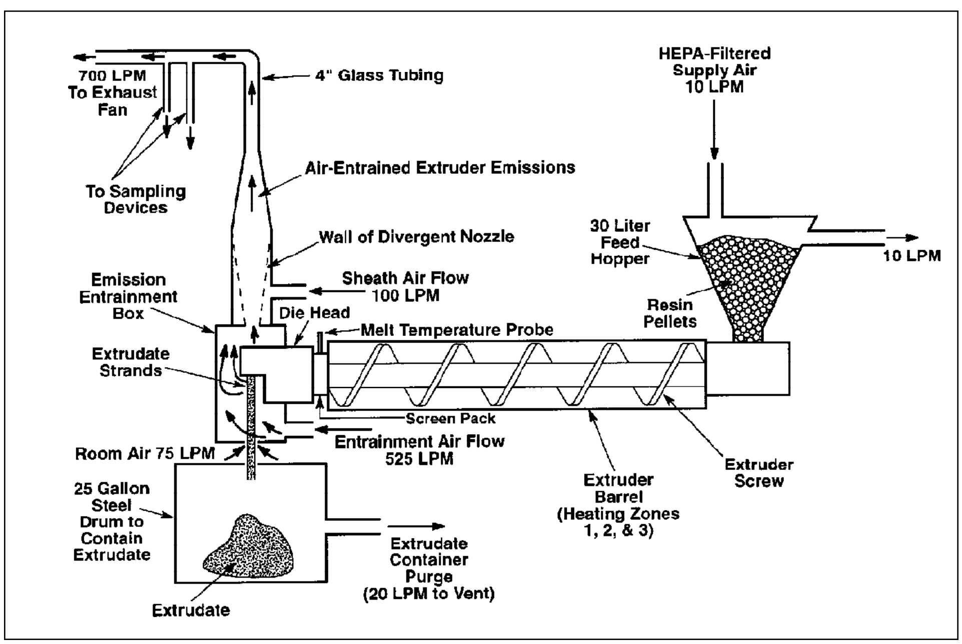


Figure 2. View of the extruder system and the various sampling locations.

Table 2. Resin throughput and key flow parameters during the polypropylene extrusion runs.

Test Run No.	1	2	3	4	5	6	7	8
Extruder Conditions								
Resin Type	Controlled rheology homopolymer	Controlled rheology homopolymer	Controlled rheology homopolymer	Controlled rheology homopolymer (with antistat)	Reactor grade homopolymer	Reactor grade homopolymer	Reactor impact copolymer (15–20 wt % EPR)	Random copolymer (3–6 wt % ET)
Melt Flow Rate	MFR 30-35	MFR 30-35	MFR 30-35	MFR 30-35	MFR 3-7	MFR 3-7	MFR 3-10	MFR-3-7
Average Die Head Melt Temp (°F)	400	510	605	490	490	570	505	510
Zone 3 Temp (°F)	428	488	568	471	497	643	496	497
Zone 2 Temp (°F)	403	430	469	320	369	436	369	369
Zone 1 Temp (°F)	382	318	315	308	312	313	300	308
Pressure (psig)	< 50	< 50	< 50	< 50	750	250	400	200
Resin Throughput [(lb/hr)/(gm/min)]	12.1/ 91.6	9.29/ 70.3	9.23/ 69.8	7.58/ 57.4	53.8/ 407	41.9/ 317	39.5/ 299	23.6/ 179
Rotor Speed (rpm)	98	98	98	98	83	68	83	83
Run Duration (min)	30	30	30	30	30	30	30	30
Air Flows								
Total Manifold Flow (L/min)	700	700	700	700	700	700	700	700
Flow Rate Into Sheath Area (L/min)	100	100	100	100	100	100	100	100
Flow Rate Into Entrainment Area, (L/min)	525	525	525	525	525	525	525	525
Flow Rate Through Hopper (L/min)	10	10	10	10	10	10	10	10
Flow Through Tubes for Carbonyls (L/min)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Flow Through Tubes for Organic Acids (L/min)	5	5	5	5	5	5	5	5
Flow Into Canisters (L/min)	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16
Flow Through 402 THC Analyzer (L/min)	1	1	1	1	1	1	1	1
Flow Through Filter Holder (L/min)	15	15	15	15	15	15	15	15

Table 3. Analytical scheme for polypropylene test runs.

Substances Monitored		Organic Acids	Aldehydes/ Ketones	Particulate	VOCs		
					Heavy Hydrocarbon		Light Hydrocarbon
Collection Media		KOH Impregnated Filter	DNPH Tube	Glass Fiber Filter	SUMMA Canister		
Analytical Method		Desorption With Dilute H_2SO_4 and Analysis by Ion Exclusion Chromotography/UV	Desorption With Acetonitrile an Analysis by HPLC	Gravimetric	Modified TO-14		
					HP-1 Fused Silica Capillary Column		Al_2O_3/Na_2SO_4 Capillary Column
					GC/MS	GC/FID	GC/FID
Sampling Location		Manifold					
Melt Temp (°F)	Run No.	Number of Samples Analyzed					
400	1	2	2	1	1	2	1
510	2	2	2	1	1	2	1
605	3	2	2	1	1	2	1
490	4	2	2	1	1	2	1
490	5	2	2	1	1	2	1
570	6	2	2	1	1	2	1
505	7	2	2	1	1	2	1

the polymer. These flows are depicted in Figures 2 and 3. An orifice plate and control valve connected to a magnahelic gauge were used to set the flow at each location. A calibrated mass flow meter was used before and after the test runs to verify the settings. The flow setpoints were within +/-3% of the stated values.

Die head emissions were transported by the 700-L/min air flow to a sampling point 10 ft downstream of the die head using 4-inch-diameter glass tubing. The location for this sampling point (Figure 2) was based on previous studies performed at Battelle that involved design, engineering, implementation, and proof-of-principle stages for the pilot plant system.[2,12]

Two separate sampling manifolds were used at the sampling location; one for collecting gases and vapors and the other for collecting particulates (Figure 4). For gases and vapors, a 10-L/min substream was diverted from the main emission entrainment stream using a 0.5-inch stainless steel tube (0.425 inch i.d.) wrapped with heating tape and maintained at 50 °C. VOCs and oxygenates were sampled from this manifold. Similarly, particulates were sampled isokinetically from a separate 15-L/min substream using a 0.25-inch stainless unheated steel probe (0.1375 in. i.d.)

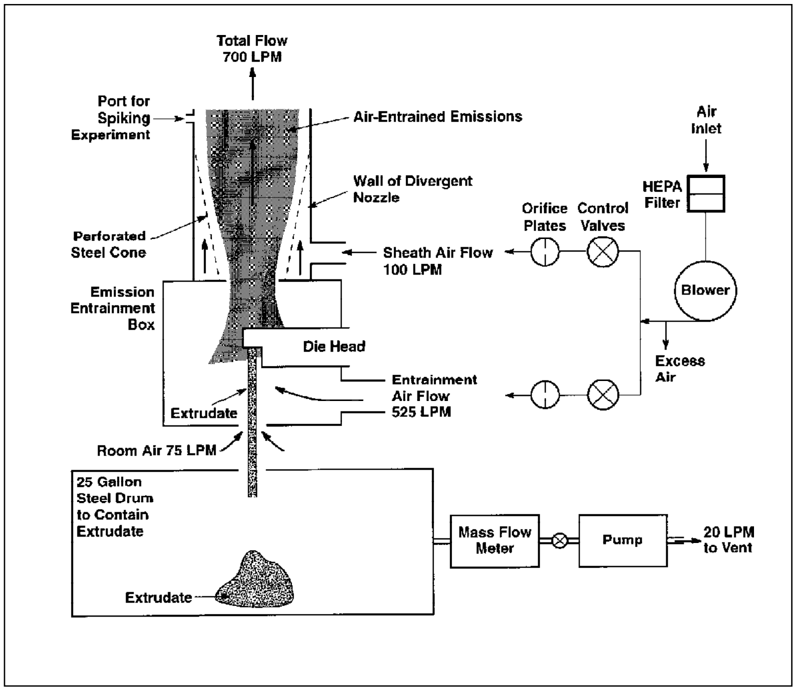


Figure 3. View of emission entrainment area.

Two different methods were used to measure VOC emissions. One was the Beckman 402 Hydrocarbon Analyzer, which continually analyzed the air emission stream throughout the run and provided a direct reading of all VOC substances responding to the flame ionization detector. The other method used an evacuated canister for sample collection and gas chromatography for analysis. With this method, total VOCs were determined by summing up the heavy hydrocarbon (containing a carbon number ranging from C_3 through C_{14}) and light hydrocarbon (containing a carbon number ranging from C_2 through C_3) results.

The total VOCs determined with the 402 Analyzer are in general agreement with the VOC values obtained by summing up the light and heavy hydrocarbons species from the two GC methods. The 402 Analyzer results are consistently higher. The data obtained with the GC speciation method more closely resembles the TO-12 method, which is frequently used to measure source emissions of VOCs. Information on the TO-12 method and the GC speciation method (TO-14) can be obtained from the literature.[9]

This study did not include any measurements of emissions from the drum collection area, as all commercial extrusion processes quench the molten resin shortly after it exits the die. Emissions from the extrudate in the collection drum were prevented from entering the die head entrainment area by drawing air from the drum at 20 L/min and venting to the exhaust duct. Several background samples were taken, and smoke tubes were employed to confirm that the discharge from the entrainment area was not contributing material to the sampling manifold.

VALIDATION OF THE ANALYTICAL METHOD

The purpose of the manifold spiking experiments was to determine the collection and recovery efficiencies of the canister, acid, and carbonyl collection methods. During the first spiking experiment, all three collection methods were evaluated.[2] During the second spiking experiment, collection/recovery efficiencies were determined only for the canister sampling method. The results from the two spiking experiments are summarized in Table 4. The analytes measured by the spiking experiments are listed in column one. Column two shows the method used. Column three shows the calculated concentrations of the spiked compounds in the air stream of the manifold. The concentrations found from duplicate sampling and analyses, corrected for background levels, are shown in the next two columns. Finally, the average percent recovered is given in the last column.

The results from the first experiment are summarized in Table 4 to show recoveries of the manifold spiked compounds. The three organic acids were spiked at a nominal air concentration of about 0.6 to 0.8 µm/L. Recoveries using the KOH-coated filters ranged from 107 to 122%.

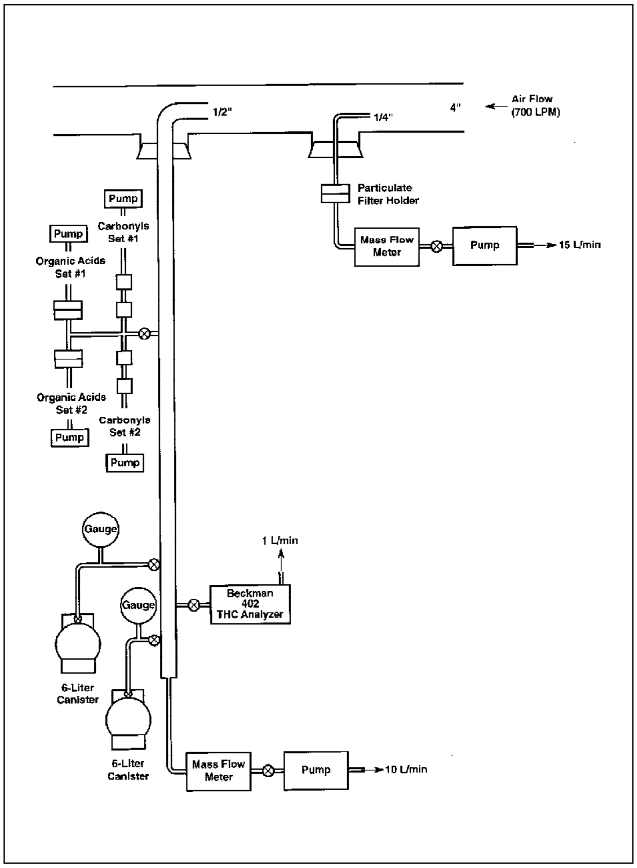


Figure 4. Sampling manifolds for emissions generated in die head.

Formaldehyde (1.63 µm/L) served as the surrogate for the aldehyde/ketone species, and the DNPH cartridge method showed a recovery of 130%. Deuterated benzene (0.092 µm/L) served as the representative compound for the canister collection method. The amount recovered was 95%.

During the second experiment, additional recovery data was obtained for the canister method using an expanded list of compounds. The additional compounds included deuterated benzene for comparison with the first experiment as well as benzene, methyl acrylate, deuterated methyl acrylate, and vinyl acetate. The expected spike level of these five species was nominally 0.24 µm/L. Mass ions from the mass spectrometric detector that were specific for each compound were used in calculating recovery efficiencies, since the five species were not well-resolved with the analytical column (i.e., the two methyl acrylates were seen as one peak when monitoring the flame ionization detector).

POLYPROPYLENE EMISSION FACTOR RESULTS

The extrusion test run results from the eight polypropylene resin mixtures are shown in Table 5. This shows the average die head melt temperature for each run and provides emission values in µg/g for the target species in the following categories: particulate matter, VOCs, and oxygenated species—aldehydes, ketones, and organic acids. The concentrations are directly translatable to pounds of material generated per million pounds of resin processed at that extrusion temperature. Figure 5 shows a bar graph of the just-mentioned emission categories by test run. Emissions plotted include particulate matter, VOCs as measured by the Beckman 402 Analyzer, VOCs as measured by the gas chromatographic speciation methods (e.g., light and heavy hydrocarbon methods), and, finally, the sum of the oxygenate species—aldehydes, ketones, and organic acids.

Examination of the five different resin mixtures extruded at a similar temperature (500 °F), that is, Test Runs 2, 4, 5, 7, and 8 show the controlled rheology homopolymer samples (2 and 4) generate the highest concentration of particulates and VOCs. Figure 5 clearly demonstrates the effect of melt temperature (400 to 600 °F) on emissions from a single resin type. Test Runs 1, 2, and 3 show, as expected, that emissions of all species increase with increasing extrusion temperature; Test Runs 5 and 6 show similar behavior, but to a lesser extent. Note that these data may not be extrapolated to the higher temperatures used for the melt spinning process.

Individual organic acid emissions ranged from less than the detection level to 6.6 µg/g). Formic and acetic acid concentration varied by factors of 20 and 15, respectively, over the eight runs, but the relative levels of formic and acetic acid were similar (within a factor of 2) from test run to test run. Acrylic acid emissions, if any, were below the detection limits of the equipment. Test Runs 3

Table 4. Results from spiking experiments.

Analyte	Method	Spike Level (µg/L)	Recovery (µg/L)		Average % Recovered[a]
			Set 1	Set 2	
First Experiment[2]					
Formic Acid	KOH filters	0.71	0.987	0.733	122 ± 18
Acetic Acid	KOH filters	0.77	1.023	0.640	121 ± 12
Acrylic Acid	KOH filters	0.59	0.687	0.567	107 ± 11
Formaldehyde	DNPH Cartridge	1.63	2.20	2.03	130 ± 5
Benzene-d_6	Canister	0.092	0.088	0.086	95 ± 2
Second Experiment[3]					
Benzene-d_6	Canister	0.24	0.27	0.25	108 ± 4
Benzene	Canister	0.22	0.22	0.22	100
Methyl Acrylate-d_3	Canister	0.25	0.26	0.24	100 ± 4
Methyl Acrylate	Canister	0.25	0.25	0.23	95 ± 4
Vinyl Acetate	Canister	0.24	0.28	0.25	110 ± 6

[a]Relative error is the relative percent difference: the absolute difference in the two samples multiplied by 100 and then divided by their average.

and 4 showed the highest levels of organic acids. The total organic acid emission values for these runs were 10.6 and 10.9 μg/g, respectively. Figure 5 graphically shows the total oxygenates detected. Even at the highest melt temperatures employed in this study, the oxygenates contributed less than 11% of the total VOCs emitted.

The individual carbonyl species ranged in emission values from less than the detection level to 26.9 μg/g. All eight species were resolved. Acetone was the most predominant component, followed by formaldehyde and acetaldehyde. Test Runs 3, 4, and 6 showed the highest level of total carbonyl species. The total carbonyl content from these runs were 73.8, 14.9, and 21.8 μg/g, respectively.

Note that the EPA is proposing to revise its definition of VOCs for purposes of preparing state implementation plans (SIPs) to attain the national ambient air quality standards (NAAQS) for ozone under Title I of the CAAA90 and for the federal implementation plan for the Chicago ozone nonattainment area. The proposed revision would add acetone to the list of compounds excluded from the definition of VOC on the basis that these compounds have negligible contribution to tropospheric ozone formation.[10]

The significance of this data becomes apparent when placed in the context of the 1990 CAAA90 definition of "major" source for VOC emissions. Categorization of an emission source as a major source subjects it to more stringent permitting requirements. The definition of a major source varies with the severity of the ozone nonattainment situation of the area where the source is located. The current VOC emission limits are 10 tons/yr for an emission source within an extreme ozone nonattainment classification, 25 tons/yr for a source in the severe classification, and 50 tons/yr for a source in the serious classification. Currently, the only extreme nonattainment area in the United States is the Los Angeles area.

The utility of this data can be illustrated in the following examples. Based on the emissions data developed in this effort, a processor with equipment similar to that used in this study can extrude annually up to 24.4 million pounds of controlled rheology polypropylene at a

Table 5. Summary of polypropylene extrusion emissions for generic resin grades (μg/g).

Test Run No.	1	2	3	4	5	6	7	8
Extruder Conditions								
Resin Type	Controlled rheology homopolymer	Controlled rheology homopolymer	Controlled rheology homopolymer	Controlled rheology homopolymer (with antistat)	Reactor grade homopolymer	Reactor grade homopolymer	Reactor impact copolymer (15–20 wt % EPR)	Random copolymer (3–6 wt % ET)
Melt Average Die Melt Temp (°F)	400	510	605	490	490	570	505	510
Particulate Matter	30.3	68.4	653	150	17.3	218	34.5	27.9
VOCs								
Beckman 402 - THC[b]	104	177	819	191	33.4	202	80.3	59.4
Heavy Hydrocarbons	79.1	175	587	104	24.6	127	65.1	29.8
Light Hydrocarbons								
Ethane	0.90	1.39	4.65	0.78	0.07	0.37	0.02	0.08
Ethylene	0.38	1.44	1.36	0.50	0.03	0.05	0.02	0.05
Propylene	0.21	0.80	13.9	0.70	0.12	2.24	0.06	0.26
Aldehydes								
Formaldehyde[b]	0.74	1.38	19.1	1.30	0.17	7.05	0.18	0.09
Acrolein[b]	< 0.01	0.05	0.81	0.14	< 0.01	0.10	< 0.01	< 0.01
Acetaldehyde[b]	0.46	0.54	15.8	0.53	0.09	5.63	0.20	0.08
Propionaldehyde[b]	0.05	0.07	1.60	3.31	0.02	0.97	0.95	0.02
Butyraldehyde	0.78	1.05	3.32	0.92	0.04	0.36	0.08	0.01
Benzaldehyde	0.12	0.14	5.21	0.51	0.08	0.88	0.02	0.06
Ketones								
Acetone	9.66	12.6	26.9	9.36	0.15	2.82	0.31	0.18
Methyl Ethyl Ketone[b]	0.19	0.24	9.62	0.26	0.07	5.23	0.04	0.04
Organic Acids								
Formic Acid	0.69	1.43	3.98	5.98	< 0.2	1.19	< 0.2	0.31
Acetic Acid	1.10	1.25	6.60	4.90	< 0.2	2.64	0.25	0.52
Acrylic Acid	< 0.08	< 0.08	< 0.08	< 0.08	< 0.08	< 0.08	< 0.08	< 0.08

[a]THC = Total hydrocarbons (methane is not included).[b]Hazardous air pollutants (HAPs).
Note: The emission values are averages from duplicate runs. In general, the differences were ≤ +/-15%.

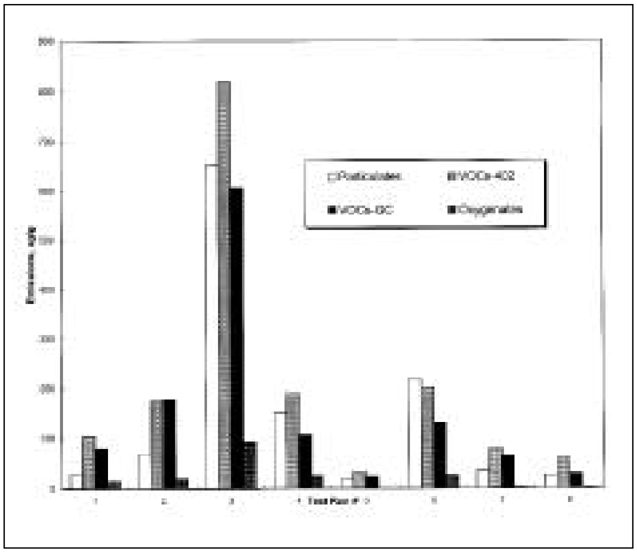


Figure 5. Bar graph showing the particulates, VOCs obtained with the 402 Analyzer, VOCs obtained by GC speciation and oxygenated organic species (factors in µg/g).

melt temperature of 600 °F or 1,156 million pounds of reactor grade homo polypropylene at a melt temperature of 500 °F without exceeding the 10-ton/yr limit for an extreme ozone nonattainment area.

CONCLUSIONS

Based upon the results of this study, the following six conclusions are made:

(1) For the resins studied, the major emission components were particulate matter and VOCs. Much lower amounts were found of the oxygenated species—aldehydes, ketones, and organic acids.

(2) Emission rates are directly correlatable with the melt temperature.

(3) Although the collection and MS speciation of VOCs most closely follows the EPA procedures (TO-12 and TO-14) for measuring VOCs, the more conservative approach using the Beckman 402 Analyzer, which yields higher VOCs values, should be employed.

(4) The data provides polypropylene processors with a baseline for estimating the VOCs generated by the resins they handle on a daily basis under processing conditions similar to those used in this study and at the maximum melt temperatures reported. The following weights of each resin can be processed without exceeding the 10-ton limit of an "extreme" ozone nonattainment area: 24.4 million pounds of controlled rheology polypropylene at 600 °F, 99.0 million pounds of reactor grade homopolymer at 570 °F, 249.1 million pounds of reactor impact copolymer at 505 °F, and 336.7 million pounds of random copolymer at 510 °F.

(5) In some cases, the emission factors determined in this study may overestimate[11] or under estimate emissions from a particular process. Professional judgement and conservative measures must be exercised as necessary when using the data for estimating emission quantities.

(6) This study was not designed to meet the needs of industrial hygienists. However, this type of apparatus can be used at different extrusion conditions to gather data on other types of extrudates such as fiber, film, or sheet.

REFERENCES

1. Sherman, L.M. "Clean-air rules challenge processors," *Plastics Technol.* **1995**, 41*, 2, 83-86.*
2. Barlow, A.; Contos, D.; Holdren, M.; Garrison, P.; Harris, L.; Janke, B. "Development of emission factors for polyethylene processing," *J. Air & Waste Manage. Assoc.* **1996**, 46, 569-580.
3. Battelle Final Report to the Society of the Plastics Industry, "Sampling and analysis of emissions evolved during thermal processing of ethylene-vinyl acetate and ethylene methyl acrylate resin composites," March 1995.
4. Hoff, A.; Jacobson, S. "Thermal oxidation of polypropylene close to industrial processing conditions," *J. Applied Polym. Sci.* **1982**, 27, 2,539.
5. Patel, S.H.; Xanthos, M. "Volatile emissions during thermoplastics processing—A Review," *Advances in Polym. Technol.* **1995**, 14, 67.
6. Hoff, A.; Jacobsson, S. "Thermo-oxidative degradation of low density polyethylene close to industrial processing conditions," *J. Applied Polym. Sci.* **1981**, 26, 3,409-3,423.
7. Hughes, T.W.; Boland, R.F.; Rinaldi, G.M. Source Assessment: Plastic Processing, State of the Art. Monsanto Research Corporation. March 1978, EPA-600/2-78/004C, 27-28.
8. "Air facility subsystem source classification codes and emission factor listing for criteria air pollutants," EPA, March 1990, EPA 450/4-90/003.
9. Compendium of Methods For The Determination of Toxic Organic Compounds in Ambient Air, U.S. Environmental Protection Agency, June 1988. Available from NTIS as PB90-127374.
10. *Fed. Regist.* **1994**, 59, 189, 49,877.
11. Forrest, M.J.; Jolly, A.M.; Holding, S.R.; Richards, S.J. "Emissions from processing thermoplastics," *Annals of Occupational Hygiene.* **1995**, 39, 1, 35-53.
12. Battelle Final Report to the Society of the Plastics Industry, "Sampling and analysis of emissions during thermal processing of polypropylene resin mixtures," April 1995.

About the Authors

Anthony Barlow, Ph.D., is a product steward for Quantum Chemical Company. John Bankston is supervisor of product regulation at Aristech Chemical Corporation. Michael Holdren is a senior research scientist at Battelle Memorial Institute. Vince Marchesani, Ph.D., is director of health and environmental affairs for Montell North America. Jeffrey Meyer, Ph.D., is manager of polymer physics and testing at Amoco Polymers, Inc. Ken Adams (corresponding author) is assistant technical director for the Society of the Plastics Industry, Inc., 1801 K St., NW, Suite 600K, Washington, DC 20006.

IDEM

INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

We Protect Hoosiers and Our Environment.

Mitchell E. Daniels Jr.
Governor

Thomas W. Easterly
Commissioner

100 North Senate Avenue
Indianapolis, Indiana 46204
(317) 232-8603
Toll Free (800) 451-6027
www.idem.IN.gov

Mr. Rob Wells
Primex Plastics Corporation
1235 North F Street
Richmond, Indiana 47374

March 3, 2009

Re: Permit By Rule Status
177-27338-00065

Dear Mr. Wells:

On January 6, 2009, Primex Plastics Corporation submitted a letter with supporting data to the Office of Air Quality (OAQ) indicating that the collocated, stationary, plastic sheet production source, located at 1235 North F Street, Richmond, Indiana 47374 and 2175 Williamsburg Pike, Richmond, Indiana 47374, satisfies the criteria to operate under the provisions of 326 IAC 2-10 (Permit by Rule). Based on the data and information submitted (Attachment A - Source Determination, Attachment B - Emissions Calculations) and the provisions of 326 IAC 2-10 (Permit by Rule), Primex Plastics Corporation, is now operating under Permit by Rule (PBR) Status.

Pursuant to 326 IAC 2-10 (Permit by Rule), this source shall comply with the following conditions:

(a) The source limits actual emissions for every twelve (12) month period to less than twenty percent (20%) of any threshold for the following:

  (1) A major source of regulated air pollutants, as defined by 326 IAC 2-7-1(22) (i.e., one hundred (100) tons per year of any regulated air pollutant, in all areas except areas classified as serious, severe, and extreme nonattainment for ozone). [326 IAC 2-10-3.1(1)(A)]

  (2) A major source of hazardous air pollutants (HAPs), as defined in Section 112 of the Clean Air Act (i.e., ten (10) tons per year of any individual HAP or twenty-five (25) tons per year of any combination of HAPs). [326 IAC 2-10-3.1(1)(B)]

(b) The source shall not rely on air pollution control equipment to comply with the above-mentioned limitations. [326 IAC 2-10-3.1(2)]

(c) Not later than thirty (30) days after receipt of written request by the Indiana Department of Environmental Management (IDEM), Office of Air Quality (OAQ), or U.S. Environmental Protection Agency (EPA), the owner or operator shall demonstrate that the source is in compliance with the above-mentioned conditions. [326 IAC 2-10-4.1]

(d) Compliance demonstration shall be based on actual emissions for the previous 12 months and may include, but is not limited to, fuel or material usage or production records. No other demonstration of compliance shall be required. [326 IAC 2-10-4.1]

This source is hereby notified that this Permit by Rule approval does not relieve the source of the responsibility to comply with the provisions of any applicable federal, state, or local requirements, such as New source Performance Standards (NSPS), 40 CFR Part 60, or National Standards for Hazardous Air Pollutants (NESHAP), 40 CFR Part 61 or 40 CFR Part 63. [326 IAC 2-10-5.1]

Any change or modification which will alter operations in such a way that the source will no longer comply with 326 IAC 2-10 (Permit by Rule), must obtain the appropriate approval from the OAQ under 326 IAC 2-1.1, 326 IAC 2-2, 326 IAC 2-3, 326 IAC 2-7, 326 IAC 2-8, or 326 IAC 2-9 before such change may occur. This source may at any time apply for a state operating permit under 326 IAC 2-6.1, a Part 70 permit under 326 IAC 2-7, a FESOP under 326 IAC 2-8, or an operating agreement under 326 IAC 2-9, as applicable. [326 IAC 2-10-1(b)]

Any violation of 326 IAC 2-10 (Permit by Rule) may result in administrative or judicial enforcement proceedings under IC 13-30-3 and penalties under IC 13-30-4, IC 13-30-5, or IC 13-30-6. [326 IAC 2-10-6.1]

A copy of the PBR is available on the Internet at: http://www.in.gov/ai/appfiles/idem-caats/. For additional information about air permits and how the public and interested parties can participate, refer to the IDEM's Guide for Citizen Participation and Permit Guide on the Internet at: www.idem.in.gov

If you have any questions on this matter, please contact Ms. Desrosiers, of my staff, at 317-234-5374 or 1-800-451-6027, and ask for extension 4-5374.

Sincerely,

Iryn Calilung

Iryn Calilung, Section Chief
Permits Branch
Office of Air Quality

Attachments: A - Source Determination
B - Emissions Calculations

IC/hd

cc: File - Wayne County
Wayne County Health Department
Air Compliance Section
Billing, Licensing, and Training Section

Attachment A - Source Determination
Primex Plastics Corporation

Primex Plastics Corporation (Primex) has two plants in Richmond. Plant A is located at 1235 North F Street and Plant B is located at 2175 Williamsburg Pike. The two plants are approximately 2.5 miles apart. IDEM, OAQ has examined whether the two plants are part of the same source.

The term “source” is defined at 326 IAC 1-2-73. In order for these two plants to be considered one source, they must meet all three of the following criteria:

(1) the plants must be under common ownership or common control;
(2) the plants must have the same two-digit Standard Industrial Classification (SIC) Code or one must serve as a support facility for the other; and,
(3) the plants must be located on contiguous or adjacent properties.

IDEM, OAQ will first look at whether the two plants will be under common ownership or common control. The two plants are owned by Primex, therefore common ownership exists, and the first element of the definition is met.

