Environmental
Resources
Management

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ERM®

DRAFT

April ____, 2007
0062963-L01

Mr. James A. Capp
Air Protection Branch
Georgia Department of Natural Resources
4244 International Parkway, Suite 120
Atlanta, GA 30354

Subject: Mannington Commercial Calhoun, GA Facility Permit Amendment Application

Dear Mr. Capp:

Attached for GA EPD review and approval is a permit application amendment request to construct and operate a new carpet manufacturing line at the Mannington Commercial Calhoun, GA facility (Permit # 2272-129-0025-S-01-1). The purpose of the amendment request is to allow for the production of modular carpet tiles and narrow width roll goods utilizing olefin polymers for the carpet backing structure. It is important to note as described below that the facility will remain a Title V synthetic minor source based on the very low VOC/HAP content of the materials that will be used in the new carpet line. Also, the NSPS Subpart VVV VOC emissions control requirements will not be triggered for the new carpet operation (designated MOTC) since annual VOC input on the line will remain below 95 Mg/yr.

A summary of the requested facility changes and the associated permitting/regulatory implications are as follows:

1. <u>Production Line Construction and Operation</u>

   - A new modular carpet line will be constructed in the existing Modular Plant building. The building will be expanded to provide sufficient room for the new coating line. Associated with the new coating line the facility will install two (2) pellet silos, hot melt process tanks and conveying mechanisms for the new coating substrates.

- The new carpet operation will utilize extrusion coating technology for processing and application of the olefin compounds. For at least the foreseeable future compounding of the carpet backing formulations will occur offsite by an independent supplier.

2. <u>Title V Synthetic Minor Status and Emission Calculations</u>

Attached with the enclosed permit application are detailed VOC/HAP emission calculations and estimates for the typical range of products that will be produced on the new carpet line. As can be seen from this emission inventory data, estimated actual uncontrolled VOC/HAP emissions from the new carpet line will be very low and facility wide emissions will remain well below 10/25/100 TPY on a rolling 12-month basis as required by our current synthetic minor permit. In this regard, we request that no specific production levels be set for the new carpet line and that we be allowed to continue to track monthly VOC/HAP emissions based on material usage records as already specified in our current permit.

3. <u>Regulatory Applicability and Emission Control Requirements</u>

NSPS Subpart VVV is applicable to the new carpet coating MOTC line based on its construction date and coating operations. However, since VOC input to the new coating line will be limited to <95 Mg (104 Tons) over any rolling 12-month period, the add-on VOC emission control requirements of NSPS Subpart VVV are not triggered (60.740(b)). Also, no other source specific US EPA or GA EPD potentially applicable air quality control requirements are triggered by the addition of the new carpet line. Specifically, GA EPD Rule (x) and (lll) do not apply, and as shown in the attached application several sources are exempt from permitting in accordance with 391-3-1-.03(6). Also, addition of the new carpet coating line will not affect our ability to comply with any of the facility's existing permit conditions. Actual site wide VOC/HAP emissions will likely decrease with the addition of the new carpet line since it has a lower emission rate than the existing modular plant coating line and the new line is anticipated to partially displace production on the existing line over time.

The attached information contains all of the required completed GA EPD application forms and the appropriate backup emission calculations, MSDSs, process description, etc. This information is considered sufficient to verify the facility can remain permitted as a Title V synthetic minor source and to allow GA EPD to issue the requested permit amendment for the new carpet line in a timely manor. In terms of project schedule, the facility currently plans to begin the required construction in the June/July 2007 time frame with the intent of starting up the new production line by ~ November 2007. GA EPD's assistance in helping the facility meet this important production schedule is appreciated.

Please contact me if you have any questions concerning this information or the attached application.

Sincerely,

Chuck Patterson
Technology Development Manager
Mannington Commercial

Enclosure

cc: Howard Elder / J&J Invision

State of Georgia
Department of Natural Resources
Environmental Protection Division
Air Protection Branch

Stationary Source Permitting Program
4244 International Parkway, Suite 120
Atlanta, Georgia 30354
404/363-7000
Fax: 404/363-7100

SIP AIR PERMIT APPLICATION

EPD Use Only

Date Received: ______ Application No. ______

FORM 1.00: GENERAL INFORMATION

1. Facility Information

Facility Name: Mannington Commercial, a business unit of Mannington Mills, Inc.
AIRS No. (if known): 04-13- -
Facility Location: Street: 1844 Highway 41 SE
City: Calhoun Georgia Zip: 30701 County: Gordon

2. Facility Coordinates

Latitude: 34° 27’ 17” **NORTH** Longitude: 84° 56’ 14” **WEST**
UTM Coordinates: ______ **EAST** ______ **NORTH** **ZONE** ______

3. Facility Owner

Name of Owner: Mannington Mills, Inc.
Owner Address Street: 75 Mannington Mills Road
City: Salem State: New Jersey Zip: 08079

4. Permitting Contact and Mailing Address

Contact Person: Chuck Patterson Title: Technology Development Manager
Telephone No.: 706-603-6381 Ext. ______ Fax No.: 706-629-2171
Email Address: chuckp@mannington.com
Mailing Address: Same as: Facility Location: ☒ Owner Address: ☐ Other: ☐
If Other: Street Address: PO Box 12281
City: Calhoun State: Georgia Zip: 30703-7004

5. Authorized Official

Name: Miles Wright Title: Senior Director of Manufacturing
Address of Official Street: 1844 Highway 41 SE
City: Calhoun State: Georgia Zip: 30701

This application is submitted in accordance with the provisions of the Georgia Rules for Air Quality Control and, to the best of my knowledge, is complete and correct.

Signature: ______ Date: ______

6. **Reason for Application: (Check all that apply)**

☐ New Facility (to be constructed)

☒ Existing Facility (initial or modification application)

☒ Permit to Construct

☒ Permit to Operate

☐ Change of Location

☐ Permit to Modify Existing Equipment: Affected Permit No.: 2272-129-0025-S-01-1

☐ Revision of Data Submitted in an Earlier Application

Application No.:

Date of Original Submittal:

7. **Permitting Exemption Activities (for permitted facilities only):**

Have any exempt modifications based on emission level per Georgia Rule 391-3-1-.03(6)(i)(3) been performed at the facility that have not been previously incorporated in a permit?

☒ **No** ☐ **Yes, please fill out the SIP Exemption Attachment** (See Instructions for the attachment download)

8. **Has assistance been provided to you for any part of this application?**

☐ **No** ☐ **Yes, SBAP** ☒ **Yes, a consultant has been employed or will be employed.**

If yes, please provide the following information:

Name of Consulting Company: Environmental Resources Management (ERM)
Name of Contact: David Dunn
Telephone No.: (770) 590-8383 Fax No.: (770) 590-9164
Email Address: david.dunn@erm.com
Mailing Address: Street: 300 Chastain Center Blvd. Suite 375
City: Kennesaw State: GA Zip: 30144

Describe the Consultant's Involvement:

Permit application development and review support.

9. **Submitted Application Forms:** Select only the necessary forms for the facility application that will be submitted.

No. of Forms	Form
1	2.00 Emission Unit List
1	2.01 Boilers and Fuel Burning Equipment
	2.02 Storage Tank Physical Data
	2.03 Printing Operations
1	2.04 Surface Coating Operations
	2.05 Waste Incinerators (solid/liquid waste destruction)
1	2.06 Manufacturing and Operational Data
1	3.00 Air Pollution Control Devices (APCD)
	3.01 Scrubbers
1	3.02 Baghouses & Other Filter Collectors
	3.03 Electrostatic Precipitators
1	4.00 Emissions Data
	5.00 Monitoring Information
1	6.00 Fugitive Emission Sources
1	7.00 Air Modeling Information

10. **Construction or Modification Date**

Estimated Start Date: June 15, 2007

11. If confidential information is being submitted in this application, were the guidelines followed in the "Procedures for Requesting that Submitted Information be treated as Confidential"?

☒ No ☐ Yes

12. New Facility Emissions Summary

Criteria Pollutant	New Facility	
	Potential (tpy)	Actual (tpy)
Carbon monoxide (CO)		
Nitrogen oxides (NOx)		
Particulate Matter (PM)		
PM <10 microns (PM10)		
PM <2.5 microns (PM2.5)		
Sulfur dioxide (SO_2)		
Volatile Organic Compounds (VOC)		
Total Hazardous Air Pollutants (HAPs)		
Individual HAPs Listed Below:		

13. Existing Facility Emissions Summary

Criteria Pollutant	Current Facility		After Modification	
	Potential (tpy)	Actual (tpy)	Potential (tpy)	Actual (tpy)
Carbon monoxide (CO)	< 100	5.6	< 100	7.1
Nitrogen oxides (NOx)	< 100	7.6	< 100	9.4
Particulate Matter (PM)	< 100	41.4	< 100	41.6
PM <10 microns (PM10)	< 100	< 41.4	< 100	< 41.6
PM <2.5 microns (PM2.5)	< 100	< 41.4	< 100	< 41.6
Sulfur dioxide (SO_2)	< 100	6.7	< 100	6.7
Volatile Organic Compounds (VOC)	< 100	66.0	< 100	67.0
Total Hazardous Air Pollutants (HAPs)	< 25	0.1	< 25	0.59
Individual HAPs Listed Below:				
TBD				
Toluene			0.53	< 0.28
Acetaldehyde			0.53	< 0.28
Vinyl Acetate			0.53	< 0.28
Residual Vinylchloride monomer			0.7	< 0.28

14. 4-Digit Facility Identification Code:

SIC Code: 2273 SIC Description: Carpets and Rugs

NAICS Code: 314110 NAICS Description: Carpet and Rug Mills

15. Description of general production process and operation for which a permit is being requested. If necessary, attach additional sheets to give an adequate description. Include layout drawings, as necessary, to describe each process. References should be made to source codes used in the application.