The second element of the source definition is whether the plants have the same two-digit Standard Industrial Classification (SIC) Code, or if one serves as a support facility for the other. The SIC Codes can be found at http://www.osha.gov/pls/imis/sicsearch.html on the United States Department of Labor, Occupational Safety and Health Administration website. The proper two-digit code for both plants is Major Group 30: Rubber and Miscellaneous Plastics Products.

A plant is considered a support facility if at least 50% of its total output is dedicated to another plant. Plant B sends 80% of its output, reworked plastic, to Plant A. Plant A does not send any output to Plant B. Therefore, Plant B is a support facility to Plant A. Since the two plants have the same two-digit SIC Code and a support facility relationship, the two plants meet the second element of the definition of a source.

Since the plants are located on properties 2.5 miles apart and 80% of the output of Plant B goes to Plant A, the plants are adjacent and the third element of the definition is met. IDEM, OAQ has determined that the two plants meet all the elements of the source definition and are part of the same source.

01/29/2009 initial source determination conducted.

Attachment B - Emission Calculations
Actual Collocated Emissions Summary

Company Name: Primex Plastics Corporation
Address City IN Zip: 1235 North F Street,
Richmond, Indiana 47374
Permit #: 177-12874-00065
Reviewer: Hannah L. Desrosiers
Date: January 6, 2009

	PM (tpy)	PM10* (tpy)	VOC (tpy)	CO (tpy)	Combined HAPs (tpy)
Extrusion	2.26	2.26	6.41	2.25	1.26
Grinding	8.85	8.85	--	--	--
Conveyance	0.48	0.48	--	--	--
Wood Pallets Construction	0.15	0.15	--	--	--
Plastic Scrap Cutting	0.15	0.15	--	--	--
Pallet Washing	--	--	0.04	--	--
Total	**11.89**	**11.89**	**6.45**	**2.25**	**1.26**

Notes:
***** It is assumed that PM10 Emissions equal PM Emissions, and/or, in the absence of valid PM10 Emission Factors, PM Emission Factors have been used.

Under the Part 70 Permit program (40 CFR 70), particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers (PM10), not particulate matter (PM), is considered as a "regulated air pollutant". US EPA has directed states to regulate PM10 emissions as surrogate for PM2.5 emissions.

Therefore, PM = PM10 = PM2.5

Attachment B - Emission Calculations
Actual Collocated Emissions - 12-Month Emissions for 2008

Company Name: Primex Plastics Corporation
Address City IN Zip: 1235 North F Street, Richmond, Indiana 47374
Permit #: 177-12874-00065
Reviewer: Hannah L. Desrosiers
Date: January 6, 2009

Criteria Pollutant Emissions

Actual Material Usage (lbs/yr)		
Resin	Raw Material	Colorant
ABS	13,272,000	580,000
HDPE	61,986,000	1,561,000
PETG	2,724,000	3,587
PP	6,916,000	561,000
PS	34,690,000	1,712,000
Additives	--	670,000

Extrusion		Particulate Matter (PM/PM10) *			Volatile Organic Compounds (VOC)			Carbon Monoxide (CO)		
Material	Purchases (lbs/yr)	Emission Factor (lbs/MMlbs)	Actual Emissions (lbs/yr)	Actual Emissions (tons/yr)	Emission Factor (lbs/MMlbs)	Actual Emissions (lbs/yr)	Actual Emissions (tons/yr)	Emission Factor (lbs/MMlbs)	Actual Emissions (lbs/yr)	Actual Emissions (tons/yr)
ABS	14,405,580	30.3	436.49	0.2182	190	2737.06	1.3685	0	0.00	0.0000
HDPE	65,591,430	26.6	1744.73	0.8724	30.7	2013.66	1.0068	50	3279.57	1.6398
PETG	2,947,435	30.0	88.42	0.0442	35	103.16	0.0516	50	147.37	0.0737
PP	7,839,330	30.3	237.53	0.1188	104	815.29	0.4076	90	705.54	0.3528
PS	37,632,080	53.3	2005.79	1.0029	190	7150.10	3.5750	10	376.32	0.1882
Total				**2.26**			**6.41**			**2.25**

Purchases (lbs/yr) = Raw Material (lbs/yr) + Colorant (lbs/yr) + Additives (lbs/yr)
Additives were assumed to be equally distributed between each resin
3% of material is scrapped and recycled, this amount was added to "Purchases (lbs/yr)"
Actual Emissions (tons/year) = Purchases (lbs/yr) x Emission Factor (lbs/1,000,000 lbs) / 2000 (lbs/ton)

Grinding	Max Capacity (lbs/yr)	PM/PM10 Emission Factor* (lb PM/ton)	PM/PM_{10} Emissions (tons/yr)
Total	119,588,000	0.296	**8.85**

Actual Emissions (tons/year) = [Max Capacity (lbs/yr) / 2000 (lbs/ton)] * [Emission Factor (lb PM/ton) / 2000 (lb/ton)]

Conveyance	Max Capacity (lbs/yr)	PM Emission Factor* (lb PM/ton)	*Control Efficiency	PM/PM10 Emissions (lbs/yr)	PM/PM10 Emissions (tons/yr)
Total	119,588,000	0.80	98.00%	956.70	**0.48**

*Dry filters on the silos and blowers of the storage and handling operations are considered integral to the process. Therefore, PTE is based on control.
Actual Emissions (tons/year) = Max Capacity (lbs/hr) /2000 (lbs/ton) * Emission Factor (lb PM/ton) * (1-Control Efficiency (%)) / 2000 (lbs/ton)

Miscellaneous Operations	Maximum Rate (lbs/hr)	Emission Factor (lbs PM/ton)	PM/PM10 Emissions (lb/hr)	PM/PM10* Emissions (tpy)	Allowable Emissions (lbs/hr)
Wood Pallets Construction	200	0.35	0.04	0.15	0.88
Plastic Scrap Cutting	200	0.35	0.04	0.15	0.88
Total			0.07	**0.31**	

Actual Emissions (tons/year) = [(Maximum Rate (lbs/hr) * Emission Factor (lbs PM/ton)) / 2000 (lbs/ton)] * 8760 (hrs/yr) / 2000 (lbs/ton)

Pallet Washing	Usage (gal/yr)	Density (lb/gal)	VOC (wt %)	HAP (wt %)	VOC Emissions (tons/yr)	HAP Emissions (tons/yr)
Total	96	8.66	10.00%	0.00%	**0.04**	**0.00**

Actual VOC Emissions (tons/year) = Usage (gal/yr) * Density (lb/gal) * VOC (wt %) / 2000 (lbs/ton)
Actual HAP Emissions (tons/year) = Usage (gal/yr) * Density (lb/gal) * HAP (wt %) / 2000 (lbs/ton)

Notes

* It is assumed that PM10 Emissions equal PM Emissions, and/or, in the absence of valid PM10 Emission Factors, PM Emission Factors have been used.

Under the Part 70 Permit program (40 CFR 70), particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers (PM10), not particulate matter (PM), is considered as a "regulated air pollutant". US EPA has directed states to regulate PM10 emissions as surrogate for PM2.5 emissions.

Therefore, PM = PM10 = PM2.5

Attachment B - Emission Calculations
Actual Collocated Emissions - 12-Month Emissions for 2008

Company Name:	**Primex Plastics Corporation**
Address City IN Zip:	**1235 North F Street,**
	Richmond, Indiana 47374
Permit #:	**177-12874-00065**
Reviewer:	**Hannah L. Desrosiers**
Date:	**January 6, 2009**

Hazardous Air Pollutant (HAP) Emissions from Extrusion

ABS Processing

Purchases (lbs/yr)	14,405,580						
HAP	1,3-butadiene	Acrylonitrile	Ethyl benzene	Styrene	Cumene	Acetophenone	Total
Emission Factor	0.93	5.74	27.6	130	3.29	2.78	
Emissions (tons)	0.0067	0.0413	0.1988	0.9364	0.0237	0.0200	**1.2269**

HDPE Processing

Purchases (lbs/yr)	65,591,430				
HAP	Formaldehyde	Acrolein	Acetaldehyde	Propionaldehyde	Total
Emission Factor	0.14	0.02	0.09	0.02	
Emissions (tons)	0.00459	0.00066	0.00295	0.00066	**0.0089**

PETG Processing

Purchases (lbs/yr)	2,947,435				
HAP	Formaldehyde	Acrolein	Acetaldehyde	Propionaldehyde	Total
Emission Factor	0.14	0.02	0.09	0.02	
Emissions (tons)	0.00021	0.00003	0.00013	0.00003	**0.0004**

PP Processing

Purchases (lbs/yr)	7,839,330				
HAP	Formaldehyde	Acrolein	Acetaldehyde	Propionaldehyde	Total
Emission Factor	0.74	0.01	0.46	0.05	
Emissions (tons)	0.00290	0.00004	0.00180	0.00020	**0.0049**

PS Processing

Purchases (lbs/yr)	37,632,080				
HAP	Formaldehyde	Acrolein	Acetaldehyde	Propionaldehyde	Total
Emission Factor	0.74	0.01	0.46	0.05	
Emissions (tons)	0.01392	0.00019	0.00866	0.00094	**0.0237**

Combined HAPs Total **1.2648** ***tons***

Methodology

Actual HAP Emissions (tons/year) = Purchases (lbs/yr) * Emission Factor (lbs/1,000,000 lbs) / 2000 (lbs/ton)

Attachment B - Emission Calculations
Potential Collocated Emissions Summary

Company Name: **Primex Plastics Corporation**
Address City IN Zip: **1235 North F Street,**
Richmond, Indiana 47374
Permit #: **177-12874-00065**
Reviewer: **Hannah L. Desrosiers**
Date: **January 6, 2009**

North F Street Location (Source A)

	PM* (tpy)	VOC (tpy)	CO (tpy)	Combined HAPs (tpy)
Extrusion	--	--	--	2.00
Plant 1	4.11	7.24	0.38	--
Plant 2	5.15	2.46	0.89	--
Plant 3	5.93	2.81	2.89	--
Plant 5	0.94	1.99	1.72	--
Conveyance	1.02	--	--	--
Wood Pallets Construction	0.15	--	--	--
Plastic Scrap Cutting	0.15	--	--	--

Williamsburg Pike Location (Source B)

	PM* (tpy)	VOC (tpy)	CO (tpy)	Combined HAPs (tpy)
Conveyance	0.20	--	--	--
Grinding	3.76	--	--	--
Pallet Washing	--	0.04	--	0.00

Total	**21.42**	**14.54**	**5.88**	**2.00**

Notes:

***** It is assumed that PM10 Emissions equal PM Emissions, and/or, in the absence of valid PM10 Emission Factors, PM Emission Factors have been used.

Under the Part 70 Permit program (40 CFR 70), particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers (PM10), not particulate matter (PM), is considered as a "regulated air pollutant". US EPA has directed states to regulate PM10 emissions as surrogate for PM2.5 emissions.

Therefore, PM = PM10 = PM2.5

Attachment B - Emission Calculations
Potential Emissions for Source A, Plant 1

Company Name: Primex Plastics Corporation
Address City IN Zip: 1235 North F Street, Richmond, Indiana 47374
Permit #: 177-12874-00065
Reviewer: Hannah L. Desrosiers
Date: January 6, 2009

Equipment	Resin	Max Throughput (lb/hr)	PM/PM10 Emission Factor (lb/MMlb)	PM/PM10 Emissions (lb/hr)	PM/PM10* Emissions (tpy)	VOC Emission Factor (lb/MMlb)	VOC Emissions (lb/hr)	VOC Emissions (tpy)	CO Emission Factor (lb/MMlb)	CO Emissions (lb/hr)	CO Emissions (tpy)
Extruder 1	PS	750	53.3	0.040	0.175	190	0.143	0.624	10	0.008	0.033
Extruder 2	PS	1300	53.3	0.069	0.303	190	0.247	1.082	10	0.013	0.057
Extruder 3	PS	750	53.3	0.040	0.175	190	0.143	0.624	10	0.008	0.033
Extruder 4	PS	750	53.3	0.040	0.175	190	0.143	0.624	10	0.008	0.033
Extruder 5	PS	1300	53.3	0.069	0.303	190	0.247	1.082	10	0.013	0.057
Extruder 6	PS	750	53.3	0.040	0.175	190	0.143	0.624	10	0.008	0.033
Extruder 7	PS	750	53.3	0.040	0.175	190	0.143	0.624	10	0.008	0.033
Extruder 9	PS	500	53.3	0.027	0.117	190	0.095	0.416	10	0.005	0.022
Extruder 10	PS	750	53.3	0.040	0.175	190	0.143	0.624	10	0.008	0.033
Extruder 11	PS	750	53.3	0.040	0.175	190	0.143	0.624	10	0.008	0.033
Pelletizer	Plastic Rework	350	53.3	0.019	0.082	190	0.067	0.291	10	0.004	0.015
				0.464	**2.03**		1.653	**7.24**		0.087	**0.38**

Equipment	Resin	Max Throughput (lb/hr)	PM/PM10 Emission Factor (lb/MMlb)	PM/PM10 Emissions (lb/hr)	PM/PM10* Emissions (tpy)
Grinder 1	Plastic Rework	300	0.296	0.044	0.194
Grinder 2	Plastic Rework	300	0.296	0.044	0.194
Grinder 3	Plastic Rework	300	0.296	0.044	0.194
Grinder 4	Plastic Rework	300	0.296	0.044	0.194
Grinder 5	Plastic Rework	300	0.296	0.044	0.194
Grinder 6	Plastic Rework	300	0.296	0.044	0.194
Grinder 7	Plastic Rework	300	0.296	0.044	0.194
Grinder 8	Plastic Rework	300	0.296	0.044	0.194
Grinder 9	Plastic Rework	200	0.296	0.030	0.130
Grinder 10	Plastic Rework	300	0.296	0.044	0.194
Grinder 11	Plastic Rework	300	0.296	0.044	0.194
				0.474	**2.07**

	PM (lb/hr)	PM* (tpy)	VOC (lb/hr)	VOC (tpy)	CO (lb/hr)	CO (tpy)
TOTAL PLANT 1	0.937	**4.105**	1.653	**7.240**	0.087	**0.381**

Notes

Emission factors for PS are from "Sampling and Analysis of Fumes Evolved During thermal Processing of Polystyrene Resins", Dow Chemical, et al.
* It is assumed that PM10 Emissions equal PM Emissions, and/or, in the absence of valid PM10 Emission Factors, PM Emission Factors have been used.
Under the Part 70 Permit program (40 CFR 70), particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers (PM10), not particulate matter (PM), is considered as a "regulated air pollutant".
US EPA has directed states to regulate PM10 emissions as surrogate for PM2.5 emissions.
Therefore, PM = PM10 = PM2.5
PTE (tons/year) = Maximum Rate (lbs/hr) x Emission Factor (lbs/1,000,000 lbs) x 8760 (hours/year) x (1 ton/2000 lbs)

Attachment B - Emission Calculations
Potential Emissions for Source A, Plant 2

Company Name:	**Primex Plastics Corporation**
Address City IN Zip:	**1235 North F Street,**
	Richmond, Indiana 47374
Permit #:	**177-12874-00065**
Reviewer:	**Hannah L. Desrosiers**
Date:	**January 6, 2009**

Equipment	Resin	Max Throughput (lb/hr)	PM/PM10 Emission Factor (lb/MMlb)	PM/PM10 Emissions (lb/hr)	PM/PM10* Emissions (tpy)	VOC Emission Factor (lb/MMlb)	VOC Emissions (lb/hr)	VOC Emissions (tpy)	CO Emission Factor (lb/MMlb)	CO Emissions (lb/hr)	CO Emissions (tpy)
Extruder 1	ABS	800	30.3	0.02	0.11	190	0.15	0.67	0	0.00	0.00
Extruder 2	ABS	700	30.3	0.02	0.09	190	0.13	0.58	0	0.00	0.00
Extruder 3	ABS	800	30.3	0.02	0.11	190	0.15	0.67	0	0.00	0.00
Extruder 4	HDPE	850	26.6	0.02	0.10	30.7	0.03	0.11	50	0.04	0.19
Extruder 5	HDPE	850	26.6	0.02	0.10	30.7	0.03	0.11	50	0.04	0.19
Extruder 6	HDPE	1000	26.6	0.03	0.12	30.7	0.03	0.13	50	0.05	0.22
Extruder 7	HDPE	500	26.6	0.01	0.06	30.7	0.02	0.07	50	0.03	0.11
Extruder 8	HDPE	850	26.6	0.02	0.10	30.7	0.03	0.11	50	0.04	0.19
		6,350.00		0.18	**0.78**		0.56	**2.46**		0.20	**0.89**

Equipment	Resin	Max Throughput (lb/hr)	PM/PM10 Emission Factor (lb/MMlb)	PM/PM10 Emissions (lb/hr)	PM/PM10* Emissions (tpy)
Grinder 1	HDPE	950	0.296	0.14	0.62
Grinder 2	HDPE	950	0.296	0.14	0.62
Grinder 3	HDPE	1500	0.296	0.22	0.97
Grinder 5	HDPE	950	0.296	0.14	0.62
Grinder 6	HDPE	950	0.296	0.14	0.62
Grinder 7	HDPE	500	0.296	0.07	0.32
Grinder 8	HDPE	950	0.296	0.14	0.62
				1.00	**4.38**

	PM (lb/hr)	PM* (tpy)	VOC (lb/hr)	VOC (tpy)	CO (lb/hr)	CO (tpy)
TOTAL PLANT 2	1.18	**5.15**	0.56	**2.46**	0.20	**0.89**

Notes

Emission factors for ABS are from "Sampling and Analysis of VOCs Evolved During Thermal Processing of ABS Composite Resins", D.A. Contos, et al
Emission factors for HDPE are from "Development of Emission Factors for Polyethylene Processing", Anthony Barlow, et al
* It is assumed that PM10 Emissions equal PM Emissions, and/or, in the absence of valid PM10 Emission Factors, PM Emission Factors have been used

Under the Part 70 Permit program (40 CFR 70), particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers (PM10), not particulate matter (PM), is considered as a "regulated air pollutant". US EPA has directed states to regulate PM10 emissions as surrogate for PM2.5 emissions.

Therefore, PM = PM10 = PM2.5
PTE (tons/year) = Maximum Rate (lbs/hr) x Emission Factor (lbs/1,000,000 lbs) x 8760 (hours/year) x (1 ton/2000 lbs)

Attachment B - Emission Calculations
Potential Emissions for Source A, Plant 3

Company Name:	**Primex Plastics Corporation**
Address City IN Zip:	**1235 North F Street,**
	Richmond, Indiana 47374
Permit #:	**177-12874-00065**
Reviewer:	**Hannah L. Desrosiers**
Date:	**January 6, 2009**

Equipment	Resin	Max Throughput (lb/hr)	PM/PM10 Emission Factor (lb/MMlb)	PM/PM10 Emissions (lb/hr)	PM/PM10* Emissions (tpy)	VOC Emission Factor (lb/MMlb)	VOC Emissions (lb/hr)	VOC Emissions (tpy)	CO Emission Factor (lb/MMlb)	CO Emissions (lb/hr)	CO Emissions (tpy)
Extruder 1	PETG	600	30	0.02	0.08	35	0.02	0.09	50	0.03	0.13
Extruder 2	PETG	600	30	0.02	0.08	35	0.02	0.09	50	0.03	0.13
Extruder 3	HDPE / PP	900	30.3	0.03	0.12	104	0.09	0.41	90	0.08	0.35
Extruder 4	HDPE / PP	900	30.3	**0.03**	0.12	104	0.09	0.41	90	0.08	0.35
Extruder 5	HDPE / PP	850	30.3	0.03	0.11	104	0.09	0.39	90	0.08	0.34
Extruder 6	HDPE / PP	850	30.3	0.03	0.11	104	0.09	0.39	90	0.08	0.34
Extruder 7	HDPE / PP	850	30.3	0.03	0.11	104	0.09	0.39	90	0.08	0.34
Mega Extruder 8	HDPE	4000	30.3	0.12	0.53	37	0.15	0.65	52	0.21	0.91
		9,550.00		0.29	**1.27**		0.64	**2.81**		0.66	**2.89**

Equipment	Resin	Max Throughput (lb/hr)	PM/PM10 Emission Factor (lb/MMlb)	PM/PM10 Emissions (lb/hr)	PM/PM10* Emissions (tpy)
Grinder P1	Plastic Rework	400	0.296	0.06	0.26
Grinder P3	Plastic Rework	400	0.296	0.06	0.26
Grinder P4	Plastic Rework	400	0.296	0.06	0.26
Grinder P5	Plastic Rework	1600	0.296	0.24	1.04
Grinder P6	Plastic Rework	1600	0.296	0.24	1.04
Grinder P7	Plastic Rework	400	0.296	0.06	0.26
Grinder P10	Plastic Rework	1200	0.296	0.18	0.78
Grinder P11	Plastic Rework	1200	0.296	0.18	0.78
				1.07	**4.67**

	PM (lb/hr)	PM* (tpy)	VOC (lb/hr)	VOC (tpy)	CO (lb/hr)	CO (tpy)
TOTAL PLANT 3	1.35	**5.93**	0.64	**2.81**	0.66	**2.89**

Notes

Emission factors for PP are from "Development of Emission Factors for Polypropylene Processing", Ken Adams, et al.

Emission factors for PETG are from AP-42, Table 4.4-2.

Emission factors for HDPE are from "Development of Emission Factors for Polyethylene Processing", Anthony Barlow, et al.

* It is assumed that PM10 Emissions equal PM Emissions, and/or, in the absence of valid PM10 Emission Factors, PM Emission Factors have been used.

Under the Part 70 Permit program (40 CFR 70), particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers (PM10), not particulate matter (PM), is considered as a "regulated air pollutant". US EPA has directed states to regulate PM10 emissions as surrogate for PM2.5 emissions.

Therefore, PM = PM10 = PM2.5

PTE (tons/year) = Maximum Rate (lbs/hr) x Emission Factor (lbs/1,000,000 lbs) x 8760 (hours/year) x (1 ton/2000 lbs)

Attachment B - Emission Calculations
Potential Emissions for Source A, Plant 5

Company Name:	**Primex Plastics Corporation**
Address City IN Zip:	**1235 North F Street,**
	Richmond, Indiana 47374
Permit #:	**177-12874-00065**
Reviewer:	**Hannah L. Desrosiers**
Date:	**January 6, 2009**

Equipment	Resin	Max Throughput (lb/hr)	PM/PM10 Emission Factor (lb/MMlb)	PM/PM10 Emissions (lb/hr)	PM/PM10* Emissions (tpy)	VOC Emission Factor (lb/MMlb)	VOC Emissions (lb/hr)	VOC Emissions (tpy)	CO Emission Factor (lb/MMlb)	CO Emissions (lb/hr)	CO Emissions (tpy)
Extruder 1	HDPE / PP	1000	30.3	0.03	0.13	104	0.10	0.46	90	0.09	0.39
Extruder 2	HDPE / PP	1000	30.3	0.03	0.13	104	0.10	0.46	90	0.09	0.39
Extruder 3	HDPE / PP	1000	30.3	0.03	0.13	104	0.10	0.46	90	0.09	0.39
Extruder 4	HDPE / PP	250	30.3	0.01	0.03	104	0.03	0.11	90	0.02	0.10
Extruder 5	HDPE / PP	250	30.3	0.01	0.03	104	0.03	0.11	90	0.02	0.10
Extruder 6	HDPE / PP	250	30.3	0.01	0.03	104	0.03	0.11	90	0.02	0.10
Extruder 7	HDPE / PP	250	30.3	0.01	0.03	104	0.03	0.11	90	0.02	0.10
Pelletizer	HDPE / PP	370	30.3	0.01	0.05	104	0.04	0.17	90	0.03	0.15
		4,370.00		0.13	**0.58**		0.45	**1.99**		0.39	**1.72**

Equipment	Resin	Max Throughput (lb/hr)	PM/PM10 Emission Factor (lb/MMlb)	PM/PM10 Emissions (lb/hr)	PM/PM10* Emissions (tpy)
Grinder 1	Plastic Rework	140	0.296	0.02	0.09
Grinder 2	Plastic Rework	140	0.296	0.02	0.09
Grinder 3	Plastic Rework	140	0.296	0.02	0.09
Grinder 4	Plastic Rework	140	0.296	0.02	0.09
				0.08	**0.36**

	PM (lb/hr)	PM* (tpy)	VOC (lb/hr)	VOC (tpy)	CO (lb/hr)	CO (tpy)
TOTAL PLANT 5	0.22	**0.94**	0.45	**1.99**	0.39	**1.72**

Notes

Emission factors for HDPE are from "Development of Emission Factors for Polyethylene Processing", Anthony Barlow, et al
Emission factors for PP are from "Development of Emission Factors for Polypropylene Processing", Ken Adams, et al.
* It is assumed that PM10 Emissions equal PM Emissions, and/or, in the absence of valid PM10 Emission Factors, PM Emission Factors have been used.

Under the Part 70 Permit program (40 CFR 70), particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers (PM10), not particulate matter (PM), is considered as a "regulated air pollutant". US EPA has directed states to regulate PM10 emissions as surrogate for PM2.5 emissions.

Therefore, PM = PM10 = PM2.5
PTE (tons/year) = Maximum Rate (lbs/hr) x Emission Factor (lbs/1,000,000 lbs) x 8760 (hours/year) x (1 ton/2000 lbs)

Attachment B - Emission Calculations

Hazardous Air Pollutant (HAP) Emissions from Extrusion

Company Name: Primex Plastics Corporation
Address City IN Zip: 1235 North F Street,
Richmond, Indiana 47374
Permit #: 177-12874-00065
Reviewer: Hannah L. Desrosiers
Date: January 6, 2009

Potential Material Usage

Resin	Raw Material Usage (lbs/hr)	Raw Material Usage (lbs/yr)	Colorant Usage (lbs/yr)	Additives Usage (lbs/yr)	Total Usage (lbs/yr)	Total Usage (tons/yr)
ABS	2,300	20,148,000	880,488	347,181	22,016,940	11,008
HDPE	14,800	129,648,000	3,264,939	347,181	137,257,924	68,629
PETG	1,200	10,512,000	13,842	347,181	11,199,214	5,600
PP	8,720	76,387,200	6,196,243	347,181	85,418,543	42,709
PS	8,350	73,146,000	3,609,857	347,181	79,416,130	39,708
Total	**35,370**	**309,841,200**	**13,965,371**	**1,735,907**	**335,308,752**	**167,654**

Methodology

> Additives were assumed to be equally distributed between each resin
> The potential pounds per year usage of colorant and additives was estimated from the actual usage using a simple ratio, as follows;
Potential Colorant Usage (lb/yr) = (Actual Colorant Usage * Potential Resin Usage) / Actual Resin Usage
Potential Additive Usage (lb/yr) = [(Total Actual Colorant Usage * Total Potential Resin Usage) / Total Actual Resin Usage) / 5]
> Total Usage (lbs/yr) = (Raw Material (lbs/yr) + Colorant (lbs/yr) + Additives (lbs/yr)) *1.03
3% of material is scrapped and recycled, this amount was added to "Purchases (lbs/yr)"

ABS Processing

Purchases (lbs/yr)	22,016,940						
HAP	1,3-butadiene	Acrylonitrile	Ethyl benzene	Styrene	Cumene	Acetophenone	Total
Emission Factor	0.93	5.74	27.6	130	3.29	2.78	
Emissions (tons)	0.0102	0.0632	0.3038	1.4311	0.0362	0.0306	**1.88**

HDPE Processing

Purchases (lbs/yr)	137,257,924				
HAP	Formaldehyde	Acrolein	Acetaldehyde	Propionaldehyde	Total
Emission Factor	0.14	0.02	0.09	0.02	
Emissions (tons)	0.00961	0.00137	0.00618	0.00137	**0.02**

PETG Processing

Purchases (lbs/yr)	11,199,214				
HAP	Formaldehyde	Acrolein	Acetaldehyde	Propionaldehyde	Total
Emission Factor	0.14	0.02	0.09	0.02	
Emissions (tons)	0.00078	0.00011	0.00050	0.00011	**0.002**

PP Processing

Purchases (lbs/yr)	85,418,543				
HAP	Formaldehyde	Acrolein	Acetaldehyde	Propionaldehyde	Total
Emission Factor	0.74	0.01	0.46	0.05	
Emissions (tons)	0.03160	0.00043	0.01965	0.00214	**0.05**

PS Processing

Purchases (lbs/yr)	79,416,130				
HAP	Formaldehyde	Acrolein	Acetaldehyde	Propionaldehyde	Total
Emission Factor	0.74	0.01	0.46	0.05	
Emissions (tons)	0.02938	0.00040	0.01827	0.00199	**0.05**

Total Combined HAPs	**2.00**	***tons***

Methodology

> Potential HAP Emissions (tons/year) = Total Usage (lbs/yr) * Emission Factor (lbs/1,000,000 lbs) / 2000 (lbs/ton)

Attachment B - Emission Calculations
Potential Emissions for Source A, Material Conveyance

Company Name: Primex Plastics Corporation
Address City IN Zip: 1235 North F Street,
Richmond, Indiana 47374
Permit #: 177-12874-00065
Reviewer: Hannah L. Desrosiers
Date: January 6, 2009

Plant	Max Capacity (lbs/hr)	Process Weight Rate (tons/hr)	Emission Factor* (lb/ton)	Control Efficiency	PM/PM10 Emissions (lb/hr)	PM/PM10** Emissions (tpy)
1	8,700	4.35	0.80	98.00%	0.0696	0.3048
2	6,350	3.18	0.80	98.00%	0.0508	0.2225
3	9,550	4.78	0.80	98.00%	0.0764	0.3346
5	4,370	2.19	0.80	98.00%	0.0350	0.1531
Total					0.23	**1.02**

Notes
* Emission Factor (lb/ton) taken from Permit # 177-12874-00065
****** It is assumed that PM10 Emissions equal PM Emissions, and/or, in the absence of valid PM10 Emission Factors, PM Emission Factors have been used.
Under the Part 70 Permit program (40 CFR 70), particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers (PM10), not particulate matter (PM), is considered as a "regulated air pollutant". US EPA has directed states to regulate PM10 emissions as surrogate for PM2.5 emissions.
Therefore, PM = PM10 = PM2.5
Potential PM Emissions (lbs/hr) = Max Capacity (lbs/hr) /2000 (lbs/ton) * Emission Factor (lb/ton) * (1-Control Efficiency (%))
Potential PM Emissions (tons/yr) = Potential Emissions (lbs/hr) * 8760 (hrs/yr) / 2000 (lbs/ton)

Attachment B - Emission Calculations
Potential Emissions for Source A, Pallet Construction and Scrap Cutting Operations

Company Name: **Primex Plastics Corporation**
Address City IN Zip: **1235 North F Street,**
Richmond, Indiana 47374
Permit #: **177-12874-00065**
Reviewer: **Hannah L. Desrosiers**
Date: **January 6, 2009**

				Potential	
Equipment	**Maximum Rate (lbs/hr)**	**Process Weight Rate (tons/hr)**	**Emission Factor (lbs/ton)**	**PM/PM10 Emissions (lb/hr)**	**PM/PM10* Emissions (tpy)**
Wood Pallets Construction	200	0.10	0.35	0.04	0.15
Plastic Scrap Cutting	200	0.10	0.35	0.04	0.15
TOTAL				0.07	**0.31**

Notes

***** It is assumed that PM10 Emissions equal PM Emissions, and/or, in the absence of valid PM10 Emission Factors, PM Emission Factors have been used.