Please see attached Process Description. (Attachment A)

16. Additional information provided in attachments as listed below:

Attachment A - Process Description
Attachment B - Facility Site Layout
Attachment C - Emission Points
Attachment D - Emission Calculations
Attachment E - MSDS
Attachment F -

17. Additional Information: Unless previously submitted, include the following two items:

☒ Plot plan/map of facility location or date of previous submittal: Map attached.

☒ Flow Diagram or date of previous submittal: Process Flow Diagram (PFD) attached.

Facility Name: Mannington Commercial **Date of Application:** April 2007

FORM 2.00 – EMISSION UNIT LIST

Emission Unit ID	Name	Manufacturer and Model Number	Description
MOS	Steamer	Tuftco Finishing Systems, 45 Foot Long Modular Carpet Steamer	Wet Sump Carpet Steamer (Note: Steam from existing boiler)
MOD	Carpet Dryer	Tuftco Finishing Systems	Gas fired, 4 zone forced convection oven
MOC	Precoat Applicator Station	Union Tool, Union Series # 45, Model C, 86" Hot Melt Roller Coater	Hot melt roller coater with electric IR preheat
MOEL	Laminate Coat Applicator	Davis Standard, Thermatic III, 165 mm dia	Extrusion coating station
MOEC	Cap Coat Applicator	Davis Standard, Thermatic III, 165 mm dia	Extrusion coating station
PSL	Compound Silo #1	12 ft. diameter steel silos, capacity = 100,000 lbs Tuftco	Silo containing PE pellets to feed laminating extruder
PSC	Compound Silo #2	12 ft. diameter steel silos, capacity = 100,000 lbs Tuftco	Silo containing PE pellets to feed cap coat extruder
PMT1	Precoat Melt Unit No. 1	ITW Dynatech or Equivalent	Precoat Pellet Melter, 250 gal. capacity
PMT2	Precoat Melt Unit No. 2	ITW Dynatech or Equivalent	Precoat Pellet Melter, 250 gal. capacity
DC	Die Cutter	Schoen or Equivalent	Die cutter for cutting carpet into tiles.

Facility Name: Mannington Commercial **Date of Application:** April 2007

FORM 2.01 – BOILERS AND FUEL BURNING EQUIPMENT

Emission Unit ID	Type of Burner	Type of Draft[1]	Design Capacity of Unit (MMBtu/hr Input)	Percent Excess Air	Dates		Date & Description of Last Modification
					Construction	Installation	
MOD[2]	Gas - nozzle mix	Forced Draft	3x 1.5 million		July 2007	July 2007	New
			1x 2.5 million		July 2007	July 2007	New

[1] This column does not have to be completed for natural gas only fired equipment.
[2] Data provided for informational purposes only as Emission Unit MOD is exempt from permitting in accordance with 391-3-1-.03(6)(b).

Facility Name: Mannington Commercial **Date of Application:** April 2007

FUEL DATA

Emission Unit ID	Fuel Type	Potential Annual Consumption				Hourly Consumption		Heat Content		Percent Sulfur		Percent Ash in Solid Fuel	
		Total Quantity		Percent Use by Season									
		Amount	Units	Ozone Season May 1 - Sept 30	Non-ozone Season Oct 1 - Apr 30	Max.	Avg.	Min.	Avg.	Max.	Avg.	Max.	Avg.
MOD	Natural Gas	60.12	MMSCF	42%	58%	6900 scf		1020 BTU/scf	1020 BTU/scf	N/A		N/A	
	Propane (Backup Fuel)												

Fuel Supplier Information

Fuel Type	Name of Supplier	Phone Number	Supplier Location			
			Address	City	State	Zip
Natural Gas						
Propane	Heritage Propane	770-479-2009	2920 Marietta Hwy. Suite 128	Canton	GA	30114

Facility Name: Mannington Commercial **Date of Application:** April 2007

FORM 2.04 – SURFACE COATING OPERATIONS

Emission Unit ID	Emission Unit Name	Construction Date	Type of Coating Operation[1]	Item(s) Coated	Normal Operating Hours	Coating Method	VOC Potential to Emit (tons/yr)	VOC Max Actual Emissions (lb/day)
MOTC	Modular Olefin Tile Coater	~7/07	I	Carpet	24/7/51	Hot Melt and Roll Coater	<<100[1]	<<10
[1] Source's potential to emit is << 100TPY to remain a Title V Minor Source (100 TPY) and << 104 TPY to avoid applicability of parts of NSPS Subpart VVV.								

[1] Indicate type of coating operation using the appropriate letter code from below:

A – Can Coating
D – Pressure Sensitive Tape & label Surface Coating
G – Wood Furniture Coating
J – Paper Coating
M – Plastic Parts for Business Machines Coating

B – Fabric and Vinyl Coating
E – Coil Coating
H – Magnetic Tape Coating
K – Large Appliance Surface Coating
N – Automobile & Light Truck Manufacturing

C – Wire Coating
F – Metal Furniture Coating
I – Polymeric Coating of Supporting Substrate
L – Misc. Metal Parts & Products Coating
O – Other (describe equipment coated under "Items Coated")

Facility Name: Mannington Commercial **Date of Application:** April 2007

FORM 2.06 – MANUFACTURING AND OPERATIONAL DATA

Normal Operating Schedule: 24 hours/day 5 days/week 51 weeks/yr

Additional Data Attached? ☐ - No ☐ - Yes, please include the attachment in list on Form 1.00, Item 16.

Seasonal and/or Peak Operating Periods: Summer months.

Dates of Annually Occurring Shutdowns: Christmas

PRODUCTION INPUT FACTORS

Emission Unit ID	Emission Unit Name	Const. Date	Input Raw Material(s)	Annual Input (TPY)	Hourly Process Input Rate (TPH)		
					Design	Normal	Maximum
MOS	Carpet Steamer	6/07	Tufted Nylon Carpet	6972	3.23	1.14	3.23
MOD	Carpet Dryer	6/07	Tufted Nylon Carpet	837	0.39	0.14	0.39
MOC	Precoat Station Applicator	8/07	Hot Melt Precoat	3586	1.03	0.59	1.03
MOEL	Laminated Coat Applicator	8/07	Polyethylene / Fiberglass Compound	6225	2.36	1.08	2.36
MOEC	Cap Coat Applicator	8/07	Polyethylene Compound	8715	2.26	1.42	2.26

PRODUCTS OF MANUFACTURING

Emission Unit ID	Description of Product	Production Schedule		Hourly Production Rate (Give units: e.g. lb/hr, ton/hr)			
		Tons/yr	Hr/yr	Design	Normal	Maximum	Units
MOTC	**Carpet Squares**	**22890**	**6120**	**2010 sqyd/hr**	**1407 sqyd/hr**	**2010 sqyd/hr**	**594 sqyd/hr**

Facility Name: Mannington Comercial **Date of Application:** April 2007

Form 3.00 – AIR POLLUTION CONTROL DEVICES - PART A: GENERAL EQUIPMENT INFORMATION

APCD Unit ID	Emission Unit ID	APCD Type (Baghouse, ESP, Scrubber etc)	Date Installed	Make & Model Number (Attach Mfg. Specifications & Literature)	Unit Modified from Mfg Specifications?	Gas Temp. °F		Inlet Gas Flow Rate (acfm)
						Inlet	Outlet	
PDC1	PSC	Fabric Filter	9/07	Flex-Kleen 58BVBS-16,IIG	No	Ambient	Ambient	N/A
PDC2	PSL	Fabric Filter	9/07	Flex-Kleen 58BVBS-16,IIG	No	Ambient	Ambient	N/A

Facility Name: Mannington Commercial **Date of Application:** April 2007

Form 3.00 – AIR POLLUTION CONTROL DEVICES – PART B: EMISSION INFORMATION

APCD Unit ID	Pollutants Controlled	Percent Control Efficiency		Inlet Stream To APCD		Exit Stream From APCD		Pressure Drop Across Unit (Inches of water)
		Design	**Actual**	lb/hr	Method of Determination	lb/hr	Method of Determination	
PDC1	PM	>99	>98	42	Eng. Estimate	0.84	Eng. Estimate	N/A
PDC2	PM	>99	>98	42	Eng. Estimate	0.84	Eng. Estimate	N/A

Facility Name: Mannington Commercial **Date of Application:** April 2007

FORM 3.02 – BAGHOUSES & OTHER FILTER COLLECTORS

APCD ID	Filter Surface Area (ft^2)	No. of Bags	Inlet Gas Dew Point Temp. (°F)	Inlet Gas Temp. (°F)	Bag or Filter Material	Pressure Drop (inches of water)	Cleaning Method	Gas Cooling Method	Leak Detection System Type
PDC1	115	16	Ambient	Ambient	Polyester	N/A	Pulse Jet	NA	N/A
PDC2	115	16	Ambient	Ambient	Polyester	N/A	Pulse Jet	NA	N/A

Attach a physical description, dimensions and drawings for each baghouse and any additional information available such as particle size, maintenance schedules, monitoring procedures and breakdown/by-pass procedures. Explain how collected material is disposed of or utilized. Include the attachment in the list on Form 1.00 *General Information*, Item 16

Facility Name: Mannington Commercial **Date of Application:** April 2007

FORM 4.00 – EMISSION INFORMATION

Emission Unit ID	Air Pollution Control Device ID	Stack ID	Pollutant Emitted	Emission Rates				
				Hourly Actual Emissions (lb/hr)	Hourly Potential Emissions (lb/hr)	Actual Annual Emission (tpy)	Potential Annual Emission (tpy)	Method of Determination
	PDC1		Particulate Matter	0.2	0.2	0.15	0.15	Engr. estimate and Mfgr. specifications
	PDC2		Particulate Matter	0.2	0.2	0.15	0.15	Engr. estimate and Mfgr. specifications
MOTC	N/A		VOC	0.32	0.62	0.97	2.66	Engr. estimate and Mfgr. specifications
MOTC	N/A		HAP – Total		0.08		0.35	Engr. estimate and Mfgr. specifications
MOTC	N/A		HAP – Single		0.065		0.28	Engr. estimate and Mfgr. specifications

Facility Name: Mannington Commercial **Date of Application:** April 2007

FORM 6.00 – FUGITIVE EMISSION SOURCES

Fugitive Emission Source ID	Description of Source	Emission Reduction Precautions	Pot. Fugitive Emissions	
			Amount (tpy)	Pollutant
MOTC	New Carpet Line	Use of low VOC & HAP Containing Materials		

Facility Name: Mannington Commercial **Date of Application:** April 2007

FORM 7.00 – AIR MODELING INFORMATION: Stack Data

Stack ID	Emission Unit ID(s)	Stack Information			Dimensions of largest Structure Near Stack		Exit Gas Conditions at Maximum Emission Rate			
		Height Above Grade (ft)	Inside Diameter (ft)	Exhaust Direction	Height (ft)	Longest Side (ft)	Velocity (ft/sec)	Temperature (°F)	Flow Rate (acfm)	
									Average	Maximum
MOS1	MOS	35	1	Vertical	N/A	N/A	28	210	1300	
MOS2	MOS	35	1	Vertical	N/A	N/A	28	210	1300	
MOD1	MOD	35	1.75	Vertical	N/A	N/A	49	250	7000	
MOC1	MOC	35	1.33	Vertical	N/A	N/A	53	Ambient	4400	
MOE1	MOEL	35	1.33	Vertical	N/A	N/A	53	Ambient	4400	
MOE2	MOEC	35	1.33	Vertical	N/A	N/A	53	Ambient	4400	

NOTE: If emissions are not vented through a stack, describe point of discharge below and, if necessary, include an attachment. List the attachment in Form 1.00 *General Information*, Item 16.

Attachment A

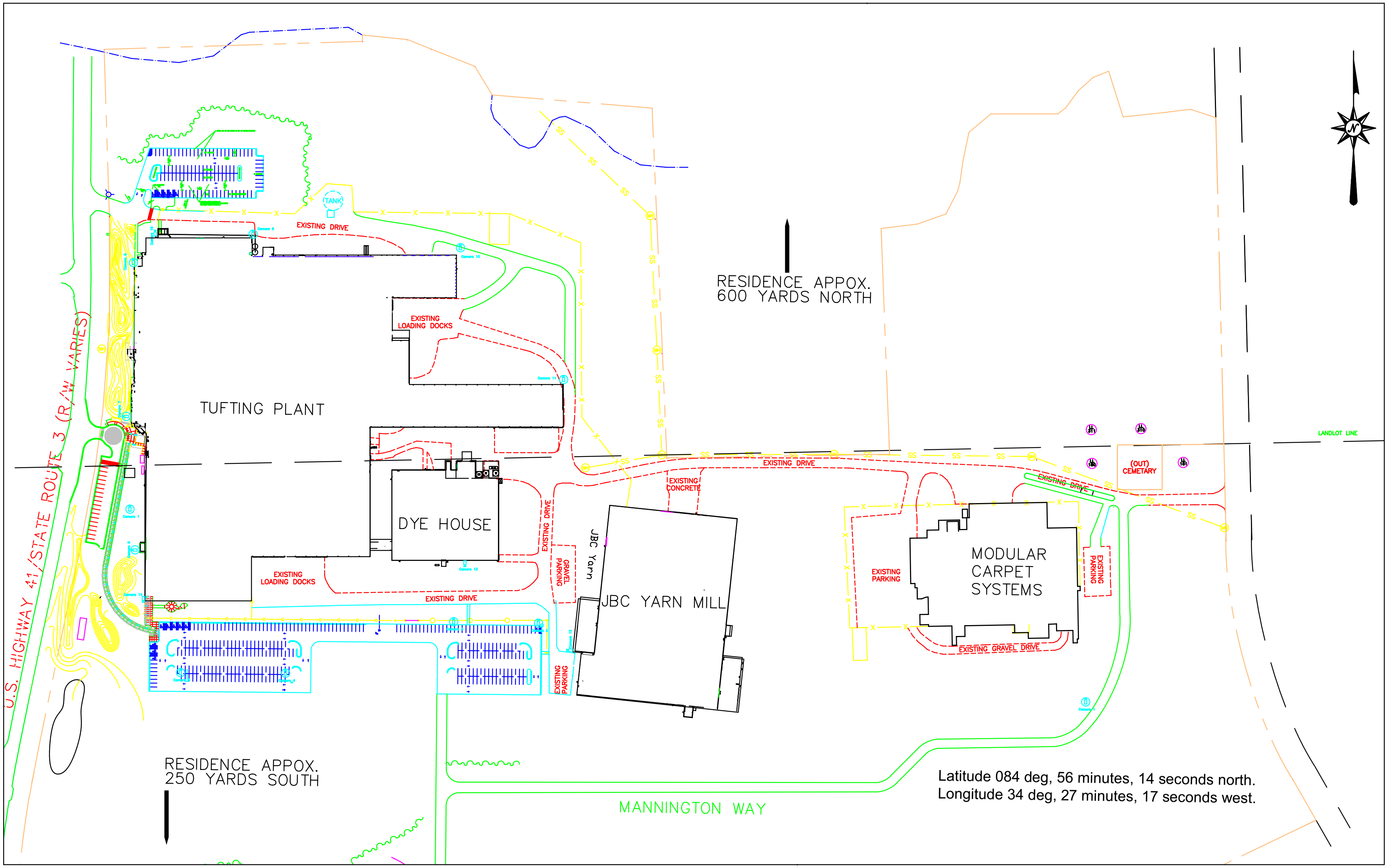
Process Description

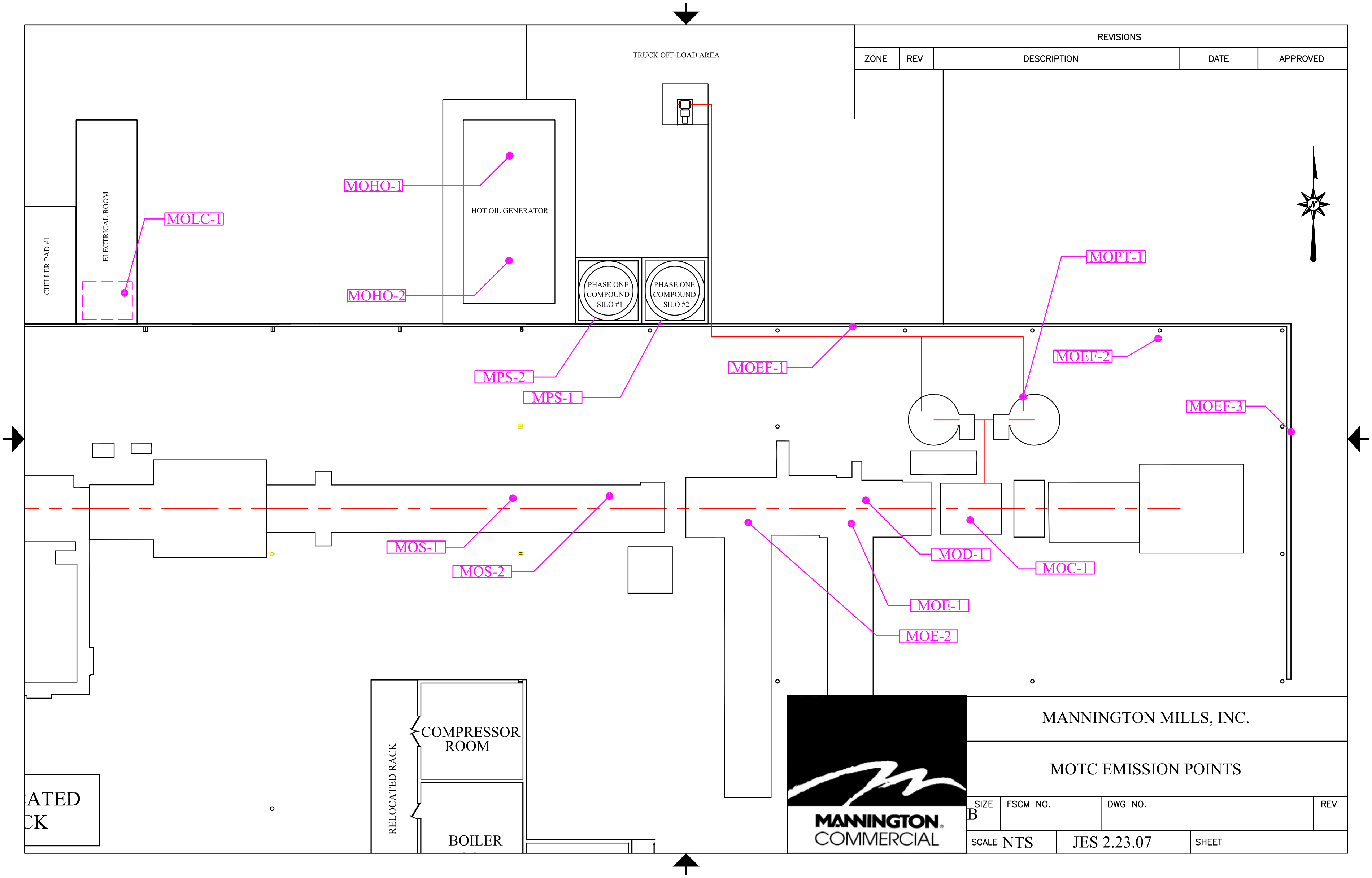
The new modular olefin tile coating line will be constructed in what has formerly been the Mannington Modular Facility on Marine Drive in Calhoun, GA. This facility is now jointly owned by Mannington Mills and J&J Industries and will be enlarged to accommodate the new processing line. The new line will consist primarily of a hot-melt precoating station followed by two single screw extrusion stations with a non-woven reinforcing fabric introduced between the two extrusion coats. (See Modular Olefin Tile Coating Line block diagram. (See 17.0 Flow diagram.))