Under the Part 70 Permit program (40 CFR 70), particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers (PM10), not particulate matter (PM), is considered as a "regulated air pollutant". US EPA has directed states to regulate PM10 emissions as surrogate for PM2.5 emissions.

Therefore, PM = PM10 = PM2.5

Emission Factors for wood and plastic cutting are from FIRE Version 6.22 for log sawing (SCC# 3-07-008-02).

Attachment B - Emission Calculations
Potential Emissions for the Source B, Warehouse
Plastic Grinding Rework

Company Name:	**Primex Plastics Corporation**
Address City IN Zip:	**1235 North F Street,**
	Richmond, Indiana 47374
Permit #:	**177-12874-00065**
Reviewer:	**Hannah L. Desrosiers**
Date:	**January 6, 2009**

Equipment	Maximum Rate (lbs/hr)	Process Weight Rate (tons/hr)	EF* (lbs/ton)	PM/PM10 Emissions (lb/hr)	PM/PM10** Emissions (tpy)
Grinder 1	1,500	0.75	0.296	0.222	0.972
Grinder 2	1,800	0.90	0.296	0.266	1.167
Grinder 3	2,500	1.25	0.296	0.370	1.621
Total				0.86	**3.76**

Notes

* Emission factors (EF) were developed by mass balance based on material processed and material collected.

** It is assumed that PM10 Emissions equal PM Emissions, and/or, in the absence of valid PM10 Emission Factors, PM Emission Factors have been used.

Under the Part 70 Permit program (40 CFR 70), particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers (PM10), not particulate matter (PM), is considered as a "regulated air pollutant". US EPA has directed states to regulate PM10 emissions as surrogate for PM2.5 emissions.

Therefore, PM = PM10 = PM2.5

Potential Emissions (tons/year) = Maximum Rate (lbs/hr) x (1 ton/2000 lbs) x Emission Factor (lbs/ton) x 8760 (hours/year) x (1 ton/2000 lbs)

Attachment B - Emission Calculations
Total Potential Emissions for Source B, Pallet Washing Station

Company Name:	**Primex Plastics Corporation**
Address City IN Zip:	**1235 North F Street, Richmond, Indiana 47374**
Permit #:	**177-12874-00065**
Reviewer:	**Hannah L. Desrosiers**
Date:	**January 6, 2009**

Cleaning Material	Max Usage (gal/yr)	Density (lb/gal)	VOC (wt %)	HAP (wt %)
WC-314 Cleaner	96	8.66	10.00%	0.00%

VOC (tons/yr)	HAP (tons/yr)
0.04	**0.00**

Notes

The product contains sodium hydroxide and glycol ether [111-76-2], neither of which are considered a HAP.

VOC (tons/yr) = Max Usage (gal/yr) x Density (lb/gal) x VOC (wt %)

Attachment B - Emission Calculations
Potential Emissions for Source B, Material Conveyance

Company Name:	**Primex Plastics Corporation**
Address City IN Zip:	**1235 North F Street,**
	Richmond, Indiana 47374
Permit #:	**177-12874-00065**
Reviewer:	**Hannah L. Desrosiers**
Date:	**January 6, 2009**

Plant	Max Capacity (lbs/hr)	Process Weight Rate (tons/hr)	Emission Factor* (lb/ton)	Control Efficiency	PM/PM10 Emissions (lb/hr)	PM/PM10** Emissions (tpy)
1	1,500	0.75	0.80	98.00%	0.0120	0.0526
2	1,800	0.90	0.80	98.00%	0.0144	0.0631
3	2,500	1.25	0.80	98.00%	0.0200	0.0876
Total					0.05	**0.20**

Notes

* Emission Factor (lb/ton) taken from Permit # 177-12874-00065.
****** It is assumed that PM10 Emissions equal PM Emissions, and/or, in the absence of valid PM10 Emission Factors, PM Emission Factors have been used.
Under the Part 70 Permit program (40 CFR 70), particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers (PM10), not particulate matter (PM), is considered as a "regulated air pollutant". US EPA has directed states to regulate PM10 emissions as surrogate for PM2.5 emissions.

Dry filters on the silos and blowers are considered integral to the process. Therefore, PTE of PM/PM10 for storage and handling is after control.

Therefore, PM = PM10 = PM2.5

Potential Emissions (lbs/hr) = Max Capacity (lbs/hr) /2000 (lbs/ton) * Emission Factor (lb/ton) * (1-Control Efficiency (%))

Potential Emissions (tons/yr) = Potential Emissions (lbs/hr) * 8760 (hrs/yr) / 2000 (lbs/ton)

From:	Squillace, Kristen M
To:	Jack Laubacher
Cc:	Craig Laubacher
Subject:	RE: IDEM OAQ New Calculations for Spartech App No.:035-47764-00078
Date:	Thursday, June 6, 2024 9:38:00 AM
Attachments:	image001.png image002.png image003.png image004.png image005.png image006.png image007.png image008.png

Hi Jack,

Thank you for sending those. I appreciate the help!

All the best,

Kristen

Indiana Department of Environmental Management

Kristen Squillace

Environmental Manager

(317) 233-9327 • KSquilla@idem.IN.gov

Protecting Hoosiers and Our Environment

| www.idem.IN.gov

From: Jack Laubacher <jlaubacher@e-c-e.org>

Sent: Thursday, June 6, 2024 9:33 AM

To: Squillace, Kristen M <KSquilla@idem.IN.gov>

Cc: Craig Laubacher <claubacher@e-c-e.org>

Subject: Re: IDEM OAQ New Calculations for Spartech App No.:035-47764-00078 click links from unknown senders or unexpected email. ****

Hi Kristen,

Craig is traveling this weekend, and asked me to send you some reference material.

Please see attached. Note that the tables are referenced in the spreadsheet and documents have relevant items highlighted.

Thanks

Jack Laubacher

Cell- 330-212-6310

ECE

Environmental Compliance & Engineering

From: "Squillace, Kristen M" <KSquilla@idem.in.gov>
Date: June 6, 2024 at 7:40:37 AM CDT
To: Craig Laubacher <claubacher@e-c-e.org>
Subject: IDEM OAQ New Calculations for Spartech App No.:035-47764-00078

Hi Craig,

For the new calculations of the coextruders, would you be able to send the documents you got the new VOC (lbs/MMlb) and PM/PM10 (lbs/MMlb) factors from? I'd appreciate it if you could provide page numbers in the documents for those numbers. We need to confirm the numbers before we can accept the calculations.

Thanks!,

Kristen

Indiana Department of Environmental Management

Kristen Squillace
Environmental Manager

(317) 233-9327 • KSquilla@idem.IN.gov

Protecting Hoosiers and Our Environment

| | | | | www.idem.IN.gov

Help us improve!
IDEM values your feedback

From: Squillace, Kristen M
To: Craig Laubacher
Subject: RE: IDEM OAQ Transition to Registration for Spartech App No 035-47764-00078
Date: Wednesday, June 12, 2024 11:30:00 AM
Attachments: image001.png
image002.png
image003.png
image004.png
image005.png
image006.png
image007.png

It's no trouble. The timeframe is 60 days for a Registration. We are already close to the end of the timeframe. I'm going to make this permit my priority so it should hopefully be finished early to mid July as long as there aren't any significant concerns that come up. I unfortunately can't give an exact date at the moment. Hope that helps!

All the best,

Kristen

IDEM

Indiana Department of Environmental Management

Kristen Squillace

Environmental Manager

(317) 233-9327 • KSquilla@idem.IN.gov

Protecting Hoosiers and Our Environment

| www.idem.IN.gov

Help us improve!
IDEM values your feedback

From: Craig Laubacher <claubacher@e-c-e.org>
Sent: Wednesday, June 12, 2024 11:24 AM
To: Squillace, Kristen M <KSquilla@idem.IN.gov>
Subject: RE: IDEM OAQ Transition to Registration for Spartech App No 035-47764-00078

I hate to be a burden, but I've been asked by the plant what your expected new timeframe is for the registration permit approval. Is that something you are able to share with me?

Thank you again,

Craig Laubacher
Regional Director
Environmental Compliance & Engineering
Mobile **512-635-4324**
Email claubacher@e-c-e.org

From: Squillace, Kristen M <KSquilla@idem.IN.gov>
Sent: Wednesday, June 12, 2024 9:43 AM
To: Craig Laubacher <claubacher@e-c-e.org>
Subject: RE: IDEM OAQ Transition to Registration for Spartech App No 035-47764-00078

Ok, I will update the permit to state that it's an emergency fire pump engine.

Thanks!,

Kristen

Indiana Department of Environmental Management

Kristen Squillace
Environmental Manager
(317) 233-9327 • KSquilla@idem.IN.gov

Protecting Hoosiers and Our Environment

| | | | | www.idem.IN.gov

Help us improve!
IDEM values your feedback

From: Craig Laubacher <claubacher@e-c-e.org>
Sent: Wednesday, June 12, 2024 10:41 AM
To: Squillace, Kristen M <KSquilla@idem.IN.gov>

Subject: RE: IDEM OAQ Transition to Registration for Spartech App No 035-47764-00078

**** This is an EXTERNAL email. Exercise caution. DO NOT open attachments or click links from unknown senders or unexpected email. ****

Okay that sounds great. I verified that the engine is an emergency fire pump engine.

Thanks for your help!

Craig Laubacher
Regional Director
Environmental Compliance & Engineering
Mobile **512-635-4324**
Email claubacher@e-c-e.org

From: Squillace, Kristen M <KSquilla@idem.IN.gov>
Sent: Wednesday, June 12, 2024 9:35 AM
To: Craig Laubacher <claubacher@e-c-e.org>
Subject: RE: IDEM OAQ Transition to Registration for Spartech App No 035-47764-00078

Great! For the calculations with the integrals, I can easily change it to show the new ones have no integral. I'll keep you posted if any more questions come up.

Thanks!,

Kristen

Indiana Department of Environmental Management

Kristen Squillace
Environmental Manager
(317) 233-9327 • KSquilla@idem.IN.gov

Protecting Hoosiers and Our Environment

| www.idem.IN.gov

Help us improve!
IDEM values your feedback

From: Craig Laubacher <claubacher@e-c-e.org>
Sent: Wednesday, June 12, 2024 10:28 AM
To: Squillace, Kristen M <KSquilla@idem.IN.gov>
Subject: RE: IDEM OAQ Transition to Registration for Spartech App No 035-47764-00078

Thanks for this feedback Kristen.

I'm looking into your question about Pump1. In the meantime, not applying for integral is fine. But does that mean I'll be needing to redo a couple of the calcs on the spreadsheet? If so, no big deal. Just wanted to make sure that's what you're suggesting. And we all love the fact that it'll speed up approval! These guys are chomping at the bit to get these processes up and running.

Thanks!

Craig Laubacher
Regional Director
Environmental Compliance & Engineering
Mobile **512-635-4324**
Email **claubacher@e-c-e.org**

From: Squillace, Kristen M <KSquilla@idem.IN.gov>
Sent: Wednesday, June 12, 2024 9:21 AM
To: Craig Laubacher <claubacher@e-c-e.org>
Subject: IDEM OAQ Transition to Registration for Spartech App No 035-47764-00078

Hi Craig,

I've started the process of transitioning the permit from a MSOP to a Registration. All of the same federal rules will still apply. I'm still working through the state rules, but most of them should still be the same. The biggest difference for a Registration is the emission levels are less than 25 tons per year versus the MSOP which is between 25 to 100 tons per year for pollutants. Registrations also do not need to be renewed and have lower fees.

The timeframe for a Registration Application is much shorter. Due to the change this late in the process, I'm going to recommend dropping the integral determination. If we went through with the integral determination, we would need to do a Notice of Deficiency which would stop our timeclock while we determine if the controls were integral or not. The determination would take much longer and it doesn't change the permit levels or have any significant change to the emission levels.

I do have one question regarding the one (1) stationary 208 hp, diesel-fired fire pump engine, identified as Pump1. Is this fire pump engine considered an emergency engine or a black start engine? Some of the applicability portions of NESHAP Subpart ZZZZ for the fire pump reference an emergency or black start engine. If it's not an emergency engine, then I can correct the applicable portion list.

Thank you for your assistance!

All the best,

Kristen

Indiana Department of Environmental Management

Kristen Squillace

Environmental Manager

(317) 233-9327 • KSquilla@idem.IN.gov

Protecting Hoosiers and Our Environment

| | | | | www.idem.IN.gov

Help us improve!

IDEM values your feedback

From: Craig Laubacher
To: Squillace, Kristen M
Subject: RE: IDEM OAQ Emission Unit Calculations App No. 035-47764-00078 for Spartech LLC The Jordan Company
Date: Tuesday, June 18, 2024 12:38:00 PM
Attachments: image001.png
image002.png
image003.png
image004.png
image005.png
image006.png
image007.png
2024 Muncie Emissions Calculations - Rev 3.xlsx

Kristen,

I have added a tab and updated the summary tab with the VOC emissions from the parts washers (per AP-42).

Please let me know if you have any more questions!

Craig Laubacher
Regional Director
Environmental Compliance & Engineering
Mobile **512-635-4324**
Email claubacher@e-c-e.org

From: Squillace, Kristen M <KSquilla@idem.IN.gov>
Sent: Tuesday, June 18, 2024 7:54 AM
To: Craig Laubacher <claubacher@e-c-e.org>
Subject: IDEM OAQ Emission Unit Calculations App No. 035-47764-00078 for Spartech LLC The Jordan Company

Hi Craig,

I was reading the description of the two parts cleaners, Tub 1 and 2, and noticed that it does use a solution that contains very low amounts of VOC. The units are:

(y) One (1) parts cleaning unit, identified as Aqueous Parts Tub1, using aqueous cleaners containing less than 1% VOC.

(z) One (1) parts cleaning unit, identified as Aqueous Parts Tub 2, using aqueous cleaners containing less than 1% VOC.

Even though it would be an extremely small amount of VOC, it still would emit some VOC. For accuracy, we need to put it in the calculations to show that it does have a small amount of emissions. Would you be able to send me some calculations for it?

All the best,

Kristen

Indiana Department of Environmental Management

Kristen Squillace

Environmental Manager

(317) 233-9327 • KSquilla@idem.IN.gov

Protecting Hoosiers and Our Environment

| | | | | www.idem.IN.gov

Appendix A: Emission Calculations
Potentail to Emit (PTE) Summary

Company Name: Spartech, LLC
Address: 1401 East Memorial Drive, Muncie, Indiana 47302
MSOP Permit No.: M035-43766-00078
Reviewer:

		Potential to Emit Before Controls (tons/year)							
Emission Unit	**Emission Unit ID**	**PM**	**PM10**	**PM2.5**	**SO_2**	**NOx**	**VOC**	**CO**	**Total HAPs**
Railcar Unloading	RRUL1 - RRUL4	5.20	5.20	5.20	-	-	-	-	-
Silos	Silo A - Silo P	1.02	1.02	1.02	-	-	-	-	-
Pneumatic Conveyors	-	2.23	2.23	2.23	-	-	-	-	-
Modified Existing Coextruders	COEX1 - COEX6	4.00	4.00	4.00	-	-	13.7	-	0.00
New Coextruders	COEX7 - COEX8	0.84	0.84	0.84	-	-	2.2	-	0.00
Coextruder Granulators	COEXG1 - COEXG8	0.15	0.15	0.15	-	-	-	-	-
Roll Granulators	G1-G5	0.18	0.18	0.18	-	-	-	-	-
Parts Cleaners	Aqueous Parts Tub1 and Tub2	0.00	0.00	0.00	0.0	0.0	0.66	0.0	0.0
Thermoformer	F5-F8, F11	1.51	1.51	1.51	-	-	0.71	-	0.47
Thermoformer Granulators/Conveyors	various	0.20	0.20	0.20	-	-	-	-	-
Slitter/Trimmer/Rewinder	SR1	0.00	0.00	0.00	-	-	-	-	-
Natural Gas Combustion	various	0.06	0.24	0.24	0.02	3.16	0.17	2.66	0.06
Printers	P4	-	-	-	-	-	7.50E-05	-	-
Ink Roll Cleaner	Roll Cleaner	-	-	-	-	-	1.03	-	0.01
Diesel-fired Fire Pump Engine	Pump1	0.11	0.11	0.11	0.11	1.61	0.13	0.35	0.001
NG Emergency Generator	Generator1	2.52E-05	3.27E-03	3.27E-03	1.92E-04	1.34	0.04	0.10	0.023
	Total (excluding fugitives)	**15.50**	**15.69**	**15.69**	**0.13**	**6.11**	**18.59**	**3.11**	**0.56**
Paved Roads (fugitive)	-	0.93	0.19	0.05	-	-	-	-	-
Cooling Tower (fugitive)	-	2.33E-03	2.33E-03	2.33E-03	-	-	-	-	-
	Total (including fugitives)	**16.43**	**15.88**	**15.74**	**0.13**	**6.11**	**18.59**	**3.11**	**0.56**

VOC – Changed from 24.26 tons/year to 18.59 tons/year
PM/PM_{10} – Changed from 35.84 tons/year to 16.43 tons/year

Appendix A: Emission Calculations
Particulate Emissions From Railcar unloading RRUL, RRUL2, and Silos

Company Name: **Spartech, LLC**
Address: **1401 East Memorial Drive, Muncie, Indiana 47302**
MSOP Permit No.: **M035-43766-00078**
Reviewer:

Emission Unit (ID#) *(Control Device)*	Maximum Throughput (tons/hour)	PM/PM10/PM2.5 Emission Factor (controlled) (lbs/ton)[1]	Assumed Control Device for Emission Factor	PTE of PM/PM10/PM2.5 before Control (lbs/hr)	PTE of PM/PM10/PM2.5 before Control (ton/yr)
Railcar Unloading (RRUL1)	10.00	2.90E-05	Screens at 99.9%	0.29	**1.27**
Railcar Unloading (RRUL2)	5.94	2.90E-05	Screens at 99.9%	0.17	**0.75**
Railcar Unloading (RRUL3)	15.00	2.90E-05	Screens at 99.9%	0.44	**1.91**
Railcar Unloading (RRUL4)	10.00	2.90E-05	Screens at 99.9%	0.29	**1.27**
				Total:	**5.20**

Silos (A - P)	8.00	2.90E-05	Screens at 99.9%	0.23	**1.02**
				Total:	**1.02**

Emission units are uncontrolled.

1. Emission factor for plastic pellets is from AP 42, Chapter 11.6, Table 11.6-4 "Limestone Transfer with Fabric Filter" (SCC 3-05-006-12)(1/95).
Assume all PM is equal to PM10 and PM2.5
Even though the RRUL is bottleneck by the Coextruders, PTE was still based on the maximum capacity of the RRUL.
2. Silo P was added during 2024
There are 16 silos, each with a max throughput capacity of 1,000 lbs/hr (0.5 tons/hour)
The filters associated with the silos are integral to the process

METHODOLOGY

Before Controls PM/PM10/PM2.5 PTE (lb/hour) = Maximum Process Rate (ton/hour) x Controlled Emission Factor (lbs/ton) /(1- Control Efficiency (%))

Before Controls PM/PM10/PM2.5 PTE (ton/year) = (lbs/hour PTE) x (8760 hours/1 year) x (1 ton/2000 lbs)

Controlled PM/PM10/PM2.5 PTE (ton/year) = Maximum Process Rate (ton/hour) x Controlled Emission Factor (lbs/ton) x (8760 hours/1 year) x (1 ton/2000 lbs)

Appendix A: Emission Calculations
Particulate Emissions From Pneumatic Conveyors

Company Name: Spartech, LLC
Address: 1401 East Memorial Drive, Muncie, Indiana 47302
MSOP Permit No.: M035-43766-00078
Reviewer:

Emission Unit (ID#)	**Single Unit** Maximum Throughput (tons/hour)	PM/PM10/PM2.5 Emission Factor (controlled) (lbs/ton)[1]	Control Efficiency	PTE of PM/PM10/PM2.5 Before Control of **Single Unit** (tons/year)	PTE of PM/PM10/PM2.5 After Control of **Single Unit** (tons/year)
Twenty-eight (28) Pneumatic Conveyors (Vaccuum Pumps) (Integral bin vent filters)	1.25	2.9E-05	99.9%	0.159	**0.0002**
Two (2) Pneumatic Conveyor (bin vent filters Not Integral)	1.25	2.9E-05	99.9%	**0.159**	0.0002
Six (6) Pneumatic Conveyor (bin vent filters Not Integral)	2.50	2.9E-05	99.9%	**0.318**	0.0003
Total for 30 Pneumatic Conveyors (with intergral control):					0.0044
Total for 2 Pneumatic Conveyors (without control):					0.32
Total for 6 Pneumatic Conveyors (without control):					1.91
Total PTE for all Pneumatic Conveyors:					**2.23**

(1)Controlled emission factor for plastic pellets and scrap is from AP 42, Chapter 11.6, Table 11.6-4 "Limestone Transfer with Fabric Filter" (SCC 3-05-006-12)(1/95).
Assume all PM is equal to PM10 and PM2.5.
Even though these conveyors are bottleneck by the Coextruders, the PTE for the conveyors was still based on the maximum capacity of the conveyors.

METHODOLOGY

Before Controls PM/PM10/PM2.5 PTE (ton/yr) = Max Throughput (ton/hour) x Controlled Emission Factor (lbs/ton) /(1- Control Efficiency (%)) x 8760 hrs/year x 1 ton/2000 lbs

Controlled PTE of PM/PM10/PM2.5 (tons/year) = Max Throughput (ton/hour) x Emission Factor (lbs/ton) x 8760 hrs/year x 1 ton/2000 lbs

Since the bin vents on the twenty-three conveyors are considered integral, permit level is based on the PTE after control. Control on other conveyors is not considered integral.

Recipe/Structure (only 1 structure can be processed at one time)	Material Type	Maximum Throughput Rate (lbs/hour)	VOC Emission Factor (lbs/MMlb)	PM/PM10 Emission Factor (lbs/MMlb)	Ethylbenzene Emission Factor (lbs/MMlb)	Styrene Emission Factor (lbs/MMlb)	PTE of VOC (tons/year)	PTE of PM/PM10 (tons/year)

PTE of Ethylbenzene (tons/year)	PTE of Styrene (tons/year)

Recipe/Structure (only 1 structure can be processed at one time)	Material Type	Maximum Throughput Rate (lbs/hour)	VOC Emission Factor (lbs/MMlb)	PM/PM10 Emission Factor (lbs/MMlb)	Ethylbenzene Emission Factor (lbs/MMlb)	Styrene Emission Factor (lbs/MMlb)	PTE of VOC (tons/year)	PTE of PM/PM10 (tons/year)
1	Polypropylene	2,595	653.0	819.0	0.0	0.0	7.42	9.31
	EVOH/HDPE	118	30.7	26.6	0.0	0.0	0.02	0.01
	Glue/EVA	87.0	0.8	61.5	0.0	0.0	0.00	0.02
							7.44	9.35
1	Polypropylene	2,600	177.0	68.4	0.0	0.0	2.02	0.78
	Ethylene Vinyl Alcohol (EVOH)	250	0.0	0.0	0.0	0.0	0.00	0.00
	Glue/Ethylene Vinyl Acetate (EVA)	87	128.2	1.0	0.0	0.0	0.05	0.00
2	High Density Polyethylene (HDPE)	2,200	0.0	0.0	0.0	0	0.00	0.00
3	High Impact Polystyrene (HIPS)	3,800	190.0	53.3	0.0	0.0	3.16	0.89
	EVOH	250	0.0	0.0	0.0	0.0	0.00	0.00
	Glue/EVA	87	128.2	1.0	0.0	0.0	0.05	0.00
							3.21	0.89
							-4.23	**-8.46**
1	Polypropylene	2,781	177	68	0	0.0	2.16	0.83
	EVOH/HDPE	126	0.0	0.0	0.0	0.0	0.00	0.00
	Glue/EVA	93.0	128.2	1.0	0.0	0.0	0.05	0.00
							2.21	0.83
1	Polypropylene	2,700	177.0	68.4	0.00	0	2.09	0.81
	EVOH	250	0.0	0.0	0.00	0	0.00	0.00
	Glue/EVA	87	128.2	1.0	0.00	0	0.05	0.00
2	HIPS	3,000	190.0	53.3	0.0	0.0	2.50	0.70
3	HDPE	2,500	0.0	0.0	0.0	0.0	0.00	0.00
	LDPE	400	35.3	30.9	0.0	0.0	0.06	0.05
							2.50	0.81
							0.29	**-0.02**
1	RPET	2,400	157.4	242.0	0.0	44.3	1.65	2.54
							1.65	2.54
1	Polypropylene	2,200	177.0	68.4	0.0	0.0	1.71	0.66
	EVOH	150	0.0	0.0	0.0	0.0	0.00	0.00
	Glue/EVA	90	128.2	1.0	0.0	0.0	0.05	0.00
2	Polyethylene Terephthalate (PET)	2,400	0.3	0.0	0.0	0.0	0.00	0.00
3	HIPS	2,400	190.0	53.3	0.0	0.0	2.00	0.56
	EVOH	150	0.0	0.0	0.0	0.0	0.00	0.00
	Glue/EVA	90	128.2	1.0	0.0	0.0	0.05	0.00

	HDPE	150	35.3	30.9	0.0	0.0	0.02	0.02
							2.07	0.66
							0.42	**-1.88**
1	Polystyrene	3000	53.3	0.0	6.1	0.0	0.70	0.00
							0.70	0.00
1	Polypropylene	2,700	177.0	68.4	0.00	0	2.09	0.81
2	HIPS	3,000	190.0	53.3	0.00	0.0	2.50	0.70
3	HDPE	2,500	0.0	0.0	0.0	0.0	0.00	0.00
4	PET	3,000	0.3	0.0	0.0	0.0	0.00	0.00
							2.50	0.81
							1.80	**0.81**
1	Polystyrene	3,353	53.3	0.0	6.1	0.0	0.78	0.00
	EVOH/HDPE	107	30.7	26.6	0.0	0.0	0.01	0.01
	Glue/EVA	194	117.2	61.5	0.0	0.0	0.10	0.05
	LDPE	35	157.4	242.2	0.0	0.0	0.02	0.04
2	PET	4,500	0.3	0.0	0.0	0.0	0.01	0.00
	Polystyrene	4,500	53.3	0.0	6.1	0.0	1.05	0.00
							0.92	0.10
1	Polypropylene	2,700	177.0	68.4	0.0	0.0	2.09	0.81
	EVOH	150	0.0	0.0	0.0	0.0	0.00	0.00
	Glue/EVA	90	128.2	1.0	0.0	0.0	0.05	0.00

PTE of Ethylbenzene (tons/year)	PTE of Styrene (tons/year)
0.00	0.00
0.00	0.00
0.00	0.00
0.00	0.00
0.00	0.00
0.00	0.00
0.00	0.00
0.00	0.00
0.00	0.00
0.00	0.00
0.00	0.00
0.00	0.00
0.00	**0.00**
0.00	0.00
0.00	0.00
0.00	0.00
0.00	0.00
0.00	0.00
0.00	0.00
0.00	0.00
0.00	0.00
0.00	0.00
0.00	0.00
0.00	0.00
0.00	**0.00**
0.00	0.47
0.00	0.47
0.00	0.00
0.00	0.00
0.00	0.00
0.00	0.00
0.00	0.00
0.00	0.00
0.00	0.00

0.00	0.00
0.00	0.00
0.00	**-0.47**
0.08	0.00
0.08	0.00
0.00	0.00
0.00	0.00
0.00	0.00
0.00	0.00
0.00	0.00
-0.08	**0.00**
0.09	0.00
0.00	0.00
0.00	0.00
0.00	0.00
0.00	0.00
0.12	0.00
0.09	0.00
0.00	0.00
0.00	0.00
0.00	0.00

Appendix A: Emission Calculations
Particulate Emissions From Coextruder Granulators and Roll Granulators

Company Name: Spartech, LLC
Address: 1401 East Memorial Drive, Muncie, Indiana 47302
MSOP Permit No.: M035-43766-00078
Reviewer:

Emission Unit (ID#) *(Control Device)*	Maximum Throughput (tons/hour)	PM/PM10/PM2.5 Emission Factor (controlled) (lbs/ton)[1]	Control Device	Control Efficiency (%)	PTE of PM/PM10/PM2.5 before Control (lbs/hr)	PTE of PM/PM10/PM2.5 After Control (lbs/hr)	PTE of PM/PM10/PM2.5 Before Control (tons/year)	PTE of PM/PM10/PM2.5 After Control (tons/year)
Coextruder Granulators/Conveyors (COEXG1) *(Bin Vent Filters)*	0.19	2.9E-05	Fabric filter	99.9%	5.51E-03	5.5E-06	0.024	2.41E-05
Coextruder Granulators/Conveyors (COEXG2) *(Bin Vent Filters)*	0.15	2.9E-05	Fabric filter	99.9%	4.35E-03	4.4E-06	0.019	1.91E-05
Coextruder Granulators/Conveyors (COEXG3) *(Bin Vent Filters)*	0.12	2.9E-05	Fabric filter	99.9%	3.48E-03	3.5E-06	0.015	1.52E-05
Coextruder Granulators/Conveyors (COEXG4) *(Bin Vent Filters)*	0.15	2.9E-05	Fabric filter	99.9%	4.35E-03	4.4E-06	0.019	1.91E-05
Coextruder Granulators/Conveyors (COEXG5) *(Bin Vent Filters)*	0.24	2.9E-05	Fabric filter	99.9%	6.82E-03	6.8E-06	0.030	2.99E-05
Coextruder Granulators/Conveyors (COEXG6) *(Bin Vent Filters)*	0.18	2.9E-05	Fabric filter	99.9%	5.08E-03	5.1E-06	0.022	2.22E-05
Coextruder Granulators/Conveyors (COEXG7) *(Bin Vent Filters)*	0.05	2.9E-05	Fabric filter	99.9%	1.45E-03	1.5E-06	0.006	6.35E-06
Coextruder Granulators/Conveyors (COEXG8) *(Bin Vent Filters)*	0.12	2.9E-05	Fabric filter	99.9%	3.34E-03	3.3E-06	0.015	1.46E-05
						Totals	**0.151**	**0.000**

Roll Granulator (G1) *(No Controls)*	1.25	2.9E-05	no control	NA	3.63E-03	3.6E-03	0.016	0.016
Roll Granulator (G2) *(Bin Vent Filters)*	1.00	2.9E-05	Fabric filter	99.9%	2.90E-02	2.9E-05	0.127	1.27E-04
Roll Granulator (G3) *(No Controls)*	1.25	2.9E-05	no control	NA	3.63E-03	3.6E-03	0.016	0.016
Roll Granulator (G4) *(No Controls)*	1.25	2.9E-05	no control	NA	3.63E-03	3.6E-03	0.016	0.016
Roll Granulator (G5) *(No Controls)*	0.50	2.9E-05	no control	NA	1.45E-03	1.5E-03	0.006	0.006
						Totals	**0.181**	**0.054**

1. Controlled emission factor for plastic pellets and scrap is from AP 42, Chapter 11.6, Table 11.6-4 "Limestone Transfer with Fabric Filter" (SCC 3-05-006-12)(1/95).
Assume all PM is equal to PM10 and PM2.5

METHODOLOGY

Controlled PTE of PM/PM10/PM2.5 (lbs/hour) = Maximum Process Rate (lbs/hour) x Emission Factor (lbs/ton)

Controlled PTE of PM/PM10/PM2.5 (tons/year) = Maximum Process Rate (lbs/hour) * Emission Factor (lbs/ton) * 8760 hrs/year *1 ton/2000 lbs

Uncontrolled PTE PM/PM10/PM2.5 (lb/hour) = Maximum Process Rate (lbs/hour) x Emission Factor (lbs/ton)/(1-Control Eff. (%)

Uncontrolled PTE PM/PM10/PM2.5 (ton/year) = Maximum Process Rate (lbs/hour) * Emission Factor (lbs/ton) * 8760 hrs/year *1 ton/2000 lbs / (1-Control Eff. (%)

Appendix A: Emission Calculations
Emissions from Parts Cleaners

Company Name: **Spartech, LLC**
Address: **1401 East Memorial Drive, Muncie, Indiana 47302**
MSOP Permit No.: **M035-43766-00078**
Reviewer:

Emission Unit (ID#)	Type of Degreasing	Activity Measure	Uncontrolled Organic Emission Factor	Units
Aqueous Parts Tub1	Cold Cleaner - Entire Unit	1 Unit in Operation	0.33	Tons/yr
Aqueous Parts Tub2	Cold Cleaner - Entire Unit	1 Unit in Operation	0.33	Tons/yr
Totals			0.66	Tons/yr

Uncontrolled emission factor is from AP-42, Table 4.6-2 - Solvent Loss Emission Factors for Degreasing Operations

Appendix A: Emission Calculations
Emissions From Thermoformers

Company Name: Spartech, LLC
Address: 1401 East Memorial Drive, Muncie, Indiana 47302
MSOP Permit No.: M035-43766-00078
Reviewer:

Emission Unit (ID#) *(Uses electric heating elements to soften and re-form plastic products, using no controls and venting inside the building.)*	Material(s) Processed on Former	EF For Worst Case Material, (lbs/ton) (VOC)	EF For Worst Case Material (lbs/ton) (PM)	EF For Worst Case Material (lbs/ton) (HAP)	Maximum Throughput (tons/hour)	Maximum Throughput (tons/yr)	Usage (%)	**PTE Tons/Year (VOC)**	**PTE Tons/Year (PM)**	**PTE Tons/Year (HAP)**
Thermoformer 5 (F5)	Polypropylene	0.0614	0.1302	0.00284	0.15	1274.58	100.0%	0.0391	0.0830	0.0018
Thermoformer 6 (F6)	Polypropylene	0.0614	0.1302	0.00284	0.56	4927.50	80.0%	0.1210	0.2566	0.0056
Thermoformer 7 (F7)	Polypropylene	0.0614	0.1302	0.00284	0.56	4927.50	85.0%	0.1286	0.2727	0.0059
Thermoformer 8 (F8)	RPET	0.0614	0.1302	0.0052	0.70	6145.14	85.0%	0.1604	0.3400	0.0136
Thermoformer 11 (F11)	Polystyrene	0.0614	0.1302	0.10286	1.40	12264.00	70.0%	0.2636	0.5589	0.4415
							Totals (ton/yr)	**0.71**	**1.51**	**0.47**

Assume all PM is equal to PM10 and PM2.5
Usage % = Percentage of time formers are running.

METHODOLOGY

Potential Emission= Emission Factor * Material Rate * 8760 / 2000

Sources for Plastics Emission Factors:

Resin Type	Citation
Polypropylene (PP)	"Development of Emission Factors for Polypropylene Processing", Adams et al, J. Journal of Air and Waste Management Association, 49:49-56, 1999
Polyethylene, Polypropylene, Polyvinyl Chloride, Polystyrene (PE/PP/PVC/PS)	Patel, S.H. and Xanthos, M., Advances in Polymer Technology, Vol 14, No 1, 67-77 (1995).
Ethylene Vinyl Acetate (EVA), Ethylene-Methyl Acrylate (EMA), Polyethylene - low density (LDPE)	Barlow et al, J. Air & Waste Manage. Assoc., 47:1111-1118, 1997
Polyamide(PA) (Nylon)	Kriek et al, J. Air & Waste Manage. Assoc., 51:1001-1008, 2001
Polycarbonate (PC)	Rhodes et al, J. Air & Waste Manage. Assoc., 52:781-788, 2002
Acrylonitrile Butadiene Styrene (ABS)	Contos et al, J. Air & Waste Manage. Assoc., 45:686-694, 1995
Polyvinyl Chloride (PVC)	Ernes, D.A. and Griffin, J.P, J. Vinyl & Additive Technology, Sept 1996, Vol 2, No. 3, 180-183.

Appendix A: Emission Calculations
Particulate Emissions From Thermoformer Granulators/Conveyors

Company Name: **Spartech, LLC**
Address: **1401 East Memorial Drive, Muncie, Indiana 47302**
MSOP Permit No.: **M035-43766-00078**
Reviewer:

Emission Unit (ID#) *(Control Device)*	Maximum Throughput (tons/hour)	PM/PM10/PM2.5 Controlled Emission Factor (lbs/ton)[1]	Control Device	Control Efficiency (%)	PTE of PM/PM10/PM2.5 before Control (lbs/hr)	PTE of PM/PM10/PM2.5 After Control (lbs/hr)	**PTE of PM/PM10/PM2.5 Before Control (tons/year)**	PTE of PM/PM10/PM2.5 After Control (tons/year)
Thermoformer Granulators/Conveyors (FG5) *(Bin Vent Filters)*	0.13	2.9E-05	Fabric filter	99.9%	3.63E-03	3.6E-06	0.016	1.59E-05
Thermoformer Granulators/Conveyors (FG6A) *(Bin Vent Filters)**	0.25	2.9E-05	Fabric filter	99.9%	7.28E-03	7.3E-06	0.032	3.19E-05
Thermoformer Granulators/Conveyors (FG7) *(Bin Vent Filters)*	0.25	2.9E-05	Fabric filter	99.9%	7.28E-03	7.3E-06	0.032	3.19E-05
Thermoformer Granulators/Conveyors (FG8A) *(Bin Vent Filters)*	0.25	2.9E-05	Fabric filter	99.9%	7.28E-03	7.3E-06	0.032	3.19E-05
Thermoformer Granulators/Conveyors (FG11A) *(Bin Vent Filters)*	0.35	2.9E-05	Fabric filter	99.9%	1.02E-02	1.0E-05	0.044	4.45E-05
Thermoformer Granulators/Conveyors (FG11B) *(Bin Vent Filters)*	0.35	2.9E-05	Fabric filter	99.9%	1.02E-02	1.0E-05	0.044	4.45E-05
						Totals (ton/yr)	**0.20**	2.00E-04

* Thermoformer Granulators/Conveyors FG11A and FG11B do not operate simultaneously, one or the other is used depending on the product produced by Thermoformer F6

1. Emission factor for plastic pellets and scrap is from AP 42, Chapter 11.6, Table 11.6-4 "Limestone Transfer with Fabric Filter" (SCC 3-05-006-12)(1/95).

Assume all PM is equal to PM10 and PM2.5

METHODOLOGY

Controlled PTE of PM/PM10/PM2.5 (lbs/hour) = Maximum Process Rate (lbs/hour) x Emission Factor (lbs/ton)

Controlled PTE of PM/PM10/PM2.5 (tons/year) = Maximum Process Rate (lbs/hour) * Emission Factor (lbs/ton) * 8760 hrs/year *1 ton/2000 lbs

Uncontrolled PTE PM/PM10/PM2.5 (lb/hour) = Maximum Process Rate (lbs/hour) x Emission Factor (lbs/ton)/(1-Control Eff. (%)

Uncontrolled PTE PM/PM10/PM2.5 (ton/year) = Maximum Process Rate (lbs/hour) * Emission Factor (lbs/ton) * 8760 hrs/year *1 ton/2000 lbs / (1-Control Eff. (%)

Appendix A: Emission Calculations
Particulate Emissions From Slitter (SR1) and Granulators (G1-G4)

Company Name: Spartech, LLC
Address: 1401 East Memorial Drive, Muncie, Indiana 47302
MSOP Permit No.: M035-43766-00078
Reviewer:

Emission Unit (ID#) *(Control Device)*	Maximum Throughput (tons/hour)	PM/PM10/PM2.5 Emission Factor (controlled) (lbs/ton)	Control Device	Control Efficiency (%)	PTE of PM/PM10/PM2.5 before Control (lbs/hr)	**PTE of PM/PM10/PM2.5 Before Control (tons/year)**
Slitter/Trimmer/Rewinder/Conveyor (SR1)[1]	0.50	0.0	NA	NA	0.0	0.0
					Totals:	**0.0**

1. The Slitter was replaced in 2022. The new Slitter does not have an associated Granulator. See Granulator tab for Roll Granulator emissions

Appendix A: Emissions Calculations
Natural Gas Combustion Emission Unit List
MM BTU/HR <100

Company Name: **Spartech, LLC**
Address: **1401 East Memorial Drive, Muncie, Indiana 47302**
MSOP Permit No.: **M035-43766-00078**
Reviewer:

3.06	18 Natural Gas-Fired Heaters, 1A, 4A-8A, 10A-13A, 1B-3B, 10B-14B @ 0.170 MMBtu/hr, each
0.15	3 Natural Gas-Fired tube heaters with heat input capacity 0.05 MMBtu/hr each
1.60	2 Natural Gas-Fired Heaters with heat input capacity of 0.80 MMBtu each
0.12	3 Natural Gas-Fired Heaters with heat input capacity of 0.04 MMBtu each
0.16	2 Natural Gas-Fired Heaters with heat input capacity of 0.08 MMBtu each
0.12	1 Natural Gas-Fired Heaters with heat input capacity of 0.12 MMBtu
0.597	CR1 natural gas-fired crystallizer unit with a maximum capacity of 0.597 MMBtu/hr
0.895	CR2 natural gas-fired crystallizer unit maximum capacity of 0.895 MMBtu/hr
0.331	DR6 natural gas-fired dryer unit with a maximum capacity of 0.331 MMBtu/hr
0.331	DR15 natural gas-fired dryer unit with a maximum capacity of 0.331 MMBtu/hr
7.4	**Total (MMBtu/hr)**

Appendix A: Emissions Calculations
Natural Gas Combustion Only
MM BTU/HR <100
Company Name: Spartech, LLC
Address: 1401 East Memorial Drive, Muncie, Indiana 47302
MSOP Permit No.: M035-43766-00078
Reviewer:

Heat Input Capacity MMBtu/hr	HHV mmBtu/mmscf	Potential Throughput MMCF/yr
7.4	1020	63.2

	Pollutant						
	PM*	PM10*	direct PM2.5*	SO2	NOx	VOC	CO
Emission Factor in lb/MMCF	1.9	7.6	7.6	0.6	100 **see below	5.5	84
Potential Emission in tons/yr	0.06	0.24	0.24	0.02	3.16	0.17	2.66

*PM emission factor is filterable PM only. PM10 emission factor is filterable and condensable PM10 combined.
PM2.5 emission factor is filterable and condensable PM2.5 combined.
**Emission Factors for NOx: Uncontrolled = 100, Low NOx Burner = 50, Low NOx Burners/Flue gas recirculation = 32

Methodology

All emission factors are based on normal firing.
MMBtu = 1,000,000 Btu
MMCF = 1,000,000 Cubic Feet of Gas
Emission Factors are from AP 42, Chapter 1.4, Tables 1.4-1, 1.4-2, 1.4-3, SCC #1-02-006-02, 1-01-006-02, 1-03-006-02, and 1-03-006-03
Potential Throughput (MMCF) = Heat Input Capacity (MMBtu/hr) x 8,760 hrs/yr x 1 MMCF/1,000 MMBtu
Emission (tons/yr) = Throughput (MMCF/yr) x Emission Factor (lb/MMCF)/2,000 lb/ton

	HAPs - Organics				
	Benzene	Dichlorobenzene	Formaldehyde	Hexane	Toluene
Emission Factor in lb/MMcf	2.1E-03	1.2E-03	7.5E-02	1.8E+00	3.4E-03
Potential Emission in tons/yr	6.641E-05	3.795E-05	2.37E-03	5.692E-02	1.075E-04

	HAPs - Metals				
	Lead	Cadmium	Chromium	Manganese	Nickel
Emission Factor in lb/MMcf	5.0E-04	1.1E-03	1.4E-03	3.8E-04	2.1E-03
Potential Emission in tons/yr	1.581E-05	3.478E-05	4.427E-05	1.202E-05	6.641E-05

Total (ton/yr)	0.060	
Highest Single (ton/yr)	0.057	hexane

Methodology is the same as the page before

The five highest organic and metal HAPs emission factors are provided above.
Additional HAPs emission factors are available in AP-42, Chapter 1.4.

Appendix A: Emission Calculations
VOC and HAP Emissions From the Printer Ink and Printer Cleaners

Company Name: Spartech, LLC
Address: 1401 East Memorial Drive, Muncie, Indiana 47302
MSOP Permit No.: M035-43766-00078
Reviewer:

Emissions Unit ID	Maximum Process Rate (parts/hour)	Usage Rate (lb of ink/part)	Weight % VOC in Ink	PTE VOC (lbs/hr)	PTE of VOC (tons/year)
Printer P4	25,200	6.8E-07	0.10%	1.71E-05	7.50E-05
			Total	**1.71E-05**	**7.50E-05**

Inks are cured with UV light.

METHODOLOGY
PTE of VOC (tons/year) = Maximum Process Rate (parts/hour) x Usage Rate (lb of ink/part) x Weight % VOC x 8760 hours/year x 1 ton/2000 lbs

Emission unit	Material	Density (lbs/gal)	Weight % VOC	Weight % Ethyl Acetate	Weight % Methyl Alcohol (HAP)	Weight % Methyl Isobutyl Ketone (HAP)	Maximum Usage (gal/year)	PTE of VOC (tons/year)	PTE of Ethyl Acetate (tons/year)	PTE of Methyl Alcohol (HAP) (tons/year)	PTE of Methyl Isobutyl Ketone (HAP) (tons/year)	Total HAP (ton/yr)
Ink Roll Hand Cleaning	Ethyl Acetate	7.51	100%	100%	0%	0%	220	0.83	0.83	0.00	0.00	0.01
	Denatured Ethyl Alcohol	8.34	100%	0%	3%	2%	50	0.21	0.00	0.007	0.004	

METHODOLOGY
PTE of VOC/HAP (tons/year) = Density (lbs/gal) x Weight % VOC/HAP x Maximum Usage (gal/year) x 1 ton/2000 lbs

Appendix A: Emission Calculations
Generator1
Reciprocating Internal Combustion Engines - Natural Gas
4-Stroke Lean-Burn (4SLB) Engines

Company Name: Spartech, LLC
Source Address: 1401 East Memorial Drive, Muncie, Indiana 47302
MSOP Permit No.: M035-43766-00078
Reviewer:

Maximum Output Horsepower Rating (hp)	187
Brake Specific Fuel Consumption (BSFC) (Btu/hp-hr)	7000
Maximum Hours Operated per Year (hr/yr)	500
Potential Fuel Usage (MMBtu/yr)	655
High Heat Value (MMBtu/MMscf)	1020
Potential Fuel Usage (MMcf/yr)	0.64

	Pollutant						
Criteria Pollutants	PM*	PM10*	PM2.5*	SO2	NOx	VOC	CO
Emission Factor (lb/MMBtu)	7.71E-05	9.99E-03	9.99E-03	5.88E-04	4.08E+00	1.18E-01	3.17E-01
Potential Emissions (tons/yr)	2.52E-05	3.27E-03	3.27E-03	1.92E-04	1.34	0.04	0.10

*PM emission factor is for filterable PM-10. PM10 emission factor is filterable PM10 + condensable PM.
PM2.5 emission factor is filterable PM2.5 + condensable PM.

Hazardous Air Pollutants (HAPs)

Pollutant	Emission Factor (lb/MMBtu)	Potential Emissions (tons/yr)
Acetaldehyde	8.36E-03	0.003
Acrolein	5.14E-03	0.002
Benzene	4.40E-04	0.000
Biphenyl	2.12E-04	0.000
1,3-Butadiene	2.67E-04	0.000
Formaldehyde	5.28E-02	**0.017**
Methanol	2.50E-03	0.001
Hexane	1.10E-03	0.000
Toluene	4.08E-04	0.000
2,2,4-Trimethylpentane	2.50E-04	0.000
Xylene	1.84E-04	0.000
	Total	**0.02**

HAP pollutants consist of the eleven highest HAPs included in AP-42 Table 3.2-2.

Methodology
Emission Factors are from AP-42 (Supplement F, July 2000), Table 3.2-2
Potential Fuel Usage (MMBtu/yr) = [Maximum Output Horsepower Rating (hp)] * [Brake Specific Fuel Consumption (Btu/hp-hr)] * [Maximum Hours Operated per Year (hr/yr)] / [1000000 Btu/MMBtu]
Potential Emissions (tons/yr) = [Potential Fuel Usage (MMBtu/yr)] * [Emission Factor (lb/MMBtu)] / [2000 lb/ton]

Appendix A: Emission Calculations
One (1) Fire Pump Engine
Reciprocating Internal Combustion Engines - Diesel Fuel
Output Rating (<=600 HP)
Maximum Input Rate (<=4.2 MMBtu/hr)

Company Name: **Spartech, LLC**
Source Address: **1401 East Memorial Drive, Muncie, Indiana 47302**
MSOP Permit No.: **M035-43766-00078**
Reviewer:

Emissions calculated based on output rating (hp)

The Fire Pump Engine is owned by Newell and is located on adjacent property across th
Spartech uses the fire water system with Newell

Output Horsepower Rating (hp)	208.0
Maximum Hours Operated per Year	500
Potential Throughput (hp-hr/yr)	104,000

	Pollutant						
	PM*	PM10*	direct PM2.5*	SO2	NOx	VOC	CO
Emission Factor in lb/hp-hr	0.0022	0.0022	0.0022	0.00205	0.0310	0.0025	0.00668
Potential Emission in tons/yr	0.11	0.11	0.11	0.11	1.61	0.13	0.35

*PM and PM2.5 emission factors are assumed to be equivalent to PM10 emission factors. No information was given regarding which method was used to determine the factor or the fraction of PM10 which is condensable.

Hazardous Air Pollutants (HAPs)

	Pollutant							
	Benzene	Toluene	Xylene	1,3-Butadiene	Formaldehyde	Acetaldehyde	Acrolein	Total PAH HAPs***
Emission Factor in lb/hp-hr****	6.53E-06	2.86E-06	2.00E-06	2.74E-07	8.26E-06	5.37E-06	6.48E-07	1.18E-06
Potential Emission in tons/yr	3.40E-04	1.49E-04	1.04E-04	1.42E-05	4.30E-04	2.79E-04	3.37E-05	6.12E-05

***PAH = Polyaromatic Hydrocarbon (PAHs are considered HAPs, since they are considered Polycyclic Organic Matter)
****Emission factors in lb/hp-hr were calculated using emission factors in lb/MMBtu and a brake specific fuel consumption of 7,000 Btu / hp-hr (AP-42 Table 3.3-1).

Potential Emission of Total HAPs (tons/yr)	**1.41E-03**

Methodology
Emission Factors are from AP 42 (Supplement B 10/96) Tables 3.3-1 and 3.3-2.
Potential Throughput (hp-hr/yr) = [Output Horsepower Rating (hp)] * [Maximum Hours Operated per Year]
Potential Emission (tons/yr) = [Potential Throughput (hp-hr/yr)] * [Emission Factor (lb/hp-hr)] / [2,000 lb/ton]

Appendix A: Emission Calculations
Fugitive Dust Emissions - Paved Roads

Company Name: **Spartech, LLC**
Source Address: **1401 East Memorial Drive, Muncie, Indiana 47302**
MSOP Permit No.: **M035-43766-00078**
Reviewer:

Paved Roads at Industrial Site
The following calculations determine the amount of emissions created by paved roads, based on 8,760 hours of use and AP-42, Ch 13.2.1 (1/2011).

Vehicle Informtation (provided by source)

Type	Maximum number of vehicles per day	Number of one-way trips per day per vehicle	Maximum trips per day (trip/day)	Maximum Weight Loaded (tons/trip)	Total Weight driven per day (ton/day)	Maximum one-way distance (feet/trip)	Maximum one-way distance (mi/trip)	Maximum one-way miles (miles/day)	Maximum one-way miles (miles/yr)
Semi Trailer (entering plant) (one-way trip)	15.0	1.0	15.0	35.0	525.0	528	0.100	1.5	547.5
Semi Trailer (leaving plant) (one-way trip)	15.0	1.0	15.0	5.0	75.0	528	0.100	1.5	547.5
Private Vehicle (entering plant) (one-way trip)	1.0	1.0	1.0	1.0	1.0	528	0.100	0.1	36.5
Private Vehicle (entering plant) (one-way trip)	1.0	1.0	1.0	1.0	1.0	528	0.100	0.1	36.5
		Total	**32.0**		**602.0**			**3.2**	**1168.0**

Average Vehicle Weight Per Trip = 18.8 tons/trip
Average Miles Per Trip = 0.10 miles/trip

Update to reflect 15 trucks entering and exiting each day
cells b13 and b14

Unmitigated Emission Factor, Ef = [k * (sL)^0.91 * (W)^1.02] (Equation 1 from AP-42 13.2.1)

	PM	PM10	PM2.5	
where k =	0.011	0.0022	0.00054	lb/VMT = particle size multiplier (AP-42 Table 13.2.1-1)
W =	18.8	18.8	18.8	tons = average vehicle weight (provided by source)
sL =	9.7	9.7	9.7	g/m^2 = silt loading value for paved roads at iron and steel production facilities - Table 13.2.1-3)

Taking natural mitigation due to precipitation into consideration, Mitigated Emission Factor, Eext = E * [1 - (p/4N)] (Equation 2 from AP-42 13.2.1)
Mitigated Emission Factor, Eext = Ef * [1 - (p/4N)]
where p = 125 days of rain greater than or equal to 0.01 inches (see Fig. 13.2.1-2)
N = 365 days per year

	PM	PM10	PM2.5	
Unmitigated Emission Factor, Ef =	1.735	0.347	0.0852	lb/mile
Mitigated Emission Factor, Eext =	1.586	0.317	0.0779	lb/mile

Process	Unmitigated PTE of PM (tons/yr)	Unmitigated PTE of PM10 (tons/yr)	Unmitigated PTE of PM2.5 (tons/yr)	Mitigated PTE of PM (tons/yr)	Mitigated PTE of PM10 (tons/yr)	Mitigated PTE of PM2.5 (tons/yr)
Semi Trailer (entering plant) (one-way trip)	0.47	0.09	0.02	0.43	0.09	0.02
Semi Trailer (leaving plant) (one-way trip)	0.47	0.09	0.02	0.43	0.09	0.02
Private Vehicle (entering plant) (one-way trip)	0.03	0.01	0.00	0.03	0.01	0.00
Private Vehicle (entering plant) (one-way trip)	0.03	0.01	0.00	0.03	0.01	0.00
	1.01	**0.20**	**0.05**	**0.93**	**0.19**	**0.05**

Methodology

Total Weight driven per day (ton/day)	= [Maximum Weight Loaded (tons/trip)] * [Maximum trips per day (trip/day)]
Maximum one-way distance (mi/trip)	= [Maximum one-way distance (feet/trip) / [5280 ft/mile]
Maximum one-way miles (miles/day)	= [Maximum trips per year (trip/day)] * [Maximum one-way distance (mi/trip)]
Average Vehicle Weight Per Trip (ton/trip)	= SUM[Total Weight driven per day (ton/day)] / SUM[Maximum trips per day (trip/day)]
Average Miles Per Trip (miles/trip)	= SUM[Maximum one-way miles (miles/day)] / SUM[Maximum trips per year (trip/day)]
Unmitigated PTE (tons/yr)	= [Maximum one-way miles (miles/yr)] * [Unmitigated Emission Factor (lb/mile)] * (ton/2000 lbs)
Mitigated PTE (tons/yr)	= [Maximum one-way miles (miles/yr)] * [Mitigated Emission Factor (lb/mile)] * (ton/2000 lbs)
Controlled PTE (tons/yr)	= [Mitigated PTE (tons/yr)] * [1 - Dust Control Efficiency]

Appendix A: Emission Calculations
Cooling Tower - Fugitive Particulate PTE

Company Name: **Spartech, LLC**
Source Address: **1401 East Memorial Drive, Muncie, Indiana 47302**
MSOP Permit No.: **M035-43766-00078**
Reviewer:

UNIT ID	Maximum Cooling Tower Water Circulation Rate (gal/hr)	Operating Hours (hours/year)	Maximum Total Dissolved Solids Content (PPM)	Maximum PM / PM10 / PM2.5 PTE (tons/yr)
Cooling Tower	4,800	8,760	700	0.002
			Total PM Emissions (tpy)	**0.002**

METHODOLOGY
PM/PM10 Emissions (tons/yr) = Recirculating Flow Rate (gal/hr) x E.F. (lb PM-PM10/10,000 gal) x Maximum Total Dissolved Solids (ppm/12000 ppm) x (Operating hours (hrs/yr)) x (1 ton/2000 lbs)
Emission Factor from AP-42, Table 13.4-1, 1/1995 version.
Lb/Drift per 10,000 gallons recirculated = 1.7
Lb PM/PM10 per 10,000 gallons recirculated = 0.019
From AP-42, Table 13.4-1, Footnote c, (1/1995 version), implied content of TDS in circulating water is 12,000 parts per million (ppm).

From:	Craig Laubacher
To:	Squillace, Kristen M
Subject:	RE: IDEM OAQ New Emission Factors for Coextruders Calculations for Spartech App No.:035-47764-00078
Date:	Thursday, June 20, 2024 2:37:08 PM
Attachments:	image001.png image002.png image003.png image004.png image005.png image006.png image007.png 23-3576TSD EVOH guidance.pdf

"EVOH is never processed with exposure to air; it is always fully encapsulated within other layers of the co-extrusion process and therefore has no emissions to the atmosphere."
per TECHNICAL SUPPORT DOCUMENT Air Discharge Permit ADP 23-3576 Air Discharge Permit Application CL-3229 Issued: April 12, 2023 ISO Flex Packaging SWCAA ID – 2419

This is the document that I referenced in the calculations sheets which refers to VOC content of EVOH as 0

Let me know if this is sufficient for you

Craig Laubacher
Regional Director
Environmental Compliance & Engineering
Mobile **512-635-4324**
Email claubacher@e-c-e.org

From: Squillace, Kristen M <KSquilla@idem.IN.gov>
Sent: Thursday, June 20, 2024 1:20 PM
To: Craig Laubacher <claubacher@e-c-e.org>
Subject: IDEM OAQ New Emission Factors for Coextruders Calculations for Spartech App No.:035-47764-00078

Hi Craig,

For the new calculations of the coextruders, would you be able to send the document you got the new VOC (lbs/MMlb) and PM/PM10 (lbs/MMlb) factors from for the **EVOH** Material? The documents Jack Laubacher had sent didn't reference EVOH.

Thanks!,

Kristen

Indiana Department of Environmental Management

Kristen Squillace

Environmental Manager

(317) 233-9327 • KSquilla@idem.IN.gov

Protecting Hoosiers and Our Environment

| | | | | www.idem.IN.gov

Help us improve!

IDEM values your feedback

TECHNICAL SUPPORT DOCUMENT

Air Discharge Permit ADP 23-3576
Air Discharge Permit Application CL-3229

Issued: April 12, 2023

ISO Flex Packaging

SWCAA ID - 2419

Prepared By: Wess Safford
Air Quality Engineer
Southwest Clean Air Agency

TABLE OF CONTENTS

ABBREVIATIONS

List of Acronyms

ADP	Air Discharge Permit	NSPS	New Source Performance Standard
AP-42	Compilation of Emission Factors, AP-42, 5th Edition, Volume 1, Stationary Point and Area Sources – published by EPA	PSD	Prevention of Significant Deterioration
ASIL	Acceptable Source Impact Level	RCW	Revised Code of Washington
BACT	Best available control technology	SCC	Source Classification Code
CAM	Compliance Assurance Monitoring	SQER	Small Quantity Emission Rate listed in WAC 173-460
CAS#	Chemical Abstracts Service registry number	Standard	Standard conditions at a temperature of 68°F (20°C) and a pressure of 29.92 in Hg (760 mm Hg)
CFR	Code of Federal Regulations	SWCAA	Southwest Clean Air Agency
EPA	U.S. Environmental Protection Agency	T-BACT	Best Available Control Technology for toxic air pollutants
EU	Emission Unit	WAC	Washington Administrative Code
NOV	Notice of Violation/		

List of Units and Measures

µg/m³	Micrograms per cubic meter	ppmv	Parts per million by volume
µm	Micrometer (10^{-6} meter)	ppmvd	Parts per million by volume, dry
acfm	Actual cubic foot per minute	ppmw	Parts per million by weight
dscfm	Dry Standard cubic foot per minute	psig	Pounds per square inch, gauge
gr/dscf	Grain per dry standard cubic foot	scfm	Standard cubic foot per minute
MMBtu	Million British thermal unit	tpy	Tons per year
ppm	Parts per million		

List of Chemical Symbols, Formulas, and Pollutants

CO	Carbon monoxide	PM_{10}	PM with an aerodynamic diameter 10 µm or less
CO_2	Carbon dioxide	$PM_{2.5}$	PM with an aerodynamic diameter 2.5 µm or less
CO_2e	Carbon dioxide equivalent	SO_2	Sulfur dioxide
HAP	Hazardous air pollutant listed pursuant to Section 112 of the Federal Clean Air Act	TAP	Toxic air pollutant pursuant to Chapter 173-460 WAC
NO_x	Nitrogen oxides	VOC	Volatile organic compound
O_2	Oxygen		
O_3	Ozone		
PM	Particulate Matter with an aerodynamic diameter 100 µm or less		

Terms not otherwise defined have the meaning assigned to them in the referenced regulations or the dictionary definition, as appropriate.