Nominal six foot wide tufted carpet will be sewn in at the entrance to the line. The carpet will first pass through a topical applicator station in which foam containing a fluorochemical and/or a stain blocker will be applied at approximately 10 to 15% on weight of fiber. The carpet will then enter a steamer in which the coating(s) applied will be fixed onto the face fiber before the carpet enters the tile backing section of the line (No new fuel burning equipment is being added associated with the new steamer as the existing modular plant boiler will provide the necessary steam. Next the carpet will pass through a dryer to dry the carpet in preparation for application of a hot-melt precoat. Based on the 7.0 x 10^6 BTU/hr capacity of the natural gas/propane fueled dryer, it is exempt from permitting in accordance with 391-3-1-.03(6)(b). Just before entering the hot-melt station, the carpet will pass an infrared preheat station which can be used to warm the carpet just before the hot-melt precoat is applied.

The precoat station will be a roll coater similar to that shown in Attachment E, page 1. The hot-melt liquid is held in the trough formed by the coating and doctor rolls. As the rolls rotate, the melt is metered onto Roll #2 and a controlled amount of coating is transferred from this roll to the tufted carpet. Melted precoat material can be fed to the trough from a hot-melt holding tank or from a pre-melter.

The next step in the process is the laminating station. Olefinic pellets are aspirated into a silo and fed mechanically into the throat of a single screw extruder. The molten polymer leaving the extruder as a sheet is fed into a nip that has the precoated carpet entering from one side and a non-woven textile fiberglass mat entering from the other. (See Attachment E, page 2.) The polymer attaches to the precoated carpet on one side and to the non-woven glass on the other. The carpet with precoat, laminate coat and non-woven fiberglass then travels to a second extruder station in which a second olefinic polymer, the cap coat, is applied to the fiberglass side of the carpet. Polymer is fed to the cap coat station from a pellet silo as described earlier. This process creates a structure in which carpet is the top layer, precoat hot-melt is the next layer, laminate polymer is just below the precoat, the fiberglass mat is just below the laminate coat and the capcoat is the bottom layer. When this coated carpet is cooled, it is cut into modules or shipped as nominal six-foot wide rolls. If modules are desired, they are placed on pallets, stretch wrapped or boxed and shipped.


LANDLOT LINE
(OUT) CEMETARY
RESIDENCE APPOX. 600 YARDS NORTH
TANK
EXISTING DRIVE
EXISTING LOADING DOCKS
TUFTING PLANT
DYE HOUSE
EXISTING DRIVE
GRAVEL PARKING
EXISTING CONCRETE
JBC Yarn
JBC YARN MILL
EXISTING PARKING
EXISTING LOADING DOCKS
EXISTING DRIVE
EXISTING PARKING
MODULAR CARPET SYSTEMS
EXISTING PARKING
EXISTING GRAVEL DRIVE
EXISTING DRIVE
SS
X
U.S. HIGHWAY 41/STATE ROUTE 3 (R/W VARIES)
RESIDENCE APPOX. 250 YARDS SOUTH
MANNINGTON WAY
N
Latitude 084 deg, 56 minutes, 14 seconds north.
Longitude 34 deg, 27 minutes, 17 seconds west.



REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED

MANNINGTON MILLS, INC.

MOTC EMISSION POINTS

SIZE	FSCM NO.	DWG NO.	REV
B			

SCALE		SHEET
NTS	JES 2.23.07	

PTE Summary

	PTE (TPY)					
	VOC	PM	CO	NOx	SO2	HAPS
PE Pellets	0.86	4.31				
HM Precoat	1.64	0				
Dryer	0.16	0.22	2.47	2.94	0.02	
Total	2.66	4.53	2.47	2.94	0.02	

Anticipated Actual (TPY)					
VOC	PM	CO	NOx	SO2	HAPS
0.29	0.07				
0.58	0				0.35
0.10	0.13	1.48	1.76	0.01	
0.97	0.21	1.48	1.76	0.01	0.35

All values in TPY.

Sq-yds/yr 19,706,400 7,812,000

0.528

0.224

							TPY			Hourly		
	Design	Normal	Max	Design	Normal	Max	Design	Normal	Max	Design	Normal	Max
production	oz/sq-yd						25,731	6,152	7,910	7956	5400	7160.4
Carpet	50	28	36	51,462,500	12,303,900	15,819,300	257	62	79	3.23	1.14	1.10
Topical	0.5	0.28	0.36	514,625	123,039	158,193	515	198	198	0.03	0.01	0.01
Precoat	1	0.9	0.9	1,029,250	395,483	395,483	18,012	5,493	6,591	0.06	0.04	0.03
Laminate Coat	35	25	30	36,023,750	10,985,625	13,182,750	772	330	330	2.26	1.02	0.92
Fiberglass	1.5	1.5	1.5	1,543,875	659,138	659,138	18,012	7,690	7,690	0.10	0.06	0.05
Cap coat	35	35	35	36,023,750	15,379,875	15,379,875	63,299	19,924	22,797	2.26	1.42	1.07

lbs/sq-yd	speed fpm	width	sq-yds/min	sq-yds/hr	sq-yds/day	sq-yds/week	sq-yds/yr
1.0	50	6.9	38.3	2300	55,200	386,400	19,706,400

lbs compound/yr	polymer lbs/yr	TPY	Emission Rate[1]	Lbs/Yr VOC	TPY
19,706,400	15,765,120	7,882.56	.416 lbs/ton	3,279.14	1.64

[1] See attached e-mail from Neel Reynolds

VOC

lbs/sq-yd	speed fpm	width	sq-yds/min	sq-yds/hr	sq-yds/day	sq-yds/week	sq-yds/yr
4.375	50	6.9	38.3	2300	55,200	386,400	19,706,400

lbs compound/yr	polymer lbs/yr	TPY	Emission Rate[1]	Lbs/Yr VOC	TPY
86,215,500	34,486,200	17,243.10	0.1 lb/ton	1,724.31	0.86

[1] See attached "MCS Emission Calculations" and "Development of Emission Factors for Polyethylene Processing"

PM

Pounds of pellets	% Dust in Collector	Collector ff	PM Emissions	TPY
86,215,500	1%	99%	8,621.55	4.31

VOC

lbs/sq-yd	speed fpm	width	sq-yds/min	sq-yds/hr	sq-yds/day	sq-yds/week	sq-yds/yr
3.75	35	6.2	24.1	1446.7	31,248	156,240	7,812,000

lbs compound/yr	polymer lbs/yr	TPY	Emission Rate[1]	Lbs/Yr VOC	TPY
29,295,000	11,718,000	5,859.00	0.1 lb/ton	585.90	0.29

[1] See attached "MCS Emission Calculations" and "Development of Emission Factors for Polyethylene Processing"

PM

Pounds of pellets	% Dust in Collector	Collector ff	PM Emissions	TPY
29,295,000	0.5%	99.9%	146.48	0.07

4/20/2007 MCS Emsiion Calculations - Polyethylene Actual Emissions

VOC Emissions

lbs/sq-yd	speed fpm	width	sq-yds/min	sq-yds/hr	sq-yds/day	sq-yds/week	sq-yds/yr
0.9	35	6.2	24.1	1446.66667	31,248	156,240	7,812,000

lbs compound/yr	polymer lbs/yr	TPY	Emission Rate[1]	Lbs/Yr VOC	TPY
7,030,800	5,624,640	2,812.32	.416 lbs/ton	1,169.93	0.58

[1] See attached e-mail from Neel Reynolds

HAPS Emissions

7,030,800

.05 tons HAPS/MM Lbs

100 lbs/mm Lbs

7.03

703.08

0.35 TPY Total HAPS

Dryer Emissions

Capacity	7	MMBTU/Hr
Hours/yr	8568	Hours

Pollutant	Emission Factor (lb/MMBtu)	Emissions	
CO	0.0823529	2.470	TPY
NOx	0.0980392	2.940	TPY
PM	0.007451	0.223	TPY
SO2	0.0005882	0.018	TPY
VOC	0.0053922	0.162	TPY

Emission Factors from AP-42, divided by 1020 BTU/SCF

From: Neel Reynolds [nreynolds@reynoldsglue.com]
Sent: Friday, March 23, 2007 9:46 AM
To: Chuck Patterson

Neel,

This response assumes that use of our Hot Melts is the only pollutant-emitting operation going on at the site in question and does not account for any other activities at the subject site. EVA hot melts are an environmentally-friendly material. But they are not pollution-free. As such, there are two issues here.

1) will the facility need an air permit? The answer is probably yes unless the usage quantity is low. This is because there are some small residuals of VOC (volatile organic compounds) and HAPs (hazardous air pollutants) in the EVA material. Based upon our review of raw materials used to make the EVA-based hot melts, a million lbs. of our EVA Hot Melts should release 0.104 tons (or less) VOCs and 0.05 tons cumulative HAPs which includes 0.04 tons of the highest concentration HAP. In SC, the state might exempt you from obtaining an air permit even if you use up to 4.8 million tons per month of EVA-based hot melt (ie. <1,000 lbs. per month of VOC emission). **In most cases, the amount of pollutants released from hot melt are low enough to qualify for a minor source (relatively simple) permit.**

2) will the facility need a Title V air permit? a Title V (major source) permit will be required if you have the potential to exceed 100 tons/yr. VOC or 25 tons/yr. cumulative HAPs or 10 tons/yr. individual HAPs. This would be equivalent to a usage rate of 272 million pounds per year of EVA product to exceed the 10 tons/yr. major source limit on individual HAPs emissions. **For use of just our EVA hot-melt, the facility would most-likely not need a Title V permit.**

The above assumptions assumes that hot melts are the only environmental impact at the site. In reality, you must consider all processes and support operations (ie. boilers, etc.) **to determine if (1) the site needs an air permit and (2) if the site will be considered a minor or major source.**

I hope that this helps.

Dave McCartney

Neel Reynolds
VP Manufacturing
The Reynolds Company
nreynolds@reynoldsglue.com
864-241-3926

4/20/2007 MCS Emission Calculations

Emission calculations used in the preparation of this permit application were derived from a technical paper. This paper was published in the Journal of The Air and Waste Management Association, Volume 46, June 1996. A copy of this paper is included with this application.

The title of the article appearing on page 569 is “Development of Emission Factors for Polyethylene Processing”. This article lists emission factors developed over a range of temperatures during extrusion of polyethylene resins. In table 7, page 578, an emission factor of 35.3 pounds per million pounds of resin extruded was chosen. This is the most representative of anticipated operation for the carpet coating line. The emission factor of 35.3 pounds per million pounds of resin is equivalent to 0.07 pounds of VOC per ton of resin extruded. We have chosen to use a more conservative emission factor of 0.1 pounds of VOC per ton of resin extruded in preparing this application.

TECHNICAL PAPER

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Development of Emission Factors for Polyethylene Processing

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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.

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.

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 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).

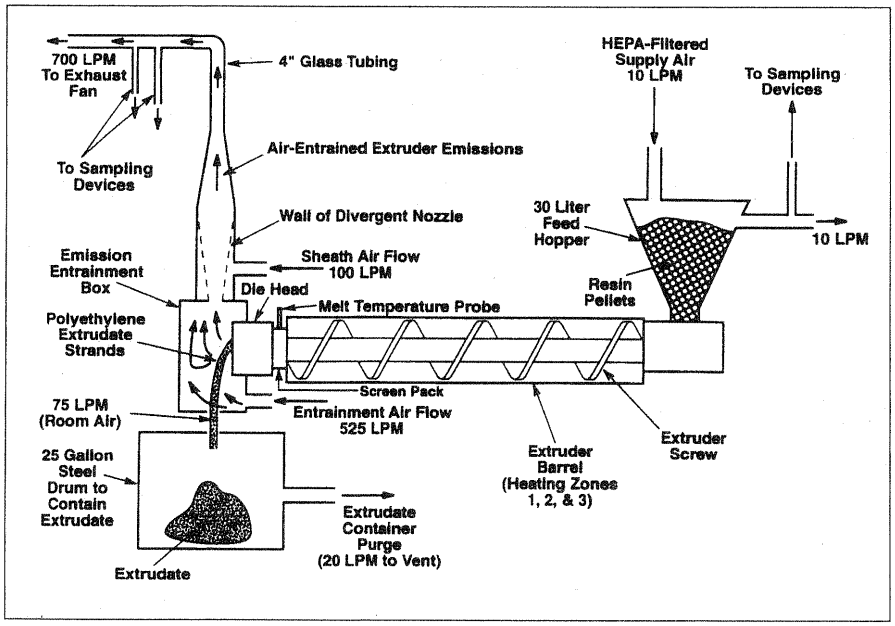

Figure 1. View of the extruder system and the various sampling locations.

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.

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.

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

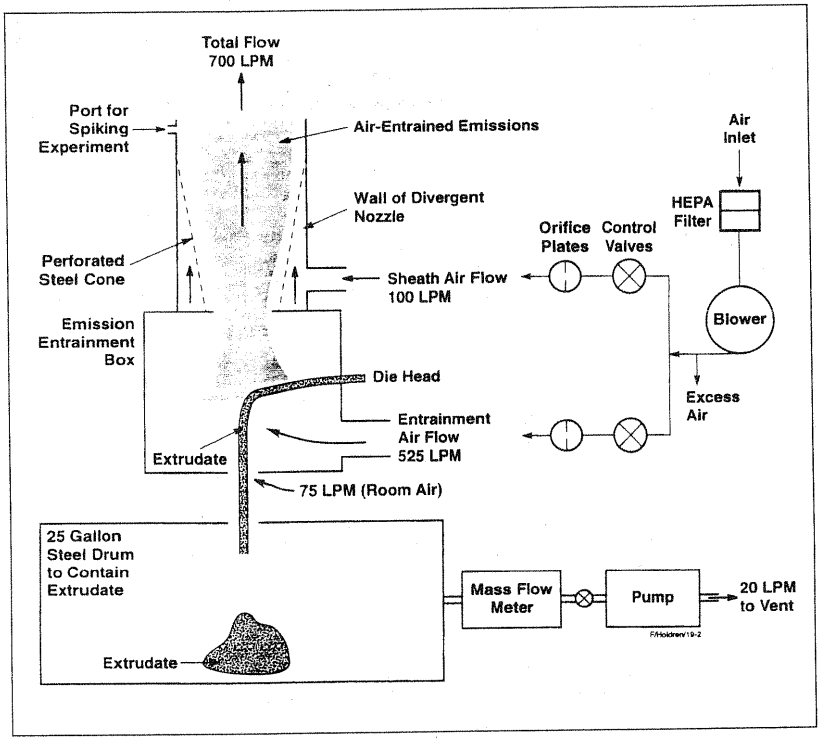

Figure 2. View of emission entrainment area.

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

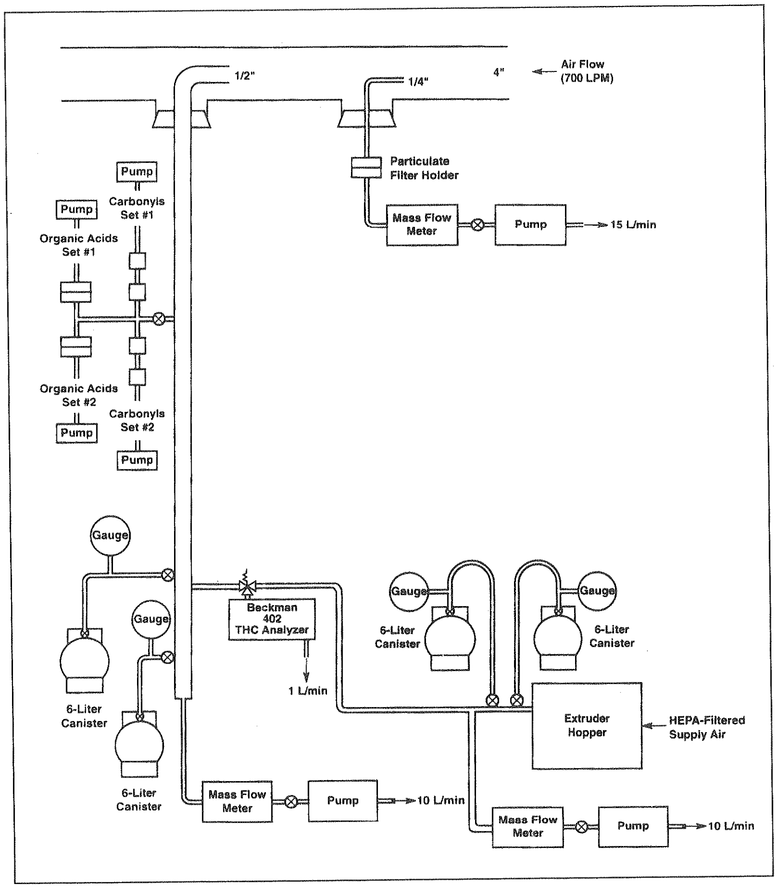

Figure 3. Sampling manifolds for emissions generated at die head and hopper.