1. FACILITY IDENTIFICATION

Applicant Name:	ISO Flex Packaging
Applicant Address:	3807 SE Hidden Way, Vancouver, WA 98661
Facility Name:	ISO Flex Packaging
Facility Address:	3807 SE Hidden Way, Vancouver, WA 98661
SWCAA Identification:	2419
Contact Person:	Bari Stockton, Plant Manager
Primary Process:	Plastic film manufacturing
SIC/NAICS Code:	3081 – Unsupported Plastics Film and Sheet Manufacturing 326113 - Unlaminated Plastics Film and Sheet Manufacturing
Facility Classification:	Natural Minor

2. FACILITY DESCRIPTION

ISO Flex Packaging (ISO Flex) manufactures blown polyethylene in the form of film sheets, mainly food grade. The film is converted into bags or wrap by their customers.

3. CURRENT PERMITTING ACTION

This permitting action is in response to Air Discharge Permit application number CL-3229 (ADP Application CL-3229) dated March 3, 2023. ISO Flex submitted ADP Application CL-3229 requesting approval of the following:

- Modification of existing ozone emission limits to lower emission control efficiency from 99.9% to 99%.
- Modification of emission monitoring requirements to allow the use of an electronic analyzer to monitor ozone emissions.

The current permitting action provides approval for the modifications proposed in ADP Application CL-3229. ADP 23-3576 will supersede ADP 19-3363 in its entirety.

4. PROCESS DESCRIPTION

4.a Plastic Film Production. Thin gauge plastic film is manufactured using a blown film process supported by co-extrusion lines. Co-extrusion is a process in which multiple extruders operate in support of one blown film die.

Raw material for the extrusion lines (resins made of low density polyethylene-LDPE, linear low density polyethylene-LLDPE, or high density polyethylene-HDPE) is received in pellet form via truck and rail cars. Truck shipments may be either "less than truck load" (LTL) or "truck load" (TL) quantities. Rail cars deliver an average weight of 185,000 pounds. Resin received at the facility is stored in one of eight resin storage silos. On average, carrier resins make up 70% of the product with the remaining 30% being additive resins.

Extrusion units at the facility are capable of processing polyethylene and EVOH resin, but currently only processes polyethylene. Resin pellets are melted in the extruders to produce thin film for plastic sheeting. The typical melt temperature is 300 – 425ºF. Heated resin is extruded through a heated barrel and pushed to a heated die. The film exits the die in a tubular shape formed by blowing air through the tube (blown film). The film tube is pulled up a tower allowing it to cool. The film tube is flattened by an A-frame at the top of the tower and sent to a corona treater after it passes through the A-frame.

The corona treater changes the surface characteristics of the plastic to allow ink or adhesive to adhere to the plastic film. The corona treating process consists of a high voltage discharge between the corona bar and the treater roll, bombarding the surface of the film with ozone as it passes over the roll. ISO Flex does not apply ink or adhesive to the film. Treated film is sent to other companies for processing. Ozone is a by-product of the corona treatment process. Ozone from the corona treaters is vented to ozone destruct units to be converted back into oxygen.

Blown film tube is usually put through a slitting station—on some lines before the corona treater and on some lines after the corona treater—where the edges of the tube are removed making two independent webs. The webs are split and wound up on separate spindles. Full rolls are taken off the spindles, weighed, palletized, packaged, and shipped to another company for additional processing.

5. EQUIPMENT/ACTIVITY IDENTIFICATION

5.a Line 21 (*existing*). One extruder line processing polyethylene resin into film.

Make / Model:	Hosokawa Alpine American Inc. / HX75S (*job #F1 187639*)
Mfg Date:	2011
Rated Capacity:	1,200 lb/hr film extrusion (three layers)
Maximum Melt Temp:	300-425 °F (LLPE, LLDPE)
Corona Treater(s):	(2) Enercon Industries Corp. units (7.5 kW each, 15 kW total)

Ozone Destruct Unit. Exhaust from the corona treaters is vented to a dedicated ozone destruct unit.

Make / Model:	Ozone-Ex II / LM3686-105-0752 Part # 03X-10 (*S/N 101785-01*)
Catalyst:	Activated Alumina Pellet A-201 7X2 and Carulite® 200 Granular Catalyst
Destruction Efficiency:	Up to 99.999% (permitted at 99%)
Exhaust Rate:	1,000 acfm
Exhaust:	10" outside dia stack at ~23' 10" above ground level

ADP Application CL-3229. The current permit for ISO Flex's Vancouver facility limits ozone emissions to a level corresponding to a minimum nominal destruction efficiency of 99.9%. ISO Flex proposes to reduce the required minimum destruction efficiency to 99%. No physical changes are proposed for this process line.

5.b Line 22 (*existing*). One extruder line processing polyethylene resin into film.

Make / Model:	Hosokawa Alpine American Inc. / HX75-30D, HX120-30D (*job #F1 209786*)
Mfg Date:	2014
Rated Capacity:	1,400 lb/hr film extrusion (three layers)
Maximum Melt Temp:	300-425 °F
Line Speed:	70-250 fpm
Corona Treater(s):	(2) Enercon Industries Corp. model LM5275-S02 units (10 kW each, 20 kW total)

Ozone Destruct Unit. Exhaust from the corona treaters is vented to a dedicated ozone destruct unit.

Make / Model:	Ozone-Ex II / LM3686-109-0M, Part # 03X-20 (*S/N 109902*)
Catalyst:	Activated Alumina Pellet A-201 7X2 and Carulite® 200 Granular Catalyst
Destruction Efficiency:	Up to 99.999% (permitted at 99%)
Exhaust Rate:	1,300 acfm
Exhaust:	12" outside dia stack at ~23' 10" above ground level

<u>ADP Application CL-3229.</u> *The current permit for ISO Flex's Vancouver facility limits ozone emissions to a level corresponding to a minimum nominal destruction efficiency of 99.9%. ISO Flex proposes to reduce the required minimum destruction efficiency to 99%. No physical changes are proposed for this process line.*

5.c <u>Line 24 (*existing*).</u> One extruder line processing polyethylene resin into film.

Make / Model:	Hosokawa Alpine American Inc. / HX65S (*job #TBA*)
Mfg Date:	2013
Rated Capacity:	1,700 lb/hr film extrusion (three layers)
Maximum Melt Temp:	300-425 °F
Corona Treater(s):	(2) Enercon Industries Corp. units (10 kW each, 20 kW total)

<u>Ozone Destruct Unit.</u> Exhaust from the corona treaters is vented to a dedicated ozone destruct unit.

Make / Model:	Ozone-Ex II / LM3686-108-0M, Part # 03X-16 (*S/N 103352-01*)
Catalyst:	Activated Alumina Pellet A-201 7X2 and Carulite® 200 Granular Catalyst
Destruction Efficiency:	Up to 99.999% (permitted at 99%)
Exhaust Rate:	1,000 acfm
Exhaust:	10" outside dia stack at ~23' 10" above ground level

<u>ADP Application CL-3229.</u> *The current permit for ISO Flex's Vancouver facility limits ozone emissions to a level corresponding to a minimum nominal destruction efficiency of 99.9%. ISO Flex proposes to reduce the required minimum destruction efficiency to 99%. No physical changes are proposed for this process line.*

5.d <u>Line 25 (*existing*).</u> One extruder line processing polyethylene resin into film.

Make / Model:	Hosokawa Alpine American Inc. / 65mm (*job #F1 19907*)
Mfg Date:	2001, rebuilt 2012
Rated Capacity:	900 lb/hr film extrusion (seven layers)
Maximum Melt Temp:	300-425 °F
Corona Treater(s):	(2) Pillar Technologies, Inc. units (5 kW each, 10 kW total)

<u>Ozone Destruct Unit.</u> Exhaust from the corona treaters is vented to a dedicated ozone destruct unit.

Make / Model:	Ozone-Ex II / LM3686-105-0M Part # 03X-10 (*S/N 103087-01*)
Catalyst:	Activated Alumina Pellet A-201 7X2 and Carulite® 200 Granular Catalyst
Destruction Efficiency:	Up to 99.999% (permitted at 99%)
Exhaust Rate:	1,000 acfm
Exhaust:	10" outside dia stack at ~23' 10" above ground level

<u>ADP Application CL-3229.</u> *The current permit for ISO Flex's Vancouver facility limits ozone emissions to a level corresponding to a minimum nominal destruction efficiency of 99.9%. ISO Flex proposes to reduce the required minimum destruction efficiency to 99%. No physical changes are proposed for this process line.*

5.e <u>Line 26 (*existing*).</u> One extruder line processing polyethylene resin into film.

Make / Model:	Hosokawa Alpine American Inc. / 40498
Mfg Date:	2018/2019
Rated Capacity:	1,500 lb/hr film extrusion (five layers)
Maximum Melt Temp:	300-425 °F
Corona Treater(s):	(2) Pillar Technologies, Inc. units (15 kW each, 30 kW total)

Ozone Destruct Unit. Exhaust from the corona treaters is vented to a dedicated ozone destruct unit.

Make / Model: Pillar Technologies / OZD 1500, Part # B5860-23
Catalyst: Activated Alumina Pellet A-201 7X2 and Carulite® 200 Granular Catalyst
Destruction Efficiency: Up to 99.999% (permitted at 99%)
Exhaust Rate: 1,000 acfm
Exhaust: 10" outside dia stack at ~23' 10" above ground level

ADP Application CL-3229. The current permit for ISO Flex's Vancouver facility limits ozone emissions to a level corresponding to a minimum nominal destruction efficiency of 99.9%. ISO Flex proposes to reduce the required minimum destruction efficiency to 99%. No physical changes are proposed for this process line.

5.f Insignificant Emission Units. The following pieces of facility equipment have been determined to have insignificant emissions, and are not registered as emission units:

Resin Storage Silos. Eight bulk storage silos with a maximum storage capacity of 220,000 pounds each. Material is transferred to the silos with high pressure conveying systems.

5.g Equipment/Activity Summary.

ID No.	Equipment/Activity	Control Equipment/Measure
1	Line 21 - Hosokawa Alpine American extruder with corona treaters	Ozone Destruct Unit (99% destruction efficiency)
2	Line 22 - Hosokawa Alpine American extruder with corona treaters	Ozone Destruct Unit (99% destruction efficiency)
3	Line 24 - Hosokawa Alpine American extruder with corona treaters	Ozone Destruct Unit (99% destruction efficiency)
4	Line 25 - Hosokawa Alpine American extruder with corona treaters	Ozone Destruct Unit (99% destruction efficiency)
5	Line 26 - Hosokawa Alpine American extruder with corona treaters	Ozone Destruct Unit (99% destruction efficiency)

6. EMISSIONS DETERMINATION

Emissions to the ambient atmosphere from extruding operations, as proposed in ADP Application CL-3229, consist of volatile organic compounds (VOC), particulate matter (PM), and ozone.

Unless otherwise specified by SWCAA, actual emissions must be determined using the specified input parameter listed for each emission unit and the following hierarchy of methodologies:

(a) Continuous emissions monitoring system (CEMS) data;
(b) Source emissions test data (EPA reference method). When source emissions test data conflicts with CEMS data for the time period of a source test, source test data must be used;
(c) Source emissions test data (other test method); and
(d) Emission factors or methodology provided in this TSD.

6.a Blown Film Extruders (*existing*). Emissions from thin film extrusion depends on the types of polymer used and the temperature of the extrusion process.

The Preferred and Alternative Methods for Estimating Air Emissions from Plastic Products Manufacturing, by STAPPA/ALAPCO/EPA (Dec. 1998) states, "an emission factor that is based on a strand extruder process may be appropriate for a conservative estimate of emissions from heavy sheet and profile extrusion (as well as closed mold operations such as injection molding) and thermoforming, but may not be the best emission factor for a film process." The study did not include emission factors for blown film.

LLDPE Emission Factors. The June 1996 edition of the *Journal of the Air & Waste Management Association* lists some emission factors for LLDPE blown film (Development of Emission Factors for Polyethylene Processing, Table 7). Other emission factors associated with the study refer to either HDPE blow molding or extrusion coating. Neither of these processes matches the process at ISO Flex.

According to ISO Flex, temperatures between 300 ºF and 425 ºF are typical for their blown film operations. Typical melt temperatures used at ISO Flex Packaging are lower than those used to determine emissions in the Journal's research for some polymers. The study states that the equations cannot accurately predict emissions from process temperatures below the established range. Therefore, if actual operational temperatures are below the lower set point of the range listed in Table 1 (see below), the lower temperature of the range should be used to determine emissions, not the actual operating temperature.

LDPE Emission Factors. The emission factors for LDPE published in the *Journal of the Air and Waste Management Association* were not developed for this process or this process temperature. The LDPE factors were based on an extrusion coating process, which operates at much higher temperatures than the blown film process used by ISO Flex. If the actual temperature used at the facility from the blown film process is used in the emissions equation, a negative emission rate is calculated. Because no other information is available, the LLDPE equation will be used for both types of resin.

HDPE Emission Factors. The emission factors for HDPE published in the *Journal of the Air and Waste Management Association* were also not developed for this process temperature. However, the process for the HDPE factors is similar. The temperature used at ISO Flex Packaging has the potential to go beyond the upper range of the associated study. The actual temperature will be used to determine the emission rate, because the processes are similar and therefore the emission rates should be fairly comparable.

Polypropylene Emission Factors. The Michigan Department of Environmental Quality published *Plastic Production and Products Manufacturing* (11/05) that includes emission factors for polypropylene.

General. EVOH is never processed with exposure to air; it is always fully encapsulated within other layers of the co-extrusion process and therefore has no emissions to the atmosphere.

Process additives are mixed with a carrier resin and that amount of resin should be included in each specific material throughput.

TAP Emissions. Based on information in the American Industrial Hygiene Association's *Quantification of Employee Exposure to Volatile Emission Products Generated by Commercial-Scale Processing of Polyethylene* (June 1994), emissions of toxic air pollutants (TAPs) from extrusion operations are negligible.

Emission Factor Derivations.

Linear/Low Density Polyethylene

VOC	=	0.0837 * T – 22.72	=	12.85 lb/MM lb resin
$PM/PM_{10}/PM_{2.5}$	=	0.3561 * T – 124.17	=	27.17 lb/MM lb resin

Where T is the extrusion temperature in °F. Study temperature range was 355 °F to 500 °F.
Emission factors calculated at 425 °F.

High Density Polyethylene

VOC	=	0.192 * T – 51.86	=	31.66 lb/MM lb resin
$PM/PM_{10}/PM_{2.5}$	=	0.14 * T – 33.60	=	27.30 lb/MM lb resin

Where T is the extrusion temperature in °F. Study temperature range was 380 °F to 430 °F. Emission factors calculated at 435 °F.

Polypropylene

VOC	=	350.00 lb/MM lb resin
$PM/PM_{10}/PM_{2.5}$	=	1,000.00 lb/MM lb resin

Potential Emissions. Facility resin throughput generally consists of 80% LLDPE, 20% LDPE, and a minor amount of HDPE. Polypropylene resin is not processed at the current time, but may be in the future.

Resin Type	Resin Throughput (MM lbs)	VOC	PM
Linear Low Density / Low Density	40	514.0	1,086.8
High Density	1	31.7	27.3
Polypropylene	1	350.0	1,000.0
	Total Emissions (lb/yr)	895.7	2,114.1
	(tpy)	0.45	1.06

6.b Corona Treaters (*modified*). The corona treaters installed on each of the extrusion lines generate ozone in the course of normal operation. The ozone is captured and converted to diatomic oxygen by dedicated ozone destruct units. The ozone destruct units use an activated alumina catalyst capable of capturing and destroying 99.999% of the ozone produced by the corona treater. Although the catalyst is capable of achieving very high levels of control, BACT has been determined to be a control efficiency of 99% in consideration of practical operating limitations and cost effectiveness.

Uncontrolled ozone emissions from the corona treaters are estimated by Pillar Technologies to be a maximum of 0.072 pounds per kilowatt hour (lb/kW-hr) when in use. Potential ozone emissions are calculated from estimated uncontrolled emissions, 8,760 hr/yr of operation, the power rating of each corona treater (kW), and a control efficiency of 99%.

Line	kW	Operation (hr/yr)	kW-hr	Emission Factor (lb/kW-hr)	Control %	Ozone (lb/hr)	Ozone (lb/yr)
21	15	8760	131,400	0.072	99.0	0.0108	94.61
22	20	8760	175,200	0.072	99.0	0.0144	126.14
24	20	8760	175,200	0.072	99.0	0.0144	126.14
25	10	8760	87,600	0.072	99.0	0.0072	63.07
26	30	8760	262,800	0.072	99.0	0.0216	189.22
					Total Emissions	0.0684	599.18

Line	Ozone Emisisons				
	Controlled lb/hr	Controlled ppm	Permitted ppm	Permitted lb/hr	Permitted lb/yr
21	0.0108	1.45	1.50	0.0112	98.20
22	0.0144	1.93	2.00	0.0149	130.94
24	0.0144	1.93	2.00	0.0149	130.94
25	0.0072	0.96	1.00	0.0075	65.47
26	0.0216	2.89	3.00	0.0224	196.41
			Total Emissions:	0.0710	621.95

Calculated ozone emission rates from the corona treaters are presented in the first table above. In order to make emission monitoring more practical, permit limits round the calculated emission concentrations from each corona treater up to the nearest tenth. Permitted emission rates are presented in the second table above.

ADP Application CL-3229. The current permit for the Vancouver facility (ADP 19-3363) limits ozone emissions to a level corresponding to a minimum nominal destruction efficiency of 99.9%. ISO Flex proposes to reduce the required minimum destruction efficiency to 99% based on cost effectiveness. ISO Flex has demonstrated a high level of cost associated with maintaining ozone destruct unit catalysts at a control efficiency of 99.9%, and review of BACT requirements for similar facilities indicates that a control efficiency of 99% is consistent with other BACT determinations. Therefore, SWCAA will modify permitted emission limits to a level corresponding to a control efficiency of 99%.

6.c Emissions Summary/Facility-wide Potential to Emit. Facility-wide potential to emit as calculated in the sections above is summarized below.

Pollutant	Potential Emissions (tpy)	Project Increase (tpy)
NO_X	0.00	0.00
CO	0.00	0.00
VOC	0.45	0.00
SO_2	0.00	0.00
Lead	0.00	0.00
PM	1.06	0.00
PM_{10}	1.06	0.00
$PM_{2.5}$	1.06	0.00
Ozone	0.31	0.28
TAP	0.31	0.28
HAP	0.00	0.00
CO_2e	0.00	0.00

Pollutant	CAS Number	Category	Facility-wide Emissions	Project Increase	WAC 173-460 SQER
Ozone	10028-15-6	TAP	0.071 lb/hr (1-hr) 620 lb/yr	0.064 lb/hr (1-hr) 560 lb/yr	0.394 lb (1-hr)

7. REGULATIONS AND EMISSION STANDARDS

Regulations that have been used to evaluate the acceptability of the proposed facility and establish emission limits and control requirements include, but are not limited to, the regulations, codes, or requirements listed below.

7.a Revised Code of Washington (RCW) 70A.15.2040 empowers any activated air pollution control authority to prepare and develop a comprehensive plan or plans for the prevention, abatement and control of air pollution within its jurisdiction. An air pollution control authority may issue such orders as may be necessary to effectuate the purposes of the Washington Clean Air Act and enforce the same by all appropriate administrative and judicial proceedings subject to the rights of appeal as provided in Chapter 62, Laws of 1970 ex. sess.

7.b RCW 70A.15.2210 provides for the inclusion of conditions of operation as are reasonably necessary to assure the maintenance of compliance with the applicable ordinances, resolutions, rules and regulations when issuing an Air Discharge Permit for installation and establishment of an air contaminant source.

7.c WAC 173-460 "Controls for New Sources of Toxic Air Pollutants" requires Best Available Control Technology for toxic air pollutants (T-BACT), identification and quantification of emissions of toxic air pollutants and demonstration of protection of human health and safety.

7.d WAC 173-476 "Ambient Air Quality Standards" establishes ambient air quality standards for PM_{10}, $PM_{2.5}$, lead, sulfur dioxide, nitrogen dioxide, ozone, and carbon monoxide in the ambient air, which shall not be exceeded.

7.e SWCAA 400-040 "General Standards for Maximum Emissions" requires all new and existing sources and emission units to meet certain performance standards with respect to Reasonably Available Control Technology (RACT), visible emissions, fallout, fugitive emissions, odors, emissions detrimental to persons or property, sulfur dioxide, concealment and masking, and fugitive dust.

7.f SWCAA 400-050 "Emission Standards for Combustion and Incineration Units" requires that all provisions of SWCAA 400-040 be met and that no person shall cause or permit the emission of particulate matter from any combustion or incineration unit in excess of 0.23 grams per dry cubic meter (0.1 grains per dry standard cubic foot) of exhaust gas at standard conditions.

7.g SWCAA 400-060 "Emission Standards for General Process Units" prohibits particulate matter emissions from all new and existing process units in excess of 0.1 grains per dry standard cubic foot of exhaust gas.

7.h SWCAA 400-109 "Air Discharge Permit Applications" requires that an Air Discharge Permit application be submitted for all new installations, modifications, changes, or alterations to process and emission control equipment consistent with the definition of "new source". Sources wishing to modify existing permit terms may submit an Air Discharge Permit application to request such changes. An Air Discharge Permit must be issued, or written confirmation of exempt status must be received, before beginning any actual construction, or implementing any other modification, change, or alteration of existing equipment, processes, or permits.

7.i SWCAA 400-110 "New Source Review" requires that SWCAA issue an Air Discharge Permit in response to an Air Discharge Permit application prior to establishment of the new source, emission unit, or modification.

7.j SWCAA 400-111 "Requirements for Sources in a Maintenance Plan Area" requires that no approval to construct or alter an air contaminant source shall be granted unless it is evidenced that:
(1) The equipment or technology is designed and will be installed to operate without causing a violation of the applicable emission standards;
(2) Emissions will be minimized to the extent that the new source will not exceed emission levels or other requirements provided in the maintenance plan;
(3) Best Available Control Technology will be employed for all air contaminants to be emitted by the proposed equipment;
(4) The proposed equipment will not cause any ambient air quality standard to be exceeded; and
(5) If the proposed equipment or facility will emit any toxic air pollutant regulated under WAC 173-460, the proposed equipment and control measures will meet all the requirements of that Chapter.

8. RACT/BACT/BART/LAER/PSD/CAM DETERMINATIONS

The proposed equipment and control systems incorporate Best Available Control Technology (BACT) for the types and amounts of air contaminants emitted by the processes as described below:

New BACT Determinations

8.a BACT Determination – Corona Treaters. The use of ozone destruct units capable of achieving a destruction efficiency of 99% has been determined to meet the requirements of BACT for control of ozone emissions from the corona treaters.

Previous BACT Determinations

8.b BACT Determination – Blown Film (*ADP 19-3363*). VOC and PM emissions from the heating and decomposition of plastic resin in the blown film process is minimal, therefore no emission controls are cost-effective. A review of current emissions factors and controls revealed no new information on this process.

8.c BACT Determination – Corona Treaters (*ADP 19-3363*). The use of ozone destruct units on the corona treaters is considered to meet BACT for the removal of ozone emissions from the corona treaters.

Other Determinations

8.d Prevention of Significant Deterioration (PSD) Applicability Determination. The potential to emit of this facility is less than applicable PSD applicability thresholds. Likewise, this permitting action will not result in a potential increase in emissions equal to or greater than the PSD thresholds. Therefore, PSD review is not applicable to this action.

8.e Compliance Assurance Monitoring (CAM) Applicability Determination. CAM is not applicable to any emission unit at this facility because it is not a major source and is not required to obtain a Part 70 permit.

9. AMBIENT IMPACT ANALYSIS

9.a TAP Small Quantity Review. The incremental increases in TAP emissions associated with this permitting action are quantified in Section 6 of this Technical Support Document. All incremental increases in individual TAP emissions are less than the applicable small quantity emission rate (SQER) identified in WAC 173-460.

9.b NAAQS Review – Ozone. Emissions of ozone were modeled using the AERSCREEN version 21112 dispersion model. The results of the model indicate that the proposed increase in ozone emissions will not cause the ambient air quality standard for ozone to be exceeded.

Pollutant	CAS #	Permitted Ozone Emissions ($\mu g/m^3$)	Acceptable Source Impact Level ($\mu g/m^3$)	Ozone Emissions with Background ($\mu g/m^3$)	Ambient Air Quality Standard ($\mu g/m^3$)
Ozone	10028-15-6	15.75 (1-hr)	180 (1-hr)	122 (8-hr)	140 (8-hr)

Conclusions

9.c Modification of ozone emission limits, as proposed in ADP Application CL-3229, will not cause the ambient air quality requirements of Title 40 Code of Federal Regulations (CFR) Part 50 "National Primary and Secondary Ambient Air Quality Standards" to be violated.

9.d Modification of ozone emission limits, as proposed in ADP Application CL-3229, will not cause the requirements of WAC 173-460 "Controls for New Sources of Toxic Air Pollutants" or WAC 173-476 "Ambient Air Quality Standards" to be violated.

9.e Modification of ozone emission limits, as proposed in ADP Application CL-3229, will not cause a violation of emission standards for sources as established under SWCAA General Regulations Sections 400-040 "General Standards for Maximum Emissions," 400-050 "Emission Standards for Combustion and Incineration Units," and 400-060 "Emission Standards for General Process Units."

10. DISCUSSION OF APPROVAL CONDITIONS

SWCAA has made a determination to issue ADP 23-3576 in response to ADP Application CL-3229. ADP 23-3576 contains approval requirements deemed necessary to assure compliance with applicable regulations and emission standards as discussed below.

10.a Supersession of Previous Permits. ADP 23-3576 supersedes ADP 19-3363 in its entirety.

10.b General Basis. Permit requirements for equipment affected by this permitting action incorporate the operating schemes proposed by the applicant in ADP Application CL-3229. Permit requirements established by this action are intended to implement BACT, minimize emissions, and assure compliance with applicable requirements on a continuous basis. Emission limits for approved equipment are based on the maximum potential emissions calculated in Section 6 of this Technical Support Document.

10.c Monitoring and Recordkeeping Requirements. ADP 23-3576 establishes monitoring and recordkeeping requirements sufficient to document compliance with applicable emission limits, ensure proper operation of approved equipment and provide for compliance with generally applicable requirements. Specific monitoring requirements are established for extruder melt temperature, hours of corona treater operation, catalyst differential pressure, and material throughput.

10.d Reporting Requirements. ADP 23-3576 establishes general reporting requirements for annual air emissions, upset conditions and excess emissions. Specific reporting requirements are established for hours of corona treater operation and material throughput. Reports are to be submitted on an annual basis.

10.e Extruders. Emissions from extruder operation will be calculated based on resin type and maximum operational temperature. Emission factors for extrusion are indicative of actual emissions only at specific temperatures. Polymer maximum melt temperatures have been established to maintain operation within those temperature ranges and to minimize emissions.

10.f Corona Treaters. As requested by ISO Flex, minimum ozone destruction efficiency has been lowered from 99.9% to 99%. This permitting action does not approve any physical changes to the corona treaters or ozone destruct units. Pressure drop across the ozone destruct catalyst will decrease as the catalyst is reduced due to attrition. Differential pressure across the catalyst serves as an indicator of catalyst life.

10.g Requirements for Unmodified Emission Units. Permit requirements for existing emission units not affected by ADP Application CL-3229 are carried forward unchanged from ADP 23-3576.

11. START-UP AND SHUTDOWN/ALTERNATIVE OPERATING SCENARIOS/POLLUTION PREVENTION

11.a Start-up and Shutdown Provisions. Pursuant to SWCAA 400-081 "Start-up and Shutdown", technology based emission standards and control technology determinations shall take into consideration the physical and operational ability of a source to comply with the applicable standards during start-up or shutdown. Where it is determined that a source is not capable of achieving continuous compliance with an emission standard during start-up or shutdown, SWCAA shall include appropriate emission limitations, operating parameters, or other criteria to regulate performance of the source during start-up or shutdown.

The applicant did not identify any start-up and shutdown periods during which affected equipment is not capable of achieving continuous compliance with applicable technology determinations or approval conditions. To SWCAA's knowledge, this facility can comply with all applicable standards during startup and shutdown.

11.b Alternate Operating Scenarios. SWCAA conducted a review of alternate operating scenarios applicable to equipment affected by this permitting action. The permittee did not propose or identify any applicable alternate operating scenarios. Therefore, none were included in the permit requirements.

11.c Pollution Prevention Measures. SWCAA conducted a review of possible pollution prevention measures for the facility. No pollution prevention measures were identified by either the permittee or SWCAA separate or in addition to those measures required under BACT considerations. Therefore, none were included in the permit requirements.

12. EMISSION MONITORING AND TESTING

12.a Emission Testing – Ozone Destruct Units. Emission testing of the ozone destruct units is required annually. All emission testing must be conducted in accordance with ADP 23-3576, Appendix A.

ADP Application CL-3229. The current permit for the Vancouver facility (ADP 19-3363) requires emission testing to be conducted using colorimetric detector tubes. ISO Flex has requested approval to use a handheld electronic analyzer (Aeroqual Series 200/300/500) in lieu of the colorimetric tubes. ISO Flex has cited difficulties in obtaining testing supplies and accurately reading test results from the tubes. After reviewing specifications for the Aeroqual analyzer, SWCAA has determined the unit may be used for ozone emission testing.

13. FACILITY HISTORY

13.a Previous Permitting Actions. SWCAA has previously issued the following Permits for this facility:

Permit Number	Application Number	Date	Purpose
19-3363	CL-3097	September 24, 2019	Installation of a new Hosokawa Alpine thin film extrusion line (Line 26) equipped with 2 Pillar Technologies corona treaters (15kW each) and an ozone destruct unit (1000 acfm). Increase facility throughput to 40 million pounds per year.
15-3148	CL-2043	August 11, 2015	Installation of a new thin film extrusion line (Line 22) equipped with a corona treaters and an ozone destruct unit.
13-3052	CL-1987	April 16, 2013	Installation of Hosokawa thin film extrusion lines equipped with Enercon corona treaters and an ozone destruct unit.