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 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.

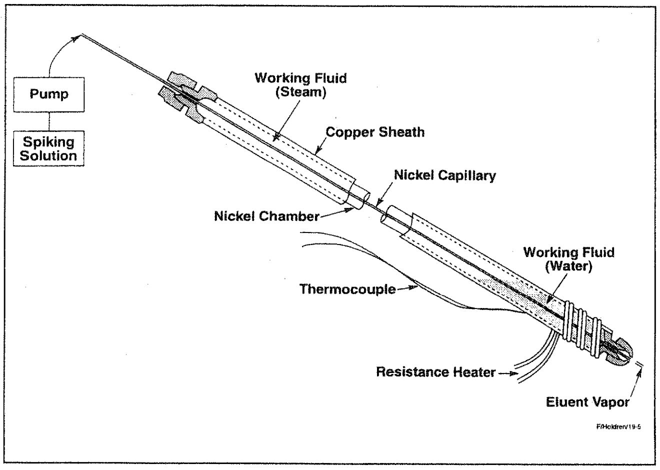

Figure 4. Battelle-developed water vaporizer.

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 Low	Range of Individual Results ppm High	Between-Run RPD[a] (%)	Range of Individual Results ppm Low	Range of Individual Results ppm 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*			*LLDPE*			*HDPE*	
	Extrusion Coating			*Blown Film*			*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.

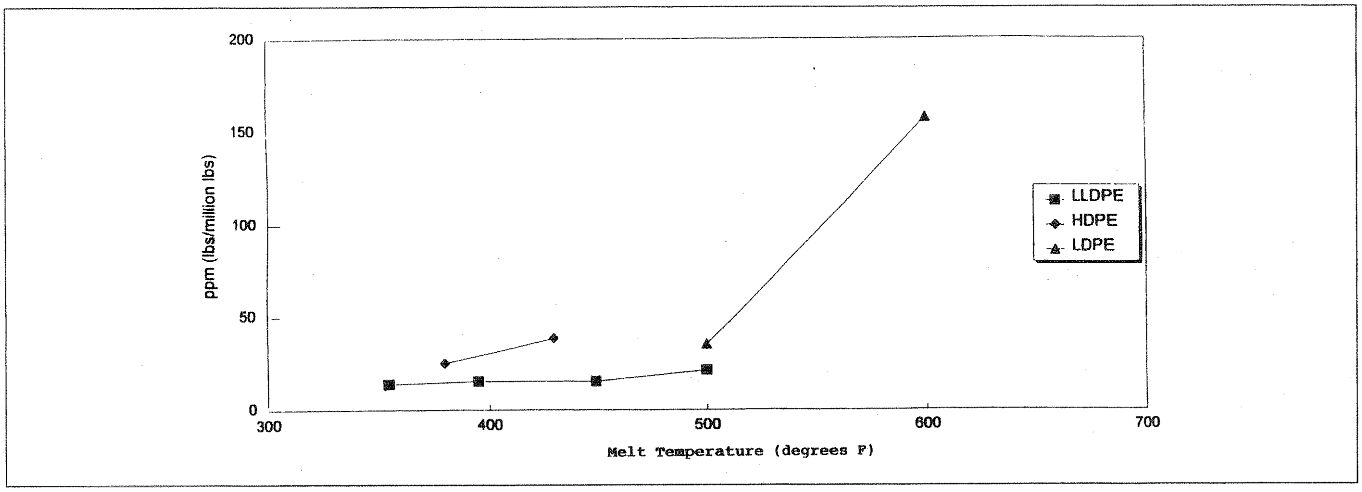

Figure 5. Emissions of VOCs from polyethylene resin composites versus temperature. Note: The equation has not been validated beyond the temperature ranges used in this study. Particular care should be taken when using the equation above the upper test temperature for each resin. Use of this equation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

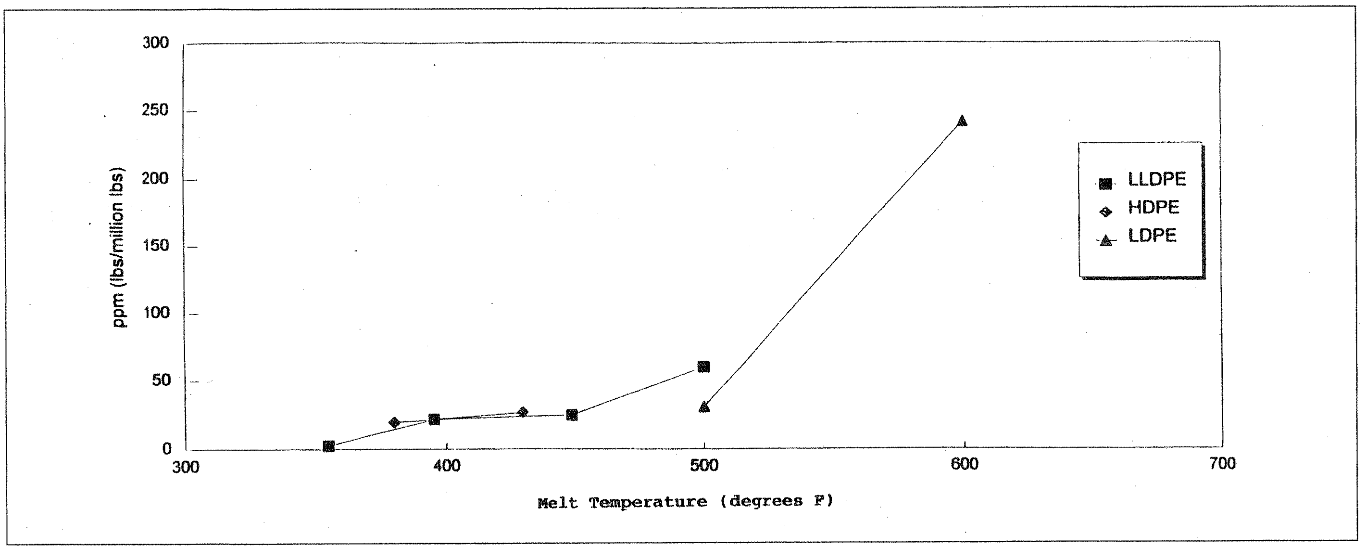

Figure 6. Particulate emissions from polyethylene resin composites versus temperature. Note: The equation has not been validated beyond the temperature ranges used in this study. Particular care should be taken when using the equation above the upper test temperature for each resin. Use of this equation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

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Reynco 54-187

The Reynolds Company
P.O. Box 1925 (29602)
Greenville, SC 29611

Material Safety Data Sheet

Emergency Overview

Molten material may cause thermal burns.

Hazard Rating

HEALTH:	1
FLAMMABILITY:	1
REACTIVITY:	0
PROTECTIVE:	

Date of Print: 1/30/2007

Revision Date: 6/26/2006

1. Identification of the substance/preparation and company

Commercial Product Name:	Reynco 54-187	**Information Phone:**	864-232-6791
Chemical Family:	Synthetic Resin Adhesive	**Chemtrec Emergency:**	1-800-CHEMTREC
Synonyms:			
Product Use:	Hot Melt Adhesive		

2. Composition/Information on Ingredient

Chemical Name	CAS #	**Max %**	OSHA PEL	ACGIH TLV

3. Hazardous Identification

3.1 Potential Health Effects:

Eye Contact: No hazard in normal industrial use.

Inhalation: No hazard in normal industrial use. Heated vapors may have offensive odor that might cause headache, nausea or vomiting.

Ingestion: No hazard in normal industrial use.

Skin Contact: Contact with molten material can cause burns!

3.2 Signs and Symptoms of Exposure:

N/A

4. First Aid Measures

Eye Contact:	Immediately flush eyes with large amounts of water for at least 15 minutes. Do not attempt to remove molten material. Get immediate medical attention.
Inhalation:	Remove affected person to fresh air. Get medical attention if symptoms develop.
Ingestion:	Do not induce vomiting. Get medical attention without delay.
Skin Contact:	Wash affected area with soap and water. If irritation persists, get medical attention.

4.1 Aggravated Medical Conditions:

N/A

4.2 Supplemental Health Information:

N/A

5. Fire-Fighting Measures

5.1 Flammable Properties:

Flash Point:	N/D	Flash Point Method Used:	N/A		
Autoignition::	No data available	**LEL:**	Not applicable	**UEL:**	Not applicable

5.2 Extinguishing Media:

Use water spray or fog, foam, dry chemical or CO2.

5.3 Special Fire-Fighting Procedures:

Wear self-contained breathing apparatus. Keep containers cooled if possible to prevent rupture.

5.4 Unusual Fire and Explosion Hazards:

Material will burn in a fire.

5.5 Combustion Products:

Carbon dioxide, carbon monoxide, various hydrocarbons

6. Accidental Release Measures

6.1 Steps to be taken in case material is released or spilled:

Sweep or vacuum material. Wet material may become slippery.

7. Handling and Storage

7.1 Precautions to be taken in handling and storage:

Avoid contact with molten material. Avoid prolonged breathing of hot vapors.

7.2 Other Precautions:

Store away from heat.

8. Exposure Control/Personal Protection

8.1 Engineering Controls:

Good ventilation should be sufficient to control airborne levels.

Ventilation:

Use in well ventilated area.

8.2 Personal Protection Equipment:

Respiratory Protection:

No respiratory protection required under normal use conditions.

Hand Protection:

Wear gloves to prevent thermal burns from molten product. Rubber or nitrile gloves are sufficient when handling solid form.

Eye Protection:

Safety glasses with side shields.

Other Protective Clothing or Equipment:

N/A

8.3 General Hygiene Practice:

Use good personal hygiene when handling this product. Wash hands after use, before smoking, or using the toilet.

8.4 Exposure Guidelines:

9. Physical and Chemical Properties

9.1 Appearance and Odor: Off-white to tan colored solid with resinous odor.

Form: Solid at room temperature

9.2 Safety Parameters:

Boiling Point: Not applicable
Vapor Pressure: Not applicable
Specific Gravity: 1.10
Melting Point: N/A
Evaporation: N/A
Freezing Point: N/A
Solubility in Water: Insoluble in water

Percent Volatile: N/D
Molecular Weight: Not determined
PH: N/A
Other Properties:
Vapor Density: Nil
VOC: Not determined

10. Stability and Reactivity

10.1 General Information:

Stable:	Stable
Conditions To Avoid:	Avoid high temperatures.
Hazardous Polymerization:	Will Not Occur
Conditions To Avoid:	N/A

10.2 Hazardous Decomposition or By-products

Carbon monoxide, carbon dioxide, various hydrocarbons

10.3 Incompatibility:

None Reported.

11. Toxicology Information

11.1 General Information:

N/A

11.2 Acute Toxicity:

N/A

12. Ecological Information

N/A

13. Disposal Considerations

13.1 Material Disposal:	Reclaim if feasible. If disposal is required, dispose of waste material in sanitary landfill or incinerate in an industrial, commercial or municipal incinerator.
13.2 Packaging Disposal:	N/A

14. Transportation Information

DOT Class:	Not Regulated by DOT - HMR
Hazard Class:	
UN Number:	
Packing:	
Guide Number:	
Proper Shipping Name:	Not Regulated by DOT - HMR

15. Regulatory Information

No information available.

TSCA: N/A

15.1 U.S. Federal Regulations:

N/A

15.2 Additional Regulations:

California: This product contains no chemicals that are known to the state of California to cause cancer, birth defects or reproductive harm.

New Jersey: N/D

Permissible Exposure Limits: N/D

SARA Title III: N/D

Sara Reportable: N/A

SARA Title III Chemicals: N/A

16. Other Information

Warranty and Terms:

The Reynolds Company ("Reynolds") warrants that our products are manufactured in accordance with Reynolds' specifications in effect on the date of manufacture. These specifications are available upon request. This Warranty does not cover test data, or any defects, damages or other harms caused to any extent or in any way by failure to follow applicable Reynolds instructions, if any, or abuse /misuse of the product.

We believe the information included on this Material Safety Data Sheet to be correct, to the best of our knowledge. The recommendations and suggestions herein are made without guarantee or representation as to results. We recommend that tests be made in a laboratory or plant to determine if this product meets all of your requirements. It is the responsibility of the buyer/user to determine the suitability of this product for his/her application/requirements.

Any claim made or action commenced by purchaser/end user under Reynolds' limited warranty as set forth herein must be brought within one year from date of shipment from Reynolds to the purchaser. Purchaser agrees that all disputes arising from Reynolds' sale of product to purchaser shall be brought, if at all, in and before a court located in the state of South Carolina, to the exclusion of the courts of any other state.

For any valid claim presented under the limited warranty, Reynolds will replace the product, or, at its option, refund the purchase price. This replacement/refund resolution is the purchaser's sole and exclusive remedy against Reynolds. The purchaser agrees that no other resolution (including but not limited to lost profits, lost sales, injury to person or property or any other incidental or consequential loss) shall be available to purchaser for claims arising out of any use of the product regardless of the legal theory (contract, tort or other). In no event will Reynolds be obligated to pay damages to purchaser in any amount exceeding the price that the purchaser paid for the product.

DISCLAIMER - The warranty, as stated above, supersedes all other warranties, express or implied. The Reynolds Company expressly disclaims any other warranties, including warranties of merchantability and fitness for a particular purpose. Reynolds Company's acceptance of purchaser's order for this product is expressly conditional on purchaser's assent to terms and conditions set forth herein. Regardless of whether The Reynolds Company suggested the product or developed the product at the purchaser's request, it is the purchaser's responsibility to test and determine the suitability of the product for the purchaser's intended use and purpose, and purchaser assumes all risk and liability whatsoever.

The Dow Chemical Company encourages and expects you to read and understand the entire (M)SDS, as there is important information throughout the document. We expect you to follow the precautions identified in this document unless your use conditions would necessitate other appropriate methods or actions.

1. Product and Company Identification

Product Name
AFFINITY* EG 8185 Polyolefin Plastomer

COMPANY IDENTIFICATION
The Dow Chemical Company
2030 Willard H. Dow Center
Midland, MI 48674
USA

Customer Information Number:	800-258-2436

EMERGENCY TELEPHONE NUMBER

24-Hour Emergency Contact:	989-636-4400
Local Emergency Contact:	989-636-4400

2. Hazards Identification

Emergency Overview

Color: Translucent
Physical State: Pellets
Odor: Odorless
Hazards of product:

Slipping hazard.

OSHA Hazard Communication Standard

This product is not a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

Potential Health Effects

Eye Contact: Solid or dust may cause irritation or corneal injury due to mechanical action. Vapor may cause eye irritation experienced as mild discomfort and redness.
Skin Contact: Prolonged contact is essentially nonirritating to skin. Mechanical injury only. Under normal processing conditions, material is heated to elevated temperatures; contact with the material may cause thermal burns.
Skin Absorption: No adverse effects anticipated by skin absorption.

Inhalation: No adverse effects are anticipated from single exposure to dust. Vapors/fumes released during thermal processing may cause respiratory irritation.
Ingestion: Very low toxicity if swallowed. Harmful effects not anticipated from swallowing small amounts. May cause choking if swallowed.

3. Composition Information

Component	CAS #	Amount
Ethene-1-octene copolymer	26221-73-8	>= 99.0 %

4. First-aid measures

Eye Contact: Flush eyes thoroughly with water for several minutes. Remove contact lenses after the initial 1-2 minutes and continue flushing for several additional minutes. If effects occur, consult a physician, preferably an ophthalmologist.
Skin Contact: If molten material comes in contact with the skin, do not apply ice but cool under ice water or running stream of water. DO NOT attempt to remove the material from skin. Removal could result in severe tissue damage. Seek medical attention immediately.
Inhalation: Move person to fresh air; if effects occur, consult a physician.
Ingestion: If swallowed, seek medical attention. May cause gastrointestinal blockage. Do not give laxatives. Do not induce vomiting unless directed to do so by medical personnel.
Notes to Physician: If burn is present, treat as any thermal burn, after decontamination. No specific antidote. Treatment of exposure should be directed at the control of symptoms and the clinical condition of the patient.

5. Fire Fighting Measures

Extinguishing Media: Water fog or fine spray. Dry chemical fire extinguishers. Carbon dioxide fire extinguishers. Foam.
Fire Fighting Procedures: Keep people away. Isolate fire and deny unnecessary entry. Soak thoroughly with water to cool and prevent re-ignition. If material is molten, do not apply direct water stream. Use fine water spray or foam. Cool surroundings with water to localize fire zone. Hand held dry chemical or carbon dioxide extinguishers may be used for small fires.
Special Protective Equipment for Firefighters: Wear positive-pressure self-contained breathing apparatus (SCBA) and protective fire fighting clothing (includes fire fighting helmet, coat, trousers, boots, and gloves). If protective equipment is not available or not used, fight fire from a protected location or safe distance.
Unusual Fire and Explosion Hazards: Pneumatic conveying and other mechanical handling operations can generate combustible dust. To reduce the potential for dust explosions, do not permit dust to accumulate. Dense smoke is emitted when burned without sufficient oxygen.
Hazardous Combustion Products: During a fire, smoke may contain the original material in addition to combustion products of varying composition which may be toxic and/or irritating. Combustion products may include and are not limited to: Carbon monoxide. Carbon dioxide.