13.b Compliance History. A search of source records on file at SWCAA did not identify any outstanding compliance issues at this facility.

14. PUBLIC INVOLVEMENT OPPORTUNITY

14.a Public Notice for ADP Application CL-3229. Public notice for ADP Application CL-3229 was published on the SWCAA internet website for a minimum of (15) days beginning on March 10, 2023.

14.b Public/Applicant Comment for ADP Application CL-3229. SWCAA did not receive specific comments, a comment period request or any other inquiry from the public regarding this ADP application. Therefore no public comment period was provided for this permitting action.

14.c State Environmental Policy Act. SWCAA issued a Determination of Nonsignificance (DNS) for expansion of the ISO Flex facility in Vancouver on September 24, 2019 (*SWCAA 19-037*). Operations at the facility subsequent to the permit modifications proposed in ADP Application CL-3229 will not be substantially different than the scope of operations reviewed in the previous DNS. Therefore a separate review has not been conducted for this permitting action.

From: Squillace, Kristen M
To: Craig Laubacher
Subject: RE: IDEM OAQ New Emission Factors for Coextruders Calculations for Spartech App No.:035-47764-00078
Date: Friday, June 21, 2024 8:08:00 AM
Attachments: image001.png
image002.png
image003.png
image004.png
image005.png
image006.png
image007.png

Thank you for sending the document. Have a good weekend!

All the best,

Kristen

IDEM

Indiana Department of Environmental Management

Kristen Squillace

Environmental Manager

(317) 233-9327 • KSquilla@idem.IN.gov

Protecting Hoosiers and Our Environment

| | | | | www.idem.IN.gov

Help us improve!
IDEM values your feedback

From: Craig Laubacher <claubacher@e-c-e.org>
Sent: Thursday, June 20, 2024 2:37 PM
To: Squillace, Kristen M <KSquilla@idem.IN.gov>
Subject: RE: IDEM OAQ New Emission Factors for Coextruders Calculations for Spartech App No.:035-47764-00078

**** This is an EXTERNAL email. Exercise caution. DO NOT open attachments or click links from unknown senders or unexpected email. ****

"EVOH is never processed with exposure to air; it is always fully encapsulated within other layers of the co-extrusion process and therefore has no emissions to the atmosphere."

per TECHNICAL SUPPORT DOCUMENT Air Discharge Permit ADP 23-3576 Air Discharge Permit Application CL-3229
Issued: April 12, 2023 ISO Flex Packaging SWCAA ID – 2419

This is the document that I referenced in the calculations sheets which refers to VOC content of EVOH as 0

Let me know if this is sufficient for you

Craig Laubacher
Regional Director
Environmental Compliance & Engineering
Mobile **512-635-4324**
Email claubacher@e-c-e.org

From: Squillace, Kristen M <KSquilla@idem.IN.gov>
Sent: Thursday, June 20, 2024 1:20 PM
To: Craig Laubacher <claubacher@e-c-e.org>
Subject: IDEM OAQ New Emission Factors for Coextruders Calculations for Spartech App No.:035-47764-00078

Hi Craig,

For the new calculations of the coextruders, would you be able to send the document you got the new VOC (lbs/MMlb) and PM/PM10 (lbs/MMlb) factors from for the **EVOH** Material? The documents Jack Laubacher had sent didn't reference EVOH.

Thanks!,

Kristen

IDEM
EST. 1986
Indiana Department of Environmental Management

Kristen Squillace
Environmental Manager
(317) 233-9327 • KSquilla@idem.IN.gov

From:	Squillace, Kristen M
To:	Craig Laubacher; Jack.Collins@Spartech.com
Subject:	Applicant Review for Registration Transition No. 035-47664-00078 for Spartech LLC The Jordan Company
Date:	Friday, June 21, 2024 1:53:00 PM
Attachments:	47764per.docx image001.png image002.png image003.png image004.png image005.png image006.png image007.png 47764calcs.xlsx 47764tsd.docx
Importance:	High

Dear Jack Collins and Craig Laubacher:

Attached please find the draft Registration Transition and supporting documents for review. As a courtesy, this draft is being provided to you for an opportunity to review and provide comments prior to the issuance of the permit approval.

The time clock for Registration Transition permit No.: 035-47664-00078 will be stopped during your review until you either provide comments or indicate that you do not have any comments. Due to permit accountability and IDEM's intention to issue the permit in a timely manner, you are being allotted 1 week to provide comments in writing. If you have any conflicts or special circumstances that would impede your review process during the time allotted, please notify me directly at the email address or phone number listed below as soon as possible. If you have not responded on or before **Friday, June 28, 2024**, IDEM will assume that you have no comments pertaining to this draft and all files will be forwarded for issuance.

During this review period, I will be available to address your concerns, answer any questions that you may have, or make necessary revisions to this draft.

Pursuant to 326 IAC 2-1.1-7, the fee for this permitting action is expected to be $600, which is based on the following:

$600	Registration

Please note: This is not a bill. This represents the anticipated fee and is subject to change if additional review is required or the permit level changes for some reason (e.g. an additional NESHAP review is required). You will receive a final bill from the OAQ Permits Administration and Support Section.

Sincerely,

Kristen Squillace

IDEM

Indiana Department of Environmental Management

Kristen Squillace

Environmental Manager

(317) 233-9327 • KSquilla@idem.IN.gov

From:	Craig Laubacher
To:	Squillace, Kristen M
Cc:	Jack.Collins@Spartech.com
Subject:	RE: Applicant Review for Registration Transition No. 035-47664-00078 for Spartech LLC The Jordan Company
Date:	Monday, June 24, 2024 4:03:20 PM
Attachments:	image001.png image002.png image003.png image004.png image005.png image006.png image007.png 47764per - with edits.docx 47764tsd - with edits.docx

---

Kristen,

I've attached two word documents which have the facility's comments. There is only one minor change (the same edit for both docs) regarding details about a slitter.

I also had a question about EVOH's emissions. I had listed it as 0 across the board due to it being processed within two layers, but you have different emission factors in the spreadsheet. I was just curious as to the source of those. (this won't be the only facility using EVOH, so I wanted to make sure we are on the same page here)

Thanks!

Craig Laubacher
Regional Director
Environmental Compliance & Engineering
Mobile **512-635-4324**
Email claubacher@e-c-e.org

From: Squillace, Kristen M <KSquilla@idem.IN.gov>
Sent: Friday, June 21, 2024 12:54 PM
To: Craig Laubacher <claubacher@e-c-e.org>; Jack.Collins@Spartech.com
Subject: Applicant Review for Registration Transition No. 035-47664-00078 for Spartech LLC The Jordan Company
Importance: High

Dear Jack Collins and Craig Laubacher:

Attached please find the draft Registration Transition and supporting documents for review. As a courtesy, this draft is being provided to you for an opportunity to review and provide comments prior to the issuance of the permit approval.

The time clock for Registration Transition permit No.: 035-47664-00078 will be stopped during your review until you either provide comments or indicate that you do not have any comments. Due to permit accountability and IDEM's intention to issue the permit in a timely manner, you are being allotted 1 week to provide comments in writing. If you have any conflicts or special circumstances that would impede your review process during the time allotted, please notify me directly at the email address or phone number listed below as soon as possible. If you have not responded on or before **Friday, June 28, 2024**, IDEM will assume that you have no comments pertaining to this draft and all files will be forwarded for issuance.

During this review period, I will be available to address your concerns, answer any questions that you may have, or make necessary revisions to this draft.

Pursuant to 326 IAC 2-1.1-7, the fee for this permitting action is expected to be $600, which is based on the following:

$600	Registration

Please note: This is not a bill. This represents the anticipated fee and is subject to change if additional review is required or the permit level changes for some reason (e.g. an additional NESHAP review is required). You will receive a final bill from the OAQ Permits Administration and Support Section.

Sincerely,

Kristen Squillace

Indiana Department of Environmental Management
Kristen Squillace
Environmental Manager
(317) 233-9327 • KSquilla@idem.IN.gov

Indiana Department of Environmental Management
We Protect Hoosiers and Our Environment.
100 N. Senate Avenue • Indianapolis, IN 46204
(800) 451-6027 • (317) 232-8603 • www.idem.IN.gov

Eric J. Holcomb
Governor

Brian C. Rockensuess
Commissioner

REGISTRATION
OFFICE OF AIR QUALITY

Spartech LLC The Jordan Company
1401 East Memorial Drive
Muncie, Indiana 47302

Pursuant to 326 IAC 2-5.1 (Construction of New Sources: Registrations) and 326 IAC 2-5.5 (Registrations), (herein known as the Registrant) is hereby authorized to construct and operate subject to the conditions contained herein, the source described in Section A (Source Summary) of this registration.

Registration No. R035-47764-00078 Master Agency Interest ID.: 15584	
Issued by: Ghassan Shalabi, Section Chief Permits Branch Office of Air Quality	Issuance Date:

SECTION A SOURCE SUMMARY

This registration is based on information requested by the Indiana Department of Environmental Management (IDEM), Office of Air Quality (OAQ). The information describing the source contained in conditions A.1 and A.2 is descriptive information and does not constitute enforceable conditions. However, the Registrant should be aware that a physical change or a change in the method of operation that may render this descriptive information obsolete or inaccurate may trigger requirements for the Registrant to obtain additional permits pursuant to 326 IAC 2.

A.1 General Information

The Registrant owns and operates a stationary plastic sheet and molded plastics plant.

Source Address:	1401 East Memorial Drive, Muncie, Indiana 47302
General Source Phone Number:	(765) 281-5120
SIC Code:	2821 (Plastics Material, Synthetic Resins, & Nonvulcanized Elastomers)
County Location:	Delaware County
Source Location Status:	Attainment for all criteria pollutants
Source Status:	Registration

A.2 Emission Units and Pollution Control Equipment Summary

This stationary source consists of the following emission units and pollution control devices:

(a) One (1) railcar unloading operation, identified as RRUL1, constructed in 1984, approved in 2024 for modification, consisting of a pneumatic material transfer system, with a maximum throughput capacity of 20,000 pounds of plastic pellets per hour, and with plastic pellets conveyed pneumatically to silos.

(b) One (1) railcar unloading operation, identified as RRUL2, consisting of a pneumatic material transfer system, constructed in 2017, with a maximum capacity of 11,883 pounds per hour.

(c) One (1) railcar unloading operation, identified as RRUL3, approved for construction in 2024, consisting of a pneumatic material transfer system, with a maximum throughput capacity of 30,000 lbs of plastic pellets per hour, with plastic pellets conveyed pneumatically to silos.

(d) One (1) railcar unloading operation, identified as RRUL4, approved for construction in 2024, consisting of a pneumatic material transfer system, with a maximum throughput capacity of 30,0000 lbs of plastic pellets per hour, with plastic pellets conveyed pneumatically to silos.

(e) Twelve (12) silos, identified as Silo A through Silo L, constructed in 1984, for storing plastic pellets, each with a maximum throughput of 0.5 tons per hour, using no controls, and venting outside the building.

(f) Three (3) silos, identified as Silo M through Silo O, constructed in 2017, for storing plastic pellets, each with a maximum throughput of 0.5 tons per hour, using no controls, and venting outside the building.

(g) One (1) silo, identified as Silo P, approved for construction in 2024, for storing plastic pellets, with a maximum throughput of 0.5 tons per hour, using no controls, and venting outside the building.

(h) Twenty-three (23) pneumatic conveyors for transporting plastic pellets or regrind from the silos, surge bins or containers to the coextruder input feed for processing, with a maximum capacity of 1,000 pounds per hour, each, with particulate emissions controlled with integral bin vent filters, and venting inside or outside the building.

(i) Two (2) pneumatic conveyors for transporting plastic pellets or regrind from the silos, surge bins, or containers to the coextruder input feed for processing, constructed in 2017, with a maximum capacity of 1,000 pounds per hour, each, with particulate emissions controlled with bin vent filters, and venting inside or outside the building.

(j) Six (6) pneumatic conveyors for transporting plastic pellets or regrind from the silos, surge bins, or containers to the coextruder input feed for processing, constructed in 2017, with a maximum capacity of 5,000 pounds per hour, each, with particulate emissions controlled with bin vent filters, and venting inside or outside the building.

(k) Five (5) pneumatic conveyors for transporting plastic pellets or regrind from the silos, surge bins or containers to the coextruder input feed for processing, approved for construction in 2024, with a maximum capacity of 1,000 pound per hour, each, using bin vents as control, and venting outside the building.

(l) Eight (8) coextruder lines for extruding multiple layers of plastic sheeting, with no particulate or VOC emission controls.

Emission Unit ID	Maximum Throughput Rate (lbs/hour)	Construction Date	Modified Date	Vent ID
COEX1	3,800	1984	2024	COEX1
COEX2	3,000	1987	2024	COEX2
COEX3	2,400	1994	2024	COEX3
COEX4	3,000	2011	2024	COEX4
COEX5	3,465	2005	2024	COEX5
COEX6	3,500	2018	2024	COEX6
COEX7	1,000	2024	-	COEX7
COEX8	2,300	2024	-	COEX8

(m) Eight (8) granulators for grinding scrap plastic (regrind) from coextruder lines, with regrind pneumatically conveyed to surge bins, with particulate emissions controlled with bin vent filters, and venting inside or outside the building.

Emission Unit ID	Maximum Throughput Rate (lbs/hour)	Construction Date	Modified Date
COEXG1	380	1984	2024
COEXG2	300	1987	2024
COEXG3	240	1994	2024
COEXG4	300	2011	2024
COEXG5	480	2005	2024
COEXG6	360	2018	2024
COEXG7	100	2024	-
COEXG8	240	2024	-

(n) Five (5) thermoformers, using electric heating elements to re-form plastic products, using no controls, and venting inside the building.

Emission Unit ID	Maximum Throughput Rate (lbs/hour)	Construction Date
F5	291	2007
F6	1,125	2010
F7	1,125	2011
F8	1,403	2017
F11	2,800	2017

(o) Six (6) granulators for grinding scrap plastic from thermoformer lines, with regrind pneumatically conveyed to surge bins, with particulate emissions controlled with bin vent filters, and venting inside the building.

Emission Unit ID	Maximum Throughput Rate (lbs/hour)	Construction Date
FG5	250	2007
FG6A	502	2010
FG7	502	2011
FG8A	502	2017
FG11A	700	2017
FG11B	700	2017

(p) One (1) Slitter/Trimmer/Rewinder, identified as SR1, constructed in ~~1985~~2023, with a maximum regrinding capacity of 2~~1~~,000 pounds of plastic product per hour, with trimmings pneumatically conveyed to the granulators, and venting inside the building.

(q) One enclosed granulator, identified as G1, constructed in 2010, with a maximum capacity of 2,500 pounds per hour, using no control and venting inside the building.

(r) One (1) enclosed Granulator, identified G2, constructed in 1984, with a maximum regrinding capacity of 2,000 pounds of plastic waste per hour, with regrind pneumatically conveyed to surge bins, with particulate emissions controlled by a bin vent filter and venting inside the building.

(s) Three (3) enclosed granulators, identified as G3 and G4, constructed in 2017, and G5, approved for construction in 2024, each with a maximum capacity of 2,500 pounder per hour, using no control and venting inside the building.

(t) Indirect natural gas-fired combustion sources with heat input equal to or less than ten (10) million Btu per hour, consisting of the following space heaters:

<table>
<tr><th>Facility</th><th>Construction Date</th><th>Operating Capacity (MMBtu/hr)</th></tr>
<tr><td>Natural Gas-Fired Heater AHU1, AHU3, AHU5, AHU6</td><td rowspan="3">Assumed 1984</td><td>0.40, each</td></tr>
<tr><td>18 Natural Gas-Fired Heaters, 1A, 4A-8A, 10A-13A, 1B-3B, 10B-14B</td><td>0.170, each</td></tr>
<tr><td>2 Natural Gas-Fired Heaters, 3A, 4B</td><td>0.060, each</td></tr>
<tr><td>3 Natural Gas-Fired Tube Heaters</td><td>2024</td><td>0.05, each</td></tr>
<tr><td>2 Natural Gas-Fired Heaters</td><td>2024</td><td>0.08, each</td></tr>
<tr><td>1 Natural Gas-Fired Heater</td><td>2024</td><td>0.12, each</td></tr>
</table>

(u) Two (2) natural gas-fired crystallizer units, identified as CR1 and CR2, constructed in 2017 and 2018, respectively, with a maximum capacity of 0.597 MMBtu/hr and 0.895 MMBtu/hr, respectively,

(v) Two (2) natural gas-fired, dryer units, identified as DR1 and DR2, constructed in 2017 and 2018, respectively, each with a maximum capacity of 0.331 MMBtu/hr and a maximum throughput of 3,000 pounds per hour for both.

(w) One (1) printer, identified as P4, constructed in 2007, with a maximum printing capacity of 25,200 parts (1,050 square feet of plastic) per hour, using a 0.078 MMBtu per hour direct natural gas flame preheater, applying UV inks and using a light cure process, using no controls and venting to stack P4.

(x) One (1) printer ink roll hand-cleaning operation, identified as Roll Cleaner, using a maximum of 270 gallons of cleaner a year.

(y) One (1) parts cleaning unit, identified as Aqueous Parts Tub1, using aqueous cleaners containing less than 1% VOC.

(z) One (1) parts cleaning unit, identified as Aqueous Parts Tub 2, using aqueous cleaners containing less than 1% VOC.

(aa) One (1) stationary 208 hp, diesel-fired emergency fire pump engine, identified as Pump1, with a displacement of 5.9 liters, installed in 1984 and modified in 2004.

Under 40 CFR 63, Subpart ZZZZ, this unit is considered an affected facility.

(bb) One (1) four stroke lean burn spark ignition natural gas-fired emergency backup electric generator engine, identified as Generator1, constructed in 1984, with a maximum capacity of 0.125 megawatts and 187 horsepower, and exhausting to stack Gen1.

Under 40 CFR 63, Subpart ZZZZ, this unit is considered an affected facility.

(cc) Paved roads and parking lots with public access.

(dd) Noncontact cooling tower systems with either of the following:

(1) Natural draft cooling towers not regulated under a NESHAP, or

(2) Forced and induced draft cooling tower systems not regulated under a NESHAP.

(ee) Two (2) vacuum-sealed electric burnout units, identified as Burnout 1 and Burnout 2, for melting plastic off machine parts in a sealed chamber under vacuum, using no controls and exhausting inside the building, and having no emissions.

(ff) VOC and HAP storage containers, consisting of vessels storing lubricating oils, hydraulic oils, machining oils, or machining fluids.

(gg) Production related activities, including the application of oils, greases, lubricants, and/or nonvolatile material, as temporary protective coatings.

(hh) Closed loop heating and cooling systems.

(ii) Exposure chambers (towers or columns), for curing of ultraviolet inks and ultraviolet coatings where heat is the intended discharge.

(jj) Replacement or repair of electrostatic precipitators, bags in baghouses, and filters in other air filtration equipment.

(kk) Heat exchanger cleaning and repair.

(ll) Routine maintenance and repair of buildings, structures, or vehicles at the source where air emissions from those activities would not be associated with any production process, including purging of gas lines and/or purging of vessels.

(mm) Blowdown for the following: sight glass, boiler, cooling tower, compressors and/or pumps.

SECTION B GENERAL CONDITIONS

B.1 Definitions [326 IAC 2-1.1-1]

Terms in this registration shall have the definition assigned to such terms in the referenced regulation. In the absence of definitions in the referenced regulation, the applicable definitions found in the statutes or regulations (IC 13-11, 326 IAC 1-2 and 326 IAC 2-1.1-1) shall prevail.

B.2 Effective Date of Registration [IC 13-15-5-3]

Pursuant to IC 13-15-5-3, this registration R035-47764-00078 is effective immediately, unless a petition for stay of effectiveness is filed and granted according to IC 13-15-6-3, and may be revoked or modified in accordance with the provisions of IC 13-15-7-1.

B.3 Registration Revocation [326 IAC 2-1.1-9]

Pursuant to 326 IAC 2-1.1-9 (Revocation), this registration to operate may be revoked for any of the following causes:

(a) Violation of any conditions of this registration.

(b) Failure to disclose all the relevant facts, or misrepresentation in obtaining this registration.

(c) Changes in regulatory requirements that mandate either a temporary or permanent reduction of discharge of contaminants. However, the amendment of appropriate sections of this registration shall not require revocation of this registration.

(d) For any cause which establishes in the judgment of IDEM the fact that continuance of this registration is not consistent with purposes of this article.

B.4 Prior Permits Superseded [326 IAC 2-1.1-9.5]

(a) All terms and conditions of permits established prior to Registration No. R035-47764-00078 and issued pursuant to permitting programs approved into the state implementation plan have been either:

(1) incorporated as originally stated,

(2) revised, or

(3) deleted.

(b) All previous registrations and permits are superseded by this registration.

B.5 Annual Notification [326 IAC 2-5.1-2(f)(3)] [326 IAC 2-5.5-4(a)(3)]

Pursuant to 326 IAC 2-5.1-2(f)(3) and 326 IAC 2-5.5-4(a)(3):

(a) An annual notification shall be submitted by an authorized individual to the Office of Air Quality stating whether or not the source is in operation and in compliance with the terms and conditions contained in this registration.

(b) The annual notice shall be submitted in the format attached no later than March 1 of each year to:

Indiana Department of Environmental Management
Compliance and Enforcement Branch, Office of Air Quality
100 North Senate Avenue
MC 61-53 IGCN 1003
Indianapolis, IN 46204-2251

(c) The notification shall be considered timely if the date postmarked on the envelope or certified mail receipt, or affixed by the shipper on the private shipping receipt, is on or before the date it is due. If the document is submitted by any other means, it shall be considered timely if received by IDEM, OAQ on or before the date it is due.

B.6 Source Modification Requirement [326 IAC 2-5.5-6(a)]

Pursuant to 326 IAC 2-5.5-6(a), an application or notification shall be submitted in accordance with 326 IAC 2 to the Office of Air Quality (OAQ) if the source proposes to construct new emission units, modify existing emission units, or otherwise modify the source.

B.7 Registrations [326 IAC 2-5.1-2(i)]

Pursuant to 326 IAC 2-5.1-2(i), this registration does not limit the source's potential to emit.

B.8 Preventive Maintenance Plan [326 IAC 1-6-3]

(a) If required by specific condition(s) in Section D of this registration, the Registrant shall prepare and maintain Preventive Maintenance Plans (PMPs) no later than ninety (90) days after issuance of this registration or ninety (90) days after initial start-up, whichever is later, including the following information on each facility:

(1) Identification of the individual(s) responsible for inspecting, maintaining, and repairing emission control devices;

(2) A description of the items or conditions that will be inspected and the inspection schedule for said items or conditions; and

(3) Identification and quantification of the replacement parts that will be maintained in inventory for quick replacement.

If, due to circumstances beyond the Registrant’s control, the PMPs cannot be prepared and maintained within the above time frame, the Registrant may extend the date an additional ninety (90) days provided the Registrant notifies:

Indiana Department of Environmental Management
Compliance and Enforcement Branch, Office of Air Quality
100 North Senate Avenue
MC 61-53 IGCN 1003
Indianapolis, Indiana 46204-2251

The Registrant shall implement the PMPs.

(b) A copy of the PMPs shall be submitted to IDEM, OAQ upon request and within a reasonable time, and shall be subject to review and approval by IDEM, OAQ. IDEM, OAQ may require the Registrant to revise its PMPs whenever lack of proper maintenance causes or is the primary contributor to an exceedance of any limitation on emissions.

(c) To the extent the Registrant is required by 40 CFR Part 60 or 40 CFR Part 63 to have an Operation Maintenance, and Monitoring (OMM) Plan for a unit, such OMM Plan is deemed to satisfy the PMP requirements of 326 IAC 1-6-3 for that unit.

SECTION C **SOURCE OPERATION CONDITIONS**

Entire Source

Emission Limitations and Standards [326 IAC 2-5.1-2(g)] [326 IAC 2-5.5-4(b)]

C.1 Opacity [326 IAC 5-1]

Pursuant to 326 IAC 5-1-2 (Opacity Limitations), except as provided in 326 IAC 5-1-1 (Applicability) and 326 IAC 5-1-3 (Temporary Alternative Opacity Limitations), opacity shall meet the following, unless otherwise stated in this registration:

(a) Opacity shall not exceed an average of forty percent (40%) in any one (1) six (6) minute averaging period as determined in 326 IAC 5-1-4.

(b) Opacity shall not exceed sixty percent (60%) for more than a cumulative total of fifteen (15) minutes (sixty (60) readings as measured according to 40 CFR 60, Appendix A, Method 9 or fifteen (15) one (1) minute nonoverlapping integrated averages for a continuous opacity monitor) in a six (6) hour period.

C.2 Fugitive Dust Emissions [326 IAC 6-4]

The Registrant shall not allow fugitive dust to escape beyond the property line or boundaries of the property, right-of-way, or easement on which the source is located, in a manner that would violate 326 IAC 6-4 (Fugitive Dust Emissions).

SECTION D.1 EMISSION UNIT OPERATION CONDITIONS

Emission Unit Description:

(t) Indirect natural gas-fired combustion sources with heat input equal to or less than ten (10) million Btu per hour, consisting of the following space heaters:

Facility	Construction Date	Operating Capacity (MMBtu/hr)
Natural Gas-Fired Heater AHU1, AHU3, AHU5, AHU6	Assumed 1984	0.40, each
18 Natural Gas-Fired Heaters, 1A, 4A-8A, 10A-13A, 1B-3B, 10B-14B		0.170, each
2 Natural Gas-Fired Heaters, 3A, 4B		0.060, each
3 Natural Gas-Fired Tube Heaters	2024	0.05, each
2 Natural Gas-Fired Heaters	2024	0.08, each
1 Natural Gas-Fired Heater	2024	0.12, each

(The information describing the process contained in this emissions unit description box is descriptive information and does not constitute enforceable conditions.)

Emission Limitations and Standards [326 IAC 2-5.1-2(f)(1)] [326 IAC 2-5.5-4(a)(1)]

D.1.1 Particulate Emissions [326 IAC 6-2-4]

Pursuant to 326 IAC 6-2-4 (Particulate Emission Limitations for Sources of Indirect Heating), PM emissions from the thirty (30) natural gas-fired heaters shall be limited to 0.6 pounds per MMBtu heat input.

D.1.2 Preventive Maintenance Plan [326 IAC 1-6-3]

A Preventive Maintenance Plan is required for this facility and its control device. Section B - Preventive Maintenance Plan contains the Registrant's obligation with regard to the preventive maintenance plan required by this condition.

SECTION E.1 **NESHAP**

Emission Unit Description:

(aa) One (1) stationary 208 hp, diesel-fired emergency fire pump engine, identified as Pump1, with a displacement of 5.9 liters, installed in 1984 and modified in 2004.

Under 40 CFR 63, Subpart ZZZZ, this unit is considered an affected facility.

(bb) One (1) four stroke lean burn spark ignition natural gas-fired emergency backup electric generator engine, identified as Generator1, constructed in 1984, with a maximum capacity of 0.125 megawatts and 187 horsepower, and exhausting to stack Gen1.

Under 40 CFR 63, Subpart ZZZZ, this unit is considered an affected facility.

(The information describing the process contained in this facility description box is descriptive information and does not constitute enforceable conditions.)

E.1.1 General Provisions Relating to National Emission Standards for Hazardous Air Pollutants under 40 CFR Part 63 [326 IAC 20-1] [40 CFR Part 63, Subpart A]

(a) Pursuant to 40 CFR 63.1 the Registrant shall comply with the provisions of 40 CFR Part 63, Subpart A – General Provisions, which are incorporated by reference as 326 IAC 20-1, for the emission unit(s) listed above, except as otherwise specified in 40 CFR Part 63, Subpart ZZZZ.

(b) Pursuant to 40 CFR 63.10, the Registrant shall submit all required notifications and reports to:

Indiana Department of Environmental Management
Compliance and Enforcement Branch, Office of Air Quality
100 North Senate Avenue
MC 61-53 IGCN 1003
Indianapolis, Indiana 46204-2251

and

United States Environmental Protection Agency, Region 5
Air and Radiation Division, Air Enforcement Branch - Indiana (AE-17J)
77 West Jackson Boulevard
Chicago, Illinois 60604-3590

E.1.2 Stationary Reciprocating Internal Combustion Engines NESHAP [40 CFR Part 63, Subpart ZZZZ] [326 IAC 20-82]

The Registrant shall comply with the following provisions of 40 CFR Part 63, Subpart ZZZZ (included as Attachment A to the registration), which are incorporated by reference as 326 IAC 20-82:

(a) The one (1) stationary 208 hp, diesel-fired emergency fire pump engine, identified as Pump1:

(1) 40 CFR 63.6580
(2) 40 CFR 63.6585
(3) 40 CFR 63.6590(a)(1)(iii) and (iv)
(4) 40 CFR 63.6595(a)(1), (b), and (c)
(5) 40 CFR 63.6603(a)
(6) 40 CFR 63.6605

(7) 40 CFR 63.6625(e)(3), (f), (h), and (i)
(8) 40 CFR 63.6635
(9) 40 CFR 63.6640(a), (b), (e), (f)(1), (f)(2)(i), and (f)(4)
(10) 40 CFR 63.6645(a)(5)
(11) 40 CFR 63.6650
(12) 40 CFR 63.6655
(13) 40 CFR 63.6660
(14) 40 CFR 63.6665
(15) 40 CFR 63.6670
(16) 40 CFR 63.6675
(17) Table 2d (item 4)
(18) Table 6 (item 9)
(19) Table 8

(b) The one (1) four stroke lean burn spark ignition natural gas-fired emergency backup electric generator engine, identified as Generator1:

(1) 40 CFR 63.6580
(2) 40 CFR 63.6585
(3) 40 CFR 63.6590(a)(1)(iii) and (iv)
(4) 40 CFR 63.6595(a)(1), (b), and (c)
(5) 40 CFR 63.6603(a)
(6) 40 CFR 63.6605
(7) 40 CFR 63.6625(e)(3), (f), (h), and (j)
(8) 40 CFR 63.6635
(9) 40 CFR 63.6640(a), (b), (e), (f)(1), (f)(2)(i), (f)(3), and (f)(4)
(10) 40 CFR 63.6645(a)(5)
(11) 40 CFR 63.6650
(12) 40 CFR 63.6655
(13) 40 CFR 63.6660
(14) 40 CFR 63.6665
(15) 40 CFR 63.6670
(16) 40 CFR 63.6675
(17) Table 2d (item 5)
(18) Table 6 (item 9)
(19) Table 8

INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR QUALITY
COMPLIANCE AND ENFORCEMENT BRANCH

REGISTRATION
ANNUAL NOTIFICATION

This form should be used to comply with the notification requirements under 326 IAC 2-5.1-2(f)(3) and 326 IAC 2-5.5-4(a)(3).

Company Name:	Spartech LLC The Jordan Company
Source Address:	1401 East Memorial Drive
City:	Muncie, Indiana, 47302
Phone Number:	(765) 281-5120
Registration No.:	R035-47764-00078

I hereby certify that Spartech LLC The Jordan Company is:

☐ still in operation.

☐ no longer in operation.

I hereby certify that Spartech LLC The Jordan Company is:

☐ in compliance with the requirements of Registration No. R035-47764-00078.

☐ not in compliance with the requirements of Registration No. R035-47764-00078.

Authorized Individual (typed):	
Title:	
Signature:	**Date:**
Email Address:	**Phone:**

If there are any conditions or requirements for which the source is not in compliance, provide a narrative description of how the source did or will achieve compliance and the date compliance was, or will be achieved.

Noncompliance:

Indiana Department of Environmental Management
Office of Air Quality

Technical Support Document (TSD) for a MSOP Transitioning to a Registration

Source Description and Location

Source Name:	**Spartech LLC The Jordan Company**
Source Location:	**1401 East Memorial Drive, Muncie, Indiana 47302**
County:	**Delaware**
SIC Code:	**2821 (Plastics Material, Synthetic Resins, & Nonvulcanized Elastomers)**
Registration No.:	**R 035-47764-00078**
Permit Reviewer:	**Kristen Squillace**

On April 23, 2024, the Office of Air Quality (OAQ) received an application from Spartech LLC The Jordan Company related to the construction and operation of new emission units at an existing stationary plastic sheet and molded plastics plant and transition from a MSOP to a Registration.

Existing Approvals

The source has been operating under previous approvals including, but not limited to, the following:

(a) MSOP Renewal No. 035-43766-00078, issued on July 13, 2021.

Due to this application, the source is transitioning from a MSOP to a Registration.

County Attainment Status

The source is located in Delaware County.

Pursuant to amendments to Indiana Code IC 13-17-3-14, effective July 1, 2023, a federal regulation that classifies or amends a designation of attainment, nonattainment, or unclassifiable for any area in Indiana under the federal Clean Air Act is effective and enforceable in Indiana on the effective date of the federal regulation.

Pollutant	Designation
SO_2	Unclassifiable or attainment effective April 9, 2018, for the 2010 primary 1-hour SO_2 standard. Better than national secondary standards effective March 3, 1978.
CO	Unclassifiable or attainment effective November 15, 1990.
O_3	Unclassifiable or attainment effective January 16, 2018, for the 2015 8-hour ozone standard.
$PM_{2.5}$	Unclassifiable or attainment effective April 15, 2015, for the 2012 annual $PM_{2.5}$ standard.
$PM_{2.5}$	Unclassifiable or attainment effective December 13, 2009, for the 2006 24-hour $PM_{2.5}$ standard.
PM_{10}	Unclassifiable effective November 15, 1990.
NO_2	Unclassifiable or attainment effective January 29, 2012, for the 2010 NO_2 standard.
Pb	Attainment effective May 15, 2020, for a portion of the city of Muncie, Indiana bounded to the north by West 26th Street/Hines Road, to the east by Cowan Road, to the south by West Fuson Road, and to the west by a line running south from the eastern edge of Victory Temple's driveway to South Hoyt Avenue and then along South Hoyt Avenue. Unclassifiable or attainment effective December 31, 2011, for the remainder of the county.

(a) Ozone Standards
Volatile organic compounds (VOC) and Nitrogen Oxides (NO_x) are regulated under the Clean Air Act (CAA) for the purposes of attaining and maintaining the National Ambient Air Quality Standards (NAAQS) for ozone. Therefore, VOC and NO_x emissions are considered when evaluating the rule applicability relating to ozone. Delaware County has been designated as attainment or unclassifiable for ozone. Therefore, VOC and NO_x emissions were reviewed pursuant to the requirements of Prevention of Significant Deterioration (PSD), 326 IAC 2-2.

(b) $PM_{2.5}$
Delaware County has been classified as attainment for $PM_{2.5}$. Therefore, direct $PM_{2.5}$, SO_2, and NOx emissions were reviewed pursuant to the requirements of Prevention of Significant Deterioration (PSD), 326 IAC 2-2.

(c) Other Criteria Pollutants
Delaware County has been classified as attainment or unclassifiable in Indiana for all the other criteria pollutants. Therefore, these emissions were reviewed pursuant to the requirements for Prevention of Significant Deterioration (PSD), 326 IAC 2-2.

Fugitive Emissions

The fugitive emissions of regulated air pollutants and hazardous air pollutants (HAP) are counted toward the determination of Registration (326 IAC 2-5.1-5) applicability and source status under Section 112 of the Clean Air Act (CAA).

Greenhouse Gas (GHG) Emissions

On June 23, 2014, in the case of *Utility Air Regulatory Group v. EPA*, cause no. 12-1146, (available at http://www.supremecourt.gov/opinions/13pdf/12-1146_4g18.pdf) the United States Supreme Court ruled that the U.S. EPA does not have the authority to treat greenhouse gases (GHGs) as an air pollutant for the purpose of determining operating permit applicability or PSD Major source status. On July 24, 2014, the U.S. EPA issued a memorandum to the Regional Administrators outlining next steps in permitting decisions in light of the Supreme Court's decision. U.S. EPA's guidance states that U.S. EPA will no longer require PSD or Title V permits for sources "previously classified as 'Major' based solely on greenhouse gas emissions."

The Indiana Environmental Rules Board adopted the GHG regulations required by U.S. EPA at 326 IAC 2-2-1(zz), pursuant to Ind. Code § 13-14-9-8(h) (Section 8 rulemaking). A rule, or part of a rule, adopted under Section 8 is automatically invalidated when the corresponding federal rule, or part of the rule, is invalidated. Due to the United States Supreme Court Ruling, IDEM, OAQ cannot consider GHG emissions to determine operating permit applicability or PSD applicability to a source or modification.

Background and Description of Emission Units and Pollution Control Equipment

The Office of Air Quality (OAQ) has reviewed an application, submitted by Spartech LLC The Jordan Company on April 23, 2024, relating to the addition and removal of several emission units and the change in calculations for the coextruder lines which transitions the source from a MSOP to a Registration.

The source consists of the following existing emission unit(s):

(a) One (1) railcar unloading operation, identified as RRUL2, consisting of a pneumatic material transfer system, constructed in 2017, with a maximum capacity of 11,883 pounds per hour.

(b) Twelve (12) silos, identified as Silo A through Silo L, constructed in 1984, for storing plastic pellets, each with a maximum throughput of 0.5 tons per hour, using no controls, and venting outside the building.

(c) Three (3) silos, identified as Silo M through Silo O, constructed in 2017, for storing plastic pellets, each with a maximum throughput of 0.5 tons per hour, using no controls, and venting outside the building.

(d) Twenty-three (23) pneumatic conveyors for transporting plastic pellets or regrind from the silos, surge bins or containers to the coextruder input feed for processing, with a maximum capacity of 1,000 pounds per hour, each, with particulate emissions controlled with integral bin vent filters, and venting inside or outside the building.

(e) Two (2) pneumatic conveyors for transporting plastic pellets or regrind from the silos, surge bins, or containers to the coextruder input feed for processing, constructed in 2017, with a maximum capacity of 1,000 pounds per hour, each, with particulate emissions controlled with bin vent filters, and venting inside or outside the building.

(f) Six (6) pneumatic conveyors for transporting plastic pellets or regrind from the silos, surge bins, or containers to the coextruder input feed for processing, constructed in 2017, with a maximum capacity of 5,000 pounds per hour, each, with particulate emissions controlled with bin vent filters, and venting inside or outside the building.

(f) Eight (8) coextruder lines for extruding multiple layers of plastic sheeting, with no particulate or VOC emission controls.

Emission Unit ID	Maximum Throughput Rate (lbs/hour)	Construction Date	Modified Date	Vent ID
COEX1	3,800	1984	2024	COEX1
COEX2	3,000	1987	2024	COEX2
COEX3	2,400	1994	2024	COEX3
COEX4	3,000	2011	2024	COEX4
COEX5	3,465	2005	2024	COEX5
COEX6	3,500	2018	2024	COEX6
COEX7	1,000	2024	-	COEX7
COEX8	2,300	2024	-	COEX8

(g) Eight (8) granulators for grinding scrap plastic (regrind) from coextruder lines, with regrind pneumatically conveyed to surge bins, with particulate emissions controlled with bin vent filters, and venting inside or outside the building.

Emission Unit ID	Maximum Throughput Rate (lbs/hour)	Construction Date	Modified Date
COEXG1	380	1984	2024
COEXG2	300	1987	2024
COEXG3	240	1994	2024
COEXG4	300	2011	2024
COEXG5	480	2005	2024
COEXG6	360	2018	2024
COEXG7	100	2024	-
COEXG8	240	2024	-

(i) Five (5) thermoformers, using electric heating elements to re-form plastic products, using no controls, and venting inside the building.

Emission Unit ID	Maximum Throughput Rate (lbs/hour)	Construction Date
F5	291	2007
F6	1,125	2010
F7	1,125	2011
F8	1,403	2017
F11	2,800	2017

(j) Six (6) granulators for grinding scrap plastic from thermoformer lines, with regrind pneumatically conveyed to surge bins, with particulate emissions controlled with bin vent filters, and venting inside the building.

Emission Unit ID	Maximum Throughput Rate (lbs/hour)	Construction Date
FG5	250	2007
FG6A	502	2010
FG7	502	2011
FG8A	502	2017
FG11A	700	2017
FG11B	700	2017

(k) One (1) Slitter/Trimmer/Rewinder, identified as SR1, constructed in ~~1985~~2023, with a maximum regrinding capacity of 2~~1~~,000 pounds of plastic product per hour, with trimmings pneumatically conveyed to the granulators, and venting inside the building.

(l) One enclosed granulator, identified as G1, constructed in 2010, with a maximum capacity of 2,500 pounds per hour, using no control and venting inside the building.

(m) One (1) enclosed Granulator, identified G2, constructed in 1984, with a maximum regrinding capacity of 2,000 pounds of plastic waste per hour, with regrind pneumatically conveyed to surge bins, with particulate emissions controlled by a bin vent filter and venting inside the building.

(n) Two (2) enclosed granulators, identified as G3 and G4, constructed in 2017, each with a maximum capacity of 2,500 pounder per hour, using no control and venting inside the building.

(o) Indirect natural gas-fired combustion sources with heat input equal to or less than ten (10) million Btu per hour, consisting of the following space heaters:

Facility	Construction Date	Operating Capacity (MMBtu/hr)
Natural Gas-Fired Heater AHU1, AHU3, AHU5, AHU6	Assumed 1984	0.40, each
18 Natural Gas-Fired Heaters, 1A, 4A-8A, 10A-13A, 1B-3B, 10B-14B		0.170, each
2 Natural Gas-Fired Heaters, 3A, 4B		0.060, each

(p) Two (2) natural gas-fired crystallizer units, identified as CR1 and CR2, constructed in 2017 and 2018, respectively, with a maximum capacity of 0.597 MMBtu/hr and 0.895 MMBtu/hr, respectively,

(q) Two (2) natural gas-fired, dryer units, identified as DR1 and DR2, constructed in 2017 and 2018, respectively, each with a maximum capacity of 0.331 MMBtu/hr and a maximum throughput of 3,000 pounds per hour for both.

(r) One (1) printer, identified as P4, constructed in 2007, with a maximum printing capacity of 25,200 parts (1,050 square feet of plastic) per hour, using a 0.078 MMBtu per hour direct natural gas flame preheater, applying UV inks and using a light cure process, using no controls and venting to stack P4.

(s) One (1) printer ink roll hand-cleaning operation, identified as Roll Cleaner, using a maximum of 270 gallons of cleaner a year.

(t) One (1) parts cleaning unit, identified as Aqueous Parts Tub1, using aqueous cleaners containing less than 1% VOC.

(u) One (1) parts cleaning unit, identified as Aqueous Parts Tub 2, using aqueous cleaners containing less than 1% VOC.

(v) One (1) stationary 208 hp, diesel-fired emergency fire pump engine, identified as Pump1, with a displacement of 5.9 liters, installed in 1984 and modified in 2004.

Under 40 CFR 63, Subpart ZZZZ, this unit is considered an affected facility.

(w) One (1) four stroke lean burn spark ignition natural gas-fired emergency backup electric generator engine, identified as Generator1, constructed in 1984, with a maximum capacity of 0.125 megawatts and 187 horsepower, and exhausting to stack Gen1.

Under 40 CFR 63, Subpart ZZZZ, this unit is considered an affected facility.

(x) Paved roads and parking lots with public access.

(y) Noncontact cooling tower systems with either of the following:

(1) Natural draft cooling towers not regulated under a NESHAP, or

(2) Forced and induced draft cooling tower systems not regulated under a NESHAP.

(z) Two (2) vacuum-sealed electric burnout units, identified as Burnout 1 and Burnout 2, for melting plastic off machine parts in a sealed chamber under vacuum, using no controls and exhausting inside the building, and having no emissions.

(aa) VOC and HAP storage containers, consisting of vessels storing lubricating oils, hydraulic oils, machining oils, or machining fluids.

(bb) Production related activities, including the application of oils, greases, lubricants, and/or nonvolatile material, as temporary protective coatings.

(cc) Closed loop heating and cooling systems.

(dd) Exposure chambers (towers or columns), for curing of ultraviolet inks and ultraviolet coatings where heat is the intended discharge.

(ee) Replacement or repair of electrostatic precipitators, bags in baghouses, and filters in other air filtration equipment.

(ff) Heat exchanger cleaning and repair.

(gg) Routine maintenance and repair of buildings, structures, or vehicles at the source where air emissions from those activities would not be associated with any production process, including purging of gas lines and/or purging of vessels.

(hh) Blowdown for the following: sight glass, boiler, cooling tower, compressors and/or pumps.

The following is a list of the new and modified emission units and pollution control device(s):

(a) One (1) railcar unloading operation, identified as RRUL1, constructed in 1984, approved for modification in 2024, consisting of a pneumatic material transfer system, with a maximum throughput capacity of 20,000 pounds of plastic pellets per hour, and with plastic pellets conveyed pneumatically to silos.

(b) One (1) railcar unloading operation, identified as RRUL3, approved for construction in 2024, consisting of a pneumatic material transfer system, with a maximum throughput capacity of 30,000 lbs of plastic pellets per hour, with plastic pellets conveyed pneumatically to silos.

(c) One (1) railcar unloading operation, identified as RRUL4, approved for construction in 2024, consisting of a pneumatic material transfer system, with a maximum throughput capacity of 30,0000 lbs of plastic pellets per hour, with plastic pellets conveyed pneumatically to silos.

(d) One (1) silo, identified as Silo P, approved for construction in 2024, for storing plastic pellets, with a maximum throughput of 0.5 tons per hour, using no controls, and venting outside the building.

(e) Five (5) pneumatic conveyors for transporting plastic pellets or regrind from the silos, surge bins or containers to the coextruder input feed for processing, approved for construction in 2024, with a maximum capacity of 1,000 pound per hour, each, using bin vents as control, and venting outside the building.

(f) Indirect natural gas-fired combustion sources with heat input equal to or less than ten (10) MMBtu per hour, consisting of the following space heaters:

Facility	Construction Date	Operating Capacity (MMBtu/hr)
3 Natural Gas-Fired Tube Heaters	2024	0.05, each
2 Natural Gas-Fired Heaters	2024	0.08, each
1 Natural Gas-Fired Heater	2024	0.12, each

(g) Eight (8) coextruder lines for extruding multiple layers of plastic sheeting, with no particulate or VOC emission controls.

Emission Unit ID	Maximum Throughput Rate (lbs/hour)	Construction Date	Modified Date	Vent ID
COEX1	3,800	1984	2024	COEX1
COEX2	3,000	1987	2024	COEX2
COEX3	2,400	1994	2024	COEX3
COEX4	3,000	2011	2024	COEX4
COEX5	3,465	2005	2024	COEX5
COEX6	3,500	2018	2024	COEX6
COEX7	1,000	2024	-	COEX7
COEX8	2,300	2024	-	COEX8

(h) Eight (8) granulators for grinding scrap plastic (regrind) from coextruder lines, with regrind pneumatically conveyed to surge bins, with particulate emissions controlled with bin vent filters, and venting inside or outside the building.

Emission Unit ID	Maximum Throughput Rate (lbs/hour)	Construction Date	Modified Date
COEXG1	380	1984	2024
COEXG2	300	1987	2024
COEXG3	240	1994	2024
COEXG4	300	2011	2024
COEXG5	480	2005	2024
COEXG6	360	2018	2024
COEXG7	100	2024	-
COEXG8	240	2024	-

(i) One (1) enclosed granulator, identified as G5, approved for construction in 2024, each with a maximum capacity of 2,500 pounder per hour, using no control and venting inside the building.

As part of this permitting action, the following emission units are being removed from the permit:

(a) Four (4) thermoformers, using electric heating elements to re-form plastic products, using no controls, and venting inside the building.

Emission Unit ID	Maximum Throughput Rate (lbs/hour)	Construction Date
F3	291	2007
F9	1,125	2017
F10	450	2017
F12	275	2017

(b) Six (6) granulators for grinding scrap plastic from thermoformer lines, with regrind pneumatically conveyed to surge bins, with particulate emissions controlled with bin vent filters, and venting inside the building.

Emission Unit ID	Maximum Throughput Rate (lbs/hour)	Construction Date
FG3	247	2007
FG9A	700	2017
FG9B	700	2017
FG10	700	2017
FG12	700	2017
FG14	700	2017

(c) Indirect natural gas-fired combustion sources with heat input equal to or less than ten (10) million Btu per hour, consisting of the following space heaters:

Facility	Construction Date	Operating Capacity (MMBtu/hr)
Natural Gas-Fired Heater MAM1	Assumed 1984	0.51
Natural Gas-Fired Heater MAM2-MAM4		0.56, each
6 Natural Gas-Fired Heaters, 9A, 5B-9B		0.30, each
6 Natural Gas-Fired HVAC Units, HVAC1, HVAC3, HVAC5-6, HAVC8, HVAC32		0.695, each
4 Natural Gas-Fired Heaters 15B-18B		0.20, each

(d) Machining where an aqueous cutting coolant continuously floods the machining interface.

Enforcement Issues

There are no pending enforcement actions related to this source.

Emission Calculations

See Appendix A of this Technical Support Document for detailed emission calculations.

Permit Level Determination –Registration

This table reflects the unrestricted potential emissions of the source. If the control equipment has been determined to be integral, the table reflects the potential to emit (PTE) after consideration of the integral control device.

	Unrestricted Source-Wide Emissions (ton/year)								
	PM[1]	PM_{10}[1]	$PM_{2.5}$[1, 2]	SO_2	NO_X	VOC	CO	Single HAP[3]	Total HAPs
Total PTE of Entire Source Including Source-Wide Fugitives	15.63	15.08	14.94	0.13	6.14	18.28	3.14	0.47	0.56
Exemptions Levels	< 5	< 5	< 5	< 10	< 10	< 10	< 25	< 10	< 25
Registration Levels	< 25	< 25	< 25	< 25	< 25	< 25	< 100	< 10	< 25

[1]Under the Part 70 Permit program (40 CFR 70), PM_{10} and $PM_{2.5}$, not particulate matter (PM), are each considered as a "regulated air pollutant."
[2]$PM_{2.5}$ listed is direct $PM_{2.5}$.
[3]Single highest source-wide HAP.
The bin vent filters for the twenty-three (23) pneumatic conveyors are considered integral.

(a) The potential to emit (as defined in 326 IAC 2-1.1-1) of PM, PM10, PM2.5, and VOC are each within the ranges listed in 326 IAC 2-5.5-1(b)(1). The potential to emit of all other regulated air pollutants are less than the ranges listed in 326 IAC 2-5.5-1(b)(1). Therefore, the source is subject to the provisions of 326 IAC 2-5.5 (Registrations). The source will be issued a Registration.

(b) The potential to emit (as defined in 326 IAC 2-1.1-1) of any single HAP is less than ten (10) tons per year and the potential to emit (as defined in 326 IAC 2-1.1-1) of a combination of HAPs is less than twenty-five (25) tons per year. Therefore, this source is an area source under Section 112 of the Clean Air Act (CAA) and not subject to the provisions of 326 IAC 2-7.

Federal Rule Applicability Determination

Federal rule applicability for this source has been reviewed as follows:

New Source Performance Standards (NSPS):

(a) The requirements of the New Source Performance Standard for Incinerators, 40 CFR 60, Subpart E and 326 IAC 12, are not included in the registration for the two (2) vacuum-sealed electric burnout units, identified as Burnout 1 and Burnout 2, because they do not meet the definition of an incinerator as defined in 40 CFR 60.51(a). The burnout units melt plastic which does not meet the definition of a solid waste as defined in 40 CFR 60.51(b).

(b) The requirements of the New Source Performance Standard for Commercial and Industrial Solid Waste Incineration Units, 40 CFR 60, Subpart CCCC and 326 IAC 12, are not included in the registration for the two (2) vacuum-sealed electric burnout units, identified as Burnout 1 and Burnout 2, because they do not burn commercial or industrial solid waste as defined in 40 CFR 241.2.

(c) The requirements of the New Source Performance Standard for Other Waste Incineration Units for Which Construction is Commenced After December 9, 2004, or for Which Modification or Reconstruction is Commenced on or After June 16, 2006, 40 CFR 60, Subpart EEEE and 326 IAC 12, are not included in the registration for the two (2) vacuum-sealed electric burnout units, identified as Burnout 1 and Burnout 2, because they are not very small municipal waste combustion units or institutional waste incineration units.

(d) The requirements of the New Source Performance Standard for Stationary Compression Ignition Internal Combustion Engines, 40 CFR 60, Subpart IIII and 326 IAC 12, are not included in the registration for the one (1) diesel-fired fire pump engine, identified as Pump 1, because it was constructed and modified before July 11, 2005.

(e) The requirements of the New Source Performance Standard for Stationary Spark Ignition Internal Combustion Engines, 40 CFR 60, Subpart JJJJ and 326 IAC 12, are not included in the registration for the one (1) four stroke lean burn spark ignition natural gas-fired emergency backup electric generator engine, identified as Generator1, because it was constructed prior to January 1, 2009.

(f) The requirements of the New Source Performance Standard for the Graphic Arts Industry: Publication Rotogravure Printing, 40 CFR 60, Subpart QQ and 326 IAC 12, are not included in the registration for the one (1) printer, identified as P4, because it is not a rotogravure printing press as defined in 40 CFR 60.431(a).

(g) The requirements of the New Source Performance Standard for Flexible Vinyl and Urethane Coating and Printing, 40 CFR 60, Subpart FFFF and 326 IAC 12, are not included in the registration for the one (1) printer, identified as P4, because it is not a rotogravure print station as defined in 40 CFR 60.581(a).

(h) There are no other New Source Performance Standards (40 CFR Part 60) and 326 IAC 12 included in the registration.

National Emission Standards for Hazardous Air Pollutants (NESHAP):

(i) The requirements of the National Emission Standards for Hazardous Air Pollutants (NESHAPs) for the Printing and Publishing Industry, 40 CFR 63, Subpart KK and 326 IAC 20-18, are not included in the registration for the one (1) printer, identified as P4, since it does not meet the definition of a publication rotogravure press, product and packaging rotogravure press, or wide-web flexographic printing press as defined in 40 CFR 63.822(a).

(j) The requirements of the National Emission Standards for Hazardous Air Pollutants (NESHAPs) for Paper and Other Web Coating, 40 CFR 63, Subpart JJJJ and 326 IAC 20-65, are not included in the registration for the one (1) printer, identified as P4, since it does not meet the definition of a web coating line as defined in 40 CFR 63.3310.

(k) The requirements of the National Emission Standards for Hazardous Air Pollutants (NESHAPs) for Halogenated Solvent Cleaning, 40 CFR 63, Subpart T and 326 IAC 20-6, are not included in the registration for the two (2) parts cleaning units, identified as Aqueous Parts Tub 1 and Aqueous Parts Tub 2, and the one (1) printer ink roll hand-cleaning operation, identified as Roll Cleaner, since they do not use a solvent that contains methylene chloride, perchloroethylene, trichloroethylene, 1,1,1-trichloroethane, carbon tetrachloride or chloroform, or any combination of these halogenated HAP solvents, in a total concentration greater than 5 percent by weight, as a cleaning and/or drying agent.

(l) The requirements of the National Emission Standards for Hazardous Air Pollutants (NESHAPs) for Surface Coating of Plastic Parts and Products, 40 CFR 63, Subpart PPPP and 326 IAC 20-81, are not included in the registration for the one (1) printer, identified as P4, since it does not use a coating that contains hazardous air pollutants (HAP) in the surface coating of plastic parts and products.

(m) The requirements of the National Emission Standards for Hazardous Air Pollutants (NESHAPs) for Industrial Process Cooling Towers, 40 CFR 63, Subpart Q and 326 IAC 20-4, are not included in the registration for the noncontact cooling tower systems, since they are not operated with chromium-based water treatment chemicals.

(n) The one (1) stationary 208 hp, diesel-fired emergency fire pump engine, identified as Pump1, and one (1) four stroke lean burn spark ignition natural gas-fired emergency backup electric generator engine, identified as Generator1, (187 HP) is subject the requirements of the 40 CFR 63, Subpart ZZZZ, National Emission Standards for Hazardous Air Pollutants (NESHAP) for Stationary Reciprocating Internal Combustion Engines (326 IAC 20-82), because they are considered an existing stationary reciprocating internal combustion engine (RICE) (construction commenced before June 12, 2006) at an area source of hazardous air pollutants (HAP). Construction of the one (1) stationary 208 hp, diesel-fired fire pump engine, identified as Pump1, commenced in 1984. Construction and modification of the one (1) four stroke lean burn spark ignition natural gas-fired emergency backup electric generator engine, identified as Generator1, commenced in 1984 and 2004.

The one (1) stationary 208 hp, diesel-fired emergency fire pump engine, identified as Pump1, is subject to the following portions of Subpart ZZZZ:

(1) 40 CFR 63.6580
(2) 40 CFR 63.6585
(3) 40 CFR 63.6590(a)(1)(iii) and (iv)
(4) 40 CFR 63.6595(a)(1), (b), and (c)
(5) 40 CFR 63.6603(a)
(6) 40 CFR 63.6605
(7) 40 CFR 63.6625(e)(3), (f), (h), and (i)
(8) 40 CFR 63.6635
(9) 40 CFR 63.6640(a), (b), (e), (f)(1), (f)(2)(i), and (f)(4)
(10) 40 CFR 63.6645(a)(5)
(11) 40 CFR 63.6650
(12) 40 CFR 63.6655
(13) 40 CFR 63.6660
(14) 40 CFR 63.6665
(15) 40 CFR 63.6670
(16) 40 CFR 63.6675
(17) Table 2d (item 4)
(18) Table 6 (item 9)
(19) Table 8

Note: Existing non-emergency compression ignition (CI) stationary RICE that have a site rating less than or equal to 300 brake horsepower (HP) and are located at an area source of HAP are not subject to numerical CO or formaldehyde emission limitations, but are only subject to work and management practices under Table 2d and Table 6.

The one (1) four stroke lean burn spark ignition natural gas-fired emergency backup electric generator engine, identified as Generator1, is subject to the following portions of Subpart ZZZZ:

(1) 40 CFR 63.6580
(2) 40 CFR 63.6585
(3) 40 CFR 63.6590(a)(1)(iii) and (iv)
(4) 40 CFR 63.6595(a)(1), (b), and (c)
(5) 40 CFR 63.6603(a)
(6) 40 CFR 63.6605
(7) 40 CFR 63.6625(e)(3), (f), (h), and (j)
(8) 40 CFR 63.6635
(9) 40 CFR 63.6640(a), (b), (e), (f)(1), (f)(2)(i), (f)(3), and (f)(4)
(10) 40 CFR 63.6645(a)(5)
(11) 40 CFR 63.6650
(12) 40 CFR 63.6655
(13) 40 CFR 63.6660
(14) 40 CFR 63.6665

(15) 40 CFR 63.6670
(16) 40 CFR 63.6675
(17) Table 2d (item 5)
(18) Table 6 (item 9)
(19) Table 8

Note: Existing emergency spark ignition (SI) stationary RICE located at an area source of HAP are not subject to numerical CO or formaldehyde emission limitations, but are only subject to work and management practices under Table 2d and Table 6.

The requirements of 40 CFR Part 63, Subpart A – General Provisions, which are incorporated as 326 IAC 20-1, apply to the one (1) stationary 208 hp, diesel-fired fire pump engine, identified as Pump1, and the one (1) four stroke lean burn spark ignition natural gas-fired emergency backup electric generator engine, identified as Generator1, except as otherwise specified in 40 CFR 63, Subpart ZZZZ.

(o) There are no other National Emission Standards for Hazardous Air Pollutants under 40 CFR 63, 326 IAC 14 and 326 IAC 20 included in the registration.

Compliance Assurance Monitoring (CAM):

Pursuant to 40 CFR 64.2, Compliance Assurance Monitoring (CAM) is not included in the registration, because the unlimited potential to emit of the source is less than the Title V major source thresholds and the source is not required to obtain a Part 70 or Part 71 permit.

State Rule Applicability - Entire Source

State rule applicability for this source has been reviewed as follows:

326 IAC 2-5.5 (Registrations)
Registration applicability is discussed under the Permit Level Determination – Registration section above.

326 IAC 2-4.1 (Major Sources of Hazardous Air Pollutants (HAP))
The operation of this source will emit less than ten (10) tons per year for a single HAP and less than twenty-five (25) tons per year for a combination of HAPs. Therefore, 326 IAC 2-4.1 does not apply.

326 IAC 2-6 (Emission Reporting)
This source is not subject to 326 IAC 2-6 (Emission Reporting), because it is not required to have an operating permit pursuant to 326 IAC 2-7 (Part 70), it is not located in Lake or Porter County, and its potential to emit lead is less than 5 tons per year. Therefore, this rule does not apply.

326 IAC 5-1 (Opacity Limitations)
Pursuant to 326 IAC 5-1-2 (Opacity Limitations), except as provided in 326 IAC 5-1-3 (Temporary Alternative Opacity Limitations), opacity shall meet the following, unless otherwise stated in the registration:

(1) Opacity shall not exceed an average of forty percent (40%) in any one (1) six (6) minute averaging period as determined in 326 IAC 5-1-4.

(2) Opacity shall not exceed sixty percent (60%) for more than a cumulative total of fifteen (15) minutes (sixty (60) readings as measured according to 40 CFR 60, Appendix A, Method 9 or fifteen (15) one (1) minute nonoverlapping integrated averages for a continuous opacity monitor) in a six (6) hour period.

326 IAC 6-4 (Fugitive Dust Emissions Limitations)
The source is subject to the requirements of 326 IAC 6-4, because the paved roads and cooling towers have the potential to emit fugitive particulate emissions. Pursuant to 326 IAC 6-4 (Fugitive Dust

Emissions Limitations), the source shall not allow fugitive dust to escape beyond the property line or boundaries of the property, right-of-way, or easement on which the source is located, in a manner that would violate 326 IAC 6-4.

326 IAC 6-5 (Fugitive Particulate Matter Emission Limitations)
This source is not subject to the requirements of 326 IAC 6-5, because the source has potential fugitive particulate emissions of less than twenty-five (25) tons per year.

326 IAC 6.5 (Particulate Matter Limitations Except Lake County)
Pursuant to 326 IAC 6.5-1-1(a), this source (located in Delaware County) is not subject to the requirements of 326 IAC 6.5 because it is not located in one of the following counties: Clark, Dearborn, Dubois, Howard, Marion, St. Joseph, Vanderburgh, Vigo or Wayne.

326 IAC 6.8 (Particulate Matter Limitations for Lake County)
Pursuant to 326 IAC 6.8-1-1(a), this source (located in Delaware County) is not subject to the requirements of 326 IAC 6.8 because it is not located in Lake County.

326 IAC 6.8 (Lake County: Fugitive Particulate Matter)
Pursuant to 326 IAC 6.8-10-1, this source (located in Delaware County) is not subject to the requirements of 326 IAC 6.8-10 because it is not located in Lake County.

State Rule Applicability – Individual Facilities

State rule applicability for this source has been reviewed as follows:

<u>Railcar Unloading Operations (RRUL1 to RRUL4), Silos (A through P) and 36 Pneumatic Conveyors</u>

326 IAC 6-3-2 (Particulate Emission Limitations for Manufacturing Processes)
Pursuant to 326 IAC 6-3-1(b)(14), the Railcar Unloading Operations (RRUL1 to RRUL4), Silos (A through P) and 36 Pneumatic Conveyors are not subject to the requirements of 326 IAC 6-3, since they each are a manufacturing process with potential emissions less than five hundred fifty-one thousandths (0.551) pound per hour.

<u>Coextruders (COEX1 to COEX8)</u>

326 IAC 6-3-2 (Particulate Emission Limitations for Manufacturing Processes)
Pursuant to 326 IAC 6-3-1(b)(14), the coextruders, identified as COEX1 to COEX8, are not subject to the requirements of 326 IAC 6-3, since they each are a manufacturing process with potential emissions less than five hundred fifty-one thousandths (0.551) pound per hour.

326 IAC 8-1-6 (VOC Rules: General Reduction Requirements for New Facilities)
Even though, the coextruders, identified as COEX1 to COEX8, were constructed after January 1, 1980, they are not subject to the requirements of 326 IAC 8-1-6 because their unlimited VOC potential emissions are less than twenty-five (25) tons per year.

<u>Granulators (COEXG1 to COEXG8 and G1 to G5)</u>

326 IAC 6-3-2 (Particulate Emission Limitations for Manufacturing Processes)
Pursuant to 326 IAC 6-3-1(b)(14), the granulators, identified as COEXG1 to COEXG8 and G1 to G5, are not subject to the requirements of 326 IAC 6-3, since they each are a manufacturing process with potential emissions less than five hundred fifty-one thousandths (0.551) pound per hour.

Thermoformers (F5 to F8 and F11)

326 IAC 6-2-1 (Particulate Emission Limitations for Sources of Indirect Heating)
The requirements of 326 IAC 6-2 do not apply to the thermoformers, identified as F5 to F8 and F11, since they do not meet the definition of an indirect heating unit.

326 IAC 6-3-2 (Particulate Emission Limitations for Manufacturing Processes)
Pursuant to 326 IAC 6-3-1(b)(14), the thermoformers, identified as F5 to F8 and F11, are not subject to the requirements of 326 IAC 6-3, since they each are a manufacturing process with potential emissions less than five hundred fifty-one thousandths (0.551) pound per hour.

326 IAC 8-1-6 (VOC Rules: General Reduction Requirements for New Facilities)
Even though, the thermoformers, identified as F5 to F8 and F11, were constructed after January 1, 1980, they are not subject to the requirements of 326 IAC 8-1-6, because their unlimited VOC potential emissions are less than twenty-five (25) tons per year.

Thermoformer Granulators (FG5 to FG8, FG11A, and FG11B)

326 IAC 6-3-2 (Particulate Emission Limitations for Manufacturing Processes)
Pursuant to 326 IAC 6-3-1(b)(14), the thermoformer granulators, identified as FG5 to FG8, FG11A, and FG11B, are not subject to the requirements of 326 IAC 6-3, since they each are a manufacturing process with potential emissions less than five hundred fifty-one thousandths (0.551) pound per hour.

Slitter/Trimmer/Rewinder (SR1)

326 IAC 6-3-2 (Particulate Emission Limitations for Manufacturing Processes)
Pursuant to 326 IAC 6-3-1(b)(14), the slitter/trimmer/rewinder, identified as SR1, is not subject to the requirements of 326 IAC 6-3, since it is a manufacturing process with potential emissions less than five hundred fifty-one thousandths (0.551) pound per hour.

Natural Gas Combustion

326 IAC 6-2-4 (Particulate Matter Emission Limitations for Sources of Indirect Heating)
Pursuant to 326 IAC 6-2-1(d), indirect heating facilities which received permit to construct after September 21, 1983 are subject to the requirements of 326 IAC 6-2-4.

The particulate matter emissions (Pt) shall be limited by the following equation:

$$Pt = \frac{1.09}{Q^{0.26}}$$

Where:

Pt = Pounds of particulate matter emitted per million British thermal units (lb/MMBtu).

Q = Total source maximum operating capacity rating in MMBtu/hr heat input. The maximum operating capacity rating is defined as the maximum capacity at which the facility is operated or the nameplate capacity, whichever is specified in the facility's permit application, except when some lower capacity is contained in the facility's operation permit; in which case, the capacity specified in the operation permit shall be used.

Pursuant to 326 IAC 6-2-4(a), for Q less than 10 MMBtu/hr, Pt shall not exceed 0.6 lb/MMBtu.

Indirect Heating Units Which Began Operation After September 21, 1983						
Facility	Construction Date (Removal Date)	Operating Capacity (MMBtu/hr)	Q (MMBtu/hr)	Calculated Pt (lb/MMBtu)	Particulate Limitation, (Pt) (lb/MMBtu)	PM PTE based on AP-42 (lb/MMBtu)
Natural Gas-Fired Heater MAM1	Assumed 1984 (2024)	0.51	13.74	0.55	0.55	0.002
Natural Gas-Fired Heater MAM2-MAM4	Assumed 1984 (2024)	0.56, each	13.74	0.55	0.55	0.002
Natural Gas-Fired Heater AHU1, AHU3, AHU5, AHU6	Assumed 1984	0.40, each	13.74	0.55	0.55	0.002
18 Natural Gas-Fired Heaters, 1A, 4A-8A, 10A-13A, 1B-3B, 10B-14B	Assumed 1984	0.170, each	13.74	0.55	0.55	0.002
6 Natural Gas-Fired Heaters, 9A, 5B-9B	Assumed 1984 (2024)	0.30, each	13.74	0.55	0.55	0.002
2 Natural Gas-Fired Heaters, 3A, 4B	Assumed 1984	0.06, each	13.74	0.55	0.55	0.002
6 Natural Gas-Fired HVAC Units, HVAC1, HVAC3, HVAC5-6, HAVC8, HVAC32	Assumed 1984 (2024)	0.695, each	13.74	0.55	0.55	0.002
4 Natural Gas-Fired Heaters 15B-18B4 Natural Gas-Fired Heaters 15B-18B	Assumed 1984 (2024)	0.20, each	13.74	0.55	0.55	0.002

Indirect Heating Units Which Began Operation After September 21, 1983						
Facility	Construction Date (Removal Date)	Operating Capacity (MMBtu/hr)	Q (MMBtu/hr)	Calculated Pt (lb/MMBtu)	Particulate Limitation, (Pt) (lb/MMBtu)	PM PTE based on AP-42 (lb/MMBtu)
3 Natural Gas-Fired Tube Heaters	2024	0.05, each	5.21	0.71	0.6	0.002
2 Natural Gas-Fired Heaters	2024	0.08, each	5.21	0.71	0.6	0.002
1 Natural Gas-Fired Heater	2024	0.12	5.21	0.71	0.6	0.002
Where: Q = Includes the capacity (MMBtu/hr) of the new unit(s) and the capacities for those unit(s) which were in operation at the source at the time the new unit(s) was constructed. Note: Emission units shown in strikethrough were subsequently removed from the source. The effect of removing these units on "Q" is shown in the year the boiler was removed.						

326 IAC 6-3-2 (Particulate Emission Limitations for Manufacturing Processes)
Pursuant to 326 IAC 6-3-1(b)(1), the thirty (30) natural gas-fired combustion units are not subject to the requirements of 326 IAC 6-3, since they are combustion units for indirect heat.

326 IAC 7-1.1 Sulfur Dioxide Emission Limitations
These emission unit are not subject to 326 IAC 326 IAC 7-1.1, because they have a potential to emit sulfur dioxide (SO2) of less than 25 tons per year or 10 pounds per hour.

326 IAC 8-1-6 (VOC Rules: General Reduction Requirements for New Facilities)
Even though, the thirty (30) natural gas-fired combustion units were constructed after January 1, 1980, they are not subject to the requirements of 326 IAC 8-1-6, because their unlimited VOC potential emissions are less than twenty-five (25) tons per year.

326 IAC 9-1 (Carbon Monoxide Emission Limits)
The requirements of 326 IAC 9-1 do not apply to the thirty (30) natural gas-fired combustion units, because this source does not operate a catalyst regeneration petroleum cracking system or a petroleum fluid coker, grey iron cupola, blast furnace, basic oxygen steel furnace, or other ferrous metal smelting equipment.

326 IAC 10-3 (Nitrogen Oxide Reduction Program for Specific Source Categories)
The requirements of 326 IAC 10-3 do not apply to the thirty (30) natural gas-fired combustion units, since these units are not a blast furnace gas-fired boiler, a Portland cement kiln, or a facility specifically listed under 326 IAC 10-3-1(a)(2).

<u>Natural Gas-fired Crystallizer Units (CR1 and CR2) and Natural Gas-fired Dryers (DR1 and DR2)</u>

326 IAC 6-2-1 (Particulate Emission Limitations for Sources of Indirect Heating)
The requirements of 326 IAC 6-2 do not apply to the natural gas-ifred crystallizer units, identified as CR1 and CR2, and natural gas-fired dryers, identified as DR1 and DR2, since they are not sources of indirect heating.

326 IAC 6-3-2 (Particulate Emission Limitations for Manufacturing Processes)
Pursuant to 326 IAC 6-3-1(b)(12), the natural gas-ifred crystallizer units, identified as CR1 and CR2, and natural gas-fired dryers, identified as DR1 and DR2, are not subject to the requirements of 326 IAC 6-3, since they each are a manufacturing process with potential emissions less than five hundred fifty-one thousandths (0.551) pound per hour.

326 IAC 7-1.1 Sulfur Dioxide Emission Limitations
These emission units are not subject to 326 IAC 326 IAC 7-1.1, because they have a potential to emit sulfur dioxide (SO2) of less than 25 tons per year or 10 pounds per hour.

326 IAC 8-1-6 (VOC Rules: General Reduction Requirements for New Facilities)
Even though, the natural gas-ifred crystallizer units, identified as CR1 and CR2, and natural gas-fired dryers, identified as DR1 and DR2, were constructed after January 1, 1980, they are not subject to the requirements of 326 IAC 8-1-6, because their unlimited VOC potential emissions are less than twenty-five (25) tons per year.

326 IAC 9-1 (Carbon Monoxide Emission Limits)
The requirements of 326 IAC 9-1 do not apply to the natural gas-ifred crystallizer units, identified as CR1 and CR2, and natural gas-fired dryers, identified as DR1 and DR2, because this source does not operate a catalyst regeneration petroleum cracking system or a petroleum fluid coker, grey iron cupola, blast furnace, basic oxygen steel furnace, or other ferrous metal smelting equipment.

326 IAC 10-3 (Nitrogen Oxide Reduction Program for Specific Source Categories)
The requirements of 326 IAC 10-3 do not apply to the natural gas-ifred crystallizer units, identified as CR1 and CR2, and natural gas-fired dryers, identified as DR1 and DR2, since these units are not a blast furnace gas-fired boiler, a Portland cement kiln, or a facility specifically listed under 326 IAC 10-3-1(a)(2).

<u>Printer (P4)</u>

326 IAC 8-1-6 (VOC Rules: General Reduction Requirements for New Facilities)
Even though, the printer, identified as P4, was constructed after January 1, 1980, it is not subject to the requirements of 326 IAC 8-1-6 because its unlimited VOC potential emissions are less than twenty-five (25) tons per year.

326 IAC 8-5-5 (Graphic Arts Operations)
The requirements of 326 IAC 8-5-5 do not apply to the printer, identified as P4, since this unit is not a packaging rotogravure, publication rotogravure, or flexograhpic printing source.

326 IAC 8-2-5 (Paper Coating)
Pursuant to 326 IAC 8-2-1(a)(4), the printer, identified as P4, is not subject to the requirements of 326 IAC 8-2-5, because it has actual emissions less than fifteen (15) pounds of VOC per day before add-on controls.

326 IAC 8-2-9 (Miscellaneous Metal and Plastic Parts Coating Operations)
Pursuant to 326 IAC 8-2-1(a)(4), the printer, identified as P4, is not subject to the requirements of 326 IAC 8-2-9, because it has actual emissions less than fifteen (15) pounds of VOC per day before add-on controls.

<u>Ink Roll Cleaner (Roll Cleaner)</u>

326 IAC 8-1-6 (VOC Rules: General Reduction Requirements for New Facilities)
Even though, the ink roll cleaner, identified as Roll Cleaner, was constructed after January 1, 1980, it is not subject to the requirements of 326 IAC 8-1-6, because its unlimited VOC potential emissions are less than twenty-five (25) tons per year.

326 IAC 8-3-2 (Cold Cleaner Degreasers)
The requirements of 326 IAC 8-3-2 Cold Cleaner Degreasers do not apply to the ink roll cleaner, identified as Roll Cleaner, as it does not meet the definition of a cold cleaner degreaser since the ink rolls are cleaned by hand wiping.

Diesel-fired emergency fire pump and natural gas-fired emergency engine

326 IAC 6-2-1 (Particulate Emission Limitations for Sources of Indirect Heating)
The requirements of 326 IAC 6-2-1 do not apply to the diesel-fired emergency fire pump, identified as Pump1, and the natural gas-fired emergency engine, identified as Generator 1, since they are not soucres of indirect heating.

326 IAC 6-3-2 (Particulate Emission Limitations for Manufacturing Processes)
Pursuant to 326 IAC 6-3-1.5(2), the diesel-fired emergency fire pump, identified as Pump1, and the natural gas-fired emergency engine, identified as Generator 1, are not subject to the requirements of 326 IAC 6-3, since they are not a manufacturing process.

326 IAC 7-1.1 Sulfur Dioxide Emission Limitations
These emissions unit are not subject to 326 IAC 326 IAC 7-1.1, because they have a potential to emit sulfur dioxide (SO2) of less than 25 tons per year or 10 pounds per hour.

326 IAC 8-1-6 (VOC Rules: General Reduction Requirements for New Facilities)
Even though, the diesel-fired emergency fire pump, identified as Pump1, and the natural gas-fired emergency engine, identified as Generator 1, were constructed after January 1, 1980, they are not subject to the requirements of 326 IAC 8-1-6 because their unlimited VOC potential emissions are less than twenty-five (25) tons per year.

326 IAC 9-1 (Carbon Monoxide Emission Limits)
The requirements of 326 IAC 9-1 do not apply to the diesel-fired emergency fire pump, identified as Pump1, and the natural gas-fired emergency engine, identified as Generator 1, because this source does not operate a catalyst regeneration petroleum cracking system or a petroleum fluid coker, grey iron cupola, blast furnace, basic oxygen steel furnace, or other ferrous metal smelting equipment.

326 IAC 10-3 (Nitrogen Oxide Reduction Program for Specific Source Categories)
The requirements of 326 IAC 10-3 do not apply to the diesel-fired emergency fire pump, identified as Pump1, and the natural gas-fired emergency engine, identified as Generator 1, since these units are not a blast furnace gas-fired boiler, a Portland cement kiln, or a facility specifically listed under 326 IAC 10-3-1(a)(2).

Two (2) Parts Cleaning Units (Aqueous Parts Tub1 and Aqueous Parts Tub2)

326 IAC 8-1-6 (VOC Rules: General Reduction Requirements for New Facilities)
Even though, the two (2) parts cleaning units, identified as Aqueous Parts Tub1 and Aqueous Parts Tub2, were constructed after January 1, 1980, they are not subject to the requirements of 326 IAC 8-1-6 because their unlimited VOC potential emissions are less than twenty-five (25) tons per year.

326 IAC 8-3-2 (Cold Cleaner Degreasers)
Pursuant to 326 IAC 8-3-1(d)(1)(B), the two (2) parts cleaning units, identified as Aqueous Parts Tub1 and Aqueous Parts Tub2, are not subject to the requirements of 326 IAC 8-3-2, since they use a solvent that contains less than one percent (1%) of VOC by weight.

Conclusion and Recommendation

Unless otherwise stated, information used in this review was derived from the application and additional information submitted by the applicant. An application for the purposes of this review was received on April 23, 2024. Additional information was received on May 30, 2024.

The construction and operation of this source shall be subject to the conditions of the attached proposed Registration No. 035-47764-00078. The staff recommends to the Commissioner that the Registration be approved.

IDEM Contact

(a) If you have any questions regarding this permit, please contact Kristen Squillace, Indiana Department Environmental Management, Office of Air Quality, Permits Branch, 100 North Senate Avenue, MC 61-53 IGCN 1003, Indianapolis, Indiana 46204-2251, or by telephone at (317) 233-9327 or (800) 451-6027, and ask for Kristen Squillace or (317) 233-9327.

(b) A copy of the findings is available on the Internet at: http://www.in.gov/ai/appfiles/idem-caats/

(c) For additional information about air permits and how the public and interested parties can participate, refer to the IDEM Air Permits page on the Internet at: https://www.in.gov/idem/airpermit/public-participation/; and the Citizens' Guide to IDEM on the Internet at: https://www.in.gov/idem/resources/citizens-guide-to-idem/.

From: Craig Laubacher
To: Squillace, Kristen M
Cc: Collins, Jack
Subject: Re: Applicant Review for Registration Transition No. 035-47664-00078 for Spartech LLC The Jordan Company
Date: Thursday, June 27, 2024 9:22:32 AM
Attachments: image001.png
image002.png
image003.png
image004.png
image005.png
image006.png
image007.png

Okay. Thank you very much kristen.

Craig Laubacher
Regional Director
ECE
Cell: 512-635-4324
Claubacher@e-c-e.org

> On Jun 27, 2024, at 8:18 AM, Squillace, Kristen M <KSquilla@idem.in.gov> wrote:
>
> I have it updated in the permit, tsd, and calculations. For the EVOH emission factor, we will use the original numbers. It won't affect the permit level and we don't use citations from permits from different states. We have different rules and standards than other states. Since the original numbers where from an accepted source and it won't change the permit level, we will leave it for EVOH.
>
> If there are no further comments, then I can get these documents ready for issuance.
>
> All the best,
>
> Kristen
>
> <image001.png>
>
> Indiana Department of Environmental Management
> Kristen Squillace
> Environmental Manager

(317) 233-9327 • KSquilla@idem.IN.gov

Protecting Hoosiers and Our Environment

<image002.png>
|
<image003.png>
|
<image004.png>
|
<image005.png>
|
<image006.png>
| www.idem.IN.gov

<image007.png>

From: Collins, Jack <Jack.Collins@spartech.com>
Sent: Tuesday, June 25, 2024 10:34 AM
To: Squillace, Kristen M <KSquilla@idem.IN.gov>; Craig Laubacher <claubacher@e-c-e.org>
Subject: RE: Applicant Review for Registration Transition No. 035-47664-00078 for Spartech LLC The Jordan Company

---

The old unit was removed, this is a new unit.

From: Squillace, Kristen M <KSquilla@idem.IN.gov>
Sent: Tuesday, June 25, 2024 10:16 AM
To: Craig Laubacher <claubacher@e-c-e.org>
Cc: Collins, Jack <Jack.Collins@spartech.com>
Subject: RE: Applicant Review for Registration Transition No. 035-47664-00078 for Spartech LLC The Jordan Company

Hi Craig,

Thank you for looking over the documents. For the slitter/trimmer/rewinder, is this a new unit that was constructed in 2023 or is it the same unit constructed in 1985 but modified in 2023?

If a unit is modified, we leave the original construction date and add the modification date such as: constructed in 1985, modified in 2023,...

Since the maximum regrinding capacity of the slitter changed from 1,000 pounds to 2,000 pounds, I'll update the calculations to show the maximum throughput changing from 0.50 tons per hour to 1.00 tons per hour.

For the EVOH emission factors, I'm confirming with my supervisor if we can accept the new numbers. Permits in the past from other sources used the original EVOH emission factors so I want to double check if we can accept the new citation especially since it's a permit from a different state.

All the best,

Kristen

<image001.png>

Indiana Department of Environmental Management

Kristen Squillace

Environmental Manager

(317) 233-9327 • KSquilla@idem.IN.gov

Protecting Hoosiers and Our Environment

<image002.png>
|
<image003.png>
|
<image004.png>
|
<image005.png>
|
<image006.png>
| www.idem.IN.gov

<image007.png>

From: Craig Laubacher <claubacher@e-c-e.org>
Sent: Monday, June 24, 2024 4:01 PM
To: Squillace, Kristen M <KSquilla@idem.IN.gov>
Cc: Jack.Collins@Spartech.com
Subject: RE: Applicant Review for Registration Transition No. 035-47664-00078 for

Spartech LLC The Jordan Company

**** This is an EXTERNAL email. Exercise caution. DO NOT open attachments or click links from unknown senders or unexpected email. ****

Kristen,

I've attached two word documents which have the facility's comments. There is only one minor change (the same edit for both docs) regarding details about a slitter.

I also had a question about EVOH's emissions. I had listed it as 0 across the board due to it being processed within two layers, but you have different emission factors in the spreadsheet. I was just curious as to the source of those. (this won't be the only facility using EVOH, so I wanted to make sure we are on the same page here)

Thanks!

Craig Laubacher
Regional Director
Environmental Compliance & Engineering
Mobile 512-635-4324
Email claubacher@e-c-e.org

From: Squillace, Kristen M <KSquilla@idem.IN.gov>
Sent: Friday, June 21, 2024 12:54 PM
To: Craig Laubacher <claubacher@e-c-e.org>; Jack.Collins@Spartech.com
Subject: Applicant Review for Registration Transition No. 035-47664-00078 for Spartech LLC The Jordan Company
Importance: High

Dear Jack Collins and Craig Laubacher:

Attached please find the draft Registration Transition and supporting documents for review. As a courtesy, this draft is being provided to you for an opportunity to review and provide comments prior to the issuance of the permit approval.

The time clock for Registration Transition permit No.: 035-47664-00078 will be stopped during your review until you either provide comments or indicate that you do not have any comments. Due to permit accountability and IDEM's intention to issue the permit in a timely manner, you are being allotted 1 week to provide comments in writing. If you have any conflicts or special circumstances that would impede your review process during the time allotted, please notify me directly at the email address or phone number listed below as soon as possible. If you have not responded on or before **Friday, June 28, 2024**, IDEM will assume that you have no comments pertaining to this draft and all files will be forwarded for issuance.

During this review period, I will be available to address your concerns, answer any questions that you may have, or make necessary revisions to this draft.

Pursuant to 326 IAC 2-1.1-7, the fee for this permitting action is expected to be $600, which is based on the following:

$600	Registration

Please note: This is not a bill. This represents the anticipated fee and is subject to change if additional review is required or the permit level changes for some reason (e.g. an additional NESHAP review is required). You will receive a final bill from the OAQ Permits Administration and Support Section.

Sincerely,

Kristen Squillace

<image001.png>

Indiana Department of Environmental Management

Kristen Squillace

Environmental Manager

(317) 233-9327 • KSquilla@idem.IN.gov

Protecting Hoosiers and Our Environment

<image002.png>
|
<image003.png>
|
<image004.png>
|
<image005.png>
|
<image006.png>
| www.idem.IN.gov

<image007.png>

From: Collins, Jack
To: Squillace, Kristen M; Craig Laubacher
Subject: RE: Applicant Review for Registration Transition No. 035-47664-00078 for Spartech LLC The Jordan Company
Date: Thursday, June 27, 2024 9:49:10 AM
Attachments: image001.png
image002.png
image003.png
image004.png
image005.png
image006.png
image007.png

Nothing from me. Thank you

From: Squillace, Kristen M <KSquilla@idem.IN.gov>
Sent: Thursday, June 27, 2024 9:18 AM
To: Collins, Jack <Jack.Collins@spartech.com>; Craig Laubacher <claubacher@e-c-e.org>
Subject: RE: Applicant Review for Registration Transition No. 035-47664-00078 for Spartech LLC The Jordan Company

I have it updated in the permit, tsd, and calculations. For the EVOH emission factor, we will use the original numbers. It won't affect the permit level and we don't use citations from permits from different states. We have different rules and standards than other states. Since the original numbers where from an accepted source and it won't change the permit level, we will leave it for EVOH.

If there are no further comments, then I can get these documents ready for issuance.

All the best,

Kristen

IDEM
Indiana Department of Environmental Management

Kristen Squillace
Environmental Manager
(317) 233-9327 • KSquilla@idem.IN.gov

Protecting Hoosiers and Our Environment

| | | | | | www.idem.IN.gov

Help us improve!
IDEM values your feedback

From: Collins, Jack <Jack.Collins@spartech.com>
Sent: Tuesday, June 25, 2024 10:34 AM
To: Squillace, Kristen M <KSquilla@idem.IN.gov>; Craig Laubacher <claubacher@e-c-e.org>
Subject: RE: Applicant Review for Registration Transition No. 035-47664-00078 for Spartech LLC The Jordan Company

**** This is an EXTERNAL email. Exercise caution. DO NOT open attachments or click links from unknown senders or unexpected email. ****

The old unit was removed, this is a new unit.

From: Squillace, Kristen M <KSquilla@idem.IN.gov>
Sent: Tuesday, June 25, 2024 10:16 AM
To: Craig Laubacher <claubacher@e-c-e.org>
Cc: Collins, Jack <Jack.Collins@spartech.com>
Subject: RE: Applicant Review for Registration Transition No. 035-47664-00078 for Spartech LLC The Jordan Company

CAUTION: This email originated from outside the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

You don't often get email from ksquilla@idem.in.gov. Learn why this is important

Hi Craig,

Thank you for looking over the documents. For the slitter/trimmer/rewinder, is this a new unit that was constructed in 2023 or is it the same unit constructed in 1985 but modified in 2023?

If a unit is modified, we leave the original construction date and add the modification date such as: constructed in 1985, modified in 2023,...

Since the maximum regrinding capacity of the slitter changed from 1,000 pounds to 2,000 pounds, I'll update the calculations to show the maximum throughput changing from 0.50 tons per hour to 1.00 tons per hour.

For the EVOH emission factors, I'm confirming with my supervisor if we can accept the new numbers. Permits in the past from other sources used the original EVOH emission factors so I want to double check if we can accept the new citation especially since it's a permit from a different state.

All the best,

Kristen

Indiana Department of Environmental Management

Kristen Squillace
Environmental Manager
(317) 233-9327 • KSquilla@idem.IN.gov

Protecting Hoosiers and Our Environment

| | | | | www.idem.IN.gov

Help us improve!
IDEM values your feedback

From: Craig Laubacher <claubacher@e-c-e.org>
Sent: Monday, June 24, 2024 4:01 PM
To: Squillace, Kristen M <KSquilla@idem.IN.gov>
Cc: Jack.Collins@Spartech.com
Subject: RE: Applicant Review for Registration Transition No. 035-47664-00078 for Spartech LLC The Jordan Company

---

Kristen,

I've attached two word documents which have the facility's comments. There is only one minor change (the same edit for both docs) regarding details about a slitter.

I also had a question about EVOH's emissions. I had listed it as 0 across the board due to it being processed within two layers, but you have different emission factors in the spreadsheet.

I was just curious as to the source of those. (this won't be the only facility using EVOH, so I wanted to make sure we are on the same page here)

Thanks!

Craig Laubacher
Regional Director
Environmental Compliance & Engineering
Mobile **512-635-4324**
Email claubacher@e-c-e.org

From: Squillace, Kristen M <KSquilla@idem.IN.gov>
Sent: Friday, June 21, 2024 12:54 PM
To: Craig Laubacher <claubacher@e-c-e.org>; Jack.Collins@Spartech.com
Subject: Applicant Review for Registration Transition No. 035-47664-00078 for Spartech LLC The Jordan Company
Importance: High

Dear Jack Collins and Craig Laubacher:

Attached please find the draft Registration Transition and supporting documents for review. As a courtesy, this draft is being provided to you for an opportunity to review and provide comments prior to the issuance of the permit approval.

The time clock for Registration Transition permit No.: 035-47664-00078 will be stopped during your review until you either provide comments or indicate that you do not have any comments. Due to permit accountability and IDEM's intention to issue the permit in a timely manner, you are being allotted 1 week to provide comments in writing. If you have any conflicts or special circumstances that would impede your review process during the time allotted, please notify me directly at the email address or phone number listed below as soon as possible. If you have not responded on or before **Friday, June 28, 2024**, IDEM will assume that you have no comments pertaining to this draft and all files will be forwarded for issuance.

During this review period, I will be available to address your concerns, answer any questions that you may have, or make necessary revisions to this draft.

Pursuant to 326 IAC 2-1.1-7, the fee for this permitting action is expected to be $600, which is based on the following:

$600	Registration

Please note: This is not a bill. This represents the anticipated fee and is subject to change if additional review is required or the permit level changes for some reason (e.g. an additional NESHAP review is required). You will receive a final bill from the OAQ Permits Administration and Support Section.

Sincerely,

Kristen Squillace

Indiana Department of Environmental Management

Kristen Squillace

Environmental Manager

(317) 233-9327 • KSquilla@idem.IN.gov

This email and any attachment(s) may contain confidential information. If you were not the intended recipient, please notify the Spartech LLC person who sent you this email and immediately delete the message and any attachments without copying them or disclosing them. Thank you.