6. Accidental Release Measures

Steps to be Taken if Material is Released or Spilled: Contain spilled material if possible. Sweep up. Collect in suitable and properly labeled containers. See Section 13, Disposal Considerations, for additional information.
Personal Precautions: Spilled material may cause a slipping hazard. Use appropriate safety equipment. For additional information, refer to Section 8, Exposure Controls and Personal Protection.
Environmental Precautions: Prevent from entering into soil, ditches, sewers, waterways and/or groundwater. See Section 12, Ecological Information.

7. Handling and Storage

Handling

General Handling: No smoking, open flames or sources of ignition in handling and storage area. Good housekeeping and controlling of dusts are necessary for safe handling of product. Avoid breathing process fumes. Use with adequate ventilation. When appropriate, unique handling information for containers can be found on the product label. Workers should be protected from the possibility of contact with molten resin. Do not get molten material in eyes, on skin or clothing. Pneumatic conveying and other mechanical handling operations can generate combustible dust. To reduce the potential for dust explosions, electrically bond and ground equipment and do not permit dust to accumulate. Dust can be ignited by static discharge.

Storage

Store in accordance with good manufacturing practices.

8. Exposure Controls / Personal Protection

Exposure Limits

None established

Personal Protection

Eye/Face Protection: Use safety glasses. If there is a potential for exposure to particles which could cause eye discomfort, wear chemical goggles. If exposure causes eye discomfort, use a full-face respirator.

Skin Protection: No precautions other than clean body-covering clothing should be needed.

> **Hand protection:** Chemical protective gloves should not be needed when handling this material. Consistent with general hygienic practice for any material, skin contact should be minimized. Use gloves with insulation for thermal protection, when needed.

Respiratory Protection: Use an approved air-purifying respirator when vapors are generated at increased temperatures or when dust or mist is present. The following should be effective types of air-purifying respirators: When dust/mist are present use a/an Particulate filter. When combinations of vapors, acids, or dusts/mists are present use a/an Organic vapor cartridge with a particulate pre-filter.

Ingestion: Use good personal hygiene. Do not consume or store food in the work area. Wash hands before smoking or eating.

Engineering Controls

Ventilation: Good general ventilation should be sufficient for most conditions. Local exhaust ventilation may be necessary for some operations.

9. Physical and Chemical Properties

Physical State	Pellets
Color	Translucent
Odor	Odorless
Flash Point - Closed Cup	No test data available
Flammable Limits In Air	**Lower**: No test data available **Upper**: No test data available
Autoignition Temperature	No test data available
Vapor Pressure	No test data available
Boiling Point (760 mmHg)	No test data available.
Vapor Density (air = 1)	No test data available
Specific Gravity (H2O = 1)	0.85 - 0.97 *Supplier*

Freezing Point	No test data available
Melting Point	*Supplier* varies
Solubility in Water (by weight)	Nil
pH	No test data available
Kinematic Viscosity	No test data available

10. Stability and Reactivity

Stability/Instability
Stable.
Conditions to Avoid: Exposure to elevated temperatures can cause product to decompose.

Incompatible Materials: None known.

Hazardous Polymerization
Will not occur.

Thermal Decomposition
Decomposition products depend upon temperature, air supply and the presence of other materials. Processing may release fumes and other decomposition products. At temperatures exceeding melt temperatures, polymer fragments can be released. Fumes can be irritating. Decomposition products can include and are not limited to: Aldehydes. Alcohols. Organic acids. Decomposition products can include trace amounts of: Hydrocarbons.

11. Toxicological Information

Acute Toxicity
Ingestion
Estimated LD50, Rat > 5,000 mg/kg
Skin Absorption
Estimated LD50, Rabbit > 2,000 mg/kg

Repeated Dose Toxicity
Additives are encapsulated in the product and are not expected to be released under normal processing conditions or foreseeable emergency.

12. Ecological Information

CHEMICAL FATE

Movement & Partitioning
No bioconcentration is expected because of the relatively high molecular weight (MW greater than 1000). In the terrestrial environment, material is expected to remain in the soil. In the aquatic environment, material is expected to float.

Persistence and Degradability
This water-insoluble polymeric solid is expected to be inert in the environment. Surface photodegradation is expected with exposure to sunlight. No appreciable biodegradation is expected.

ECOTOXICITY
Not expected to be acutely toxic, but material in pellet or bead form may mechanically cause adverse effects if ingested by waterfowl or aquatic life.

13. Disposal Considerations

DO NOT DUMP INTO ANY SEWERS, ON THE GROUND, OR INTO ANY BODY OF WATER. All disposal practices must be in compliance with all Federal, State/Provincial and local laws and regulations. Regulations may vary in different locations. Waste characterizations and compliance with applicable laws are the responsibility solely of the waste generator. DOW HAS NO CONTROL OVER THE MANAGEMENT PRACTICES OR MANUFACTURING PROCESSES OF PARTIES HANDLING OR USING THIS MATERIAL. THE INFORMATION PRESENTED HERE PERTAINS ONLY TO THE PRODUCT AS SHIPPED IN ITS INTENDED CONDITION AS DESCRIBED IN MSDS SECTION: Composition Information. FOR UNUSED & UNCONTAMINATED PRODUCT, the preferred options include sending to a licensed, permitted: Recycler. Reclaimer. Incinerator or other thermal destruction device. Landfill.

14. Transport Information

DOT Non-Bulk
NOT REGULATED

DOT Bulk
NOT REGULATED

IMDG
NOT REGULATED

ICAO/IATA
NOT REGULATED

This information is not intended to convey all specific regulatory or operational requirements/information relating to this product. Additional transportation system information can be obtained through an authorized sales or customer service representative. It is the responsibility of the transporting organization to follow all applicable laws, regulations and rules relating to the transportation of the material.

15. Regulatory Information

OSHA Hazard Communication Standard
This product is not a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

Superfund Amendments and Reauthorization Act of 1986 Title III (Emergency Planning and Community Right-to-Know Act of 1986) Sections 311 and 312

Immediate (Acute) Health Hazard	No
Delayed (Chronic) Health Hazard	No
Fire Hazard	No
Reactive Hazard	No
Sudden Release of Pressure Hazard	No

Superfund Amendments and Reauthorization Act of 1986 Title III (Emergency Planning and Community Right-to-Know Act of 1986) Section 313
To the best of our knowledge, this product does not contain chemicals at levels which require reporting under this statute.

Pennsylvania (Worker and Community Right-To-Know Act): Pennsylvania Hazardous Substances List and/or Pennsylvania Environmental Hazardous Substance List:
To the best of our knowledge, this product does not contain chemicals at levels which require reporting under this statute.

Pennsylvania (Worker and Community Right-To-Know Act): Pennsylvania Special Hazardous Substances List:
To the best of our knowledge, this product does not contain chemicals at levels which require reporting under this statute.

California Proposition 65 (Safe Drinking Water and Toxic Enforcement Act of 1986)
This product contains no listed substances known to the State of California to cause cancer, birth defects or other reproductive harm, at levels which would require a warning under the statute.

US. Toxic Substances Control Act
All components of this product are on the TSCA Inventory or are exempt from TSCA Inventory requirements under 40 CFR 720.30

CEPA - Domestic Substances List (DSL)
All substances contained in this product are listed on the Canadian Domestic Substances List (DSL) or are not required to be listed.

16. Other Information

Recommended Uses and Restrictions

A polyethylene plastic- For industrial conversion as a raw material for manufacture of articles or goods. Dow recommends that you use this product in a manner consistent with the listed use. If your intended use is not consistent with Dow's stated use, please contact Dow's Customer Information Group.

Revision

Identification Number: 80383 / 1001 / Issue Date 06/13/2006 / Version: 3.0
Most recent revision(s) are noted by the bold, double bars in left-hand margin throughout this document.

Legend

N/A	Not available
W/W	Weight/Weight
OEL	Occupational Exposure Limit
STEL	Short Term Exposure Limit
TWA	Time Weighted Average
ACGIH	American Conference of Governmental Industrial Hygienists, Inc.
DOW IHG	Dow Industrial Hygiene Guideline
WEEL	Workplace Environmental Exposure Level
HAZ_DES	Hazard Designation

The Dow Chemical Company urges each customer or recipient of this (M)SDS to study it carefully and consult appropriate expertise, as necessary or appropriate, to become aware of and understand the data contained in this (M)SDS and any hazards associated with the product. The information herein is provided in good faith and believed to be accurate as of the effective date shown above. However, no warranty, express or implied, is given. Regulatory requirements are subject to change and may differ between various locations. It is the buyer's/user's responsibility to ensure that his activities comply with all federal, state, provincial or local laws. The information presented here pertains only to the product as shipped. Since conditions for use of the product are not under the control of the manufacturer, it is the buyer's/user's duty to determine the conditions necessary for the safe use of this product. Due to the proliferation of sources for information such as manufacturer-specific (M)SDSs, we are not and cannot be responsible for (M)SDSs obtained from any source other than ourselves. If you have *obtained an (M)SDS from another source or if you are not sure that the (M)SDS you have is current, please contact us for the most current version.*

BORAL MATERIAL TECHNOLOGIES

Material Safety Data Sheet
This document has been prepared to comply
with OSHA's Hazard Communication
Standard, 29 CFR 1910.1200

45 N.E. Loop 410, Suite 700
San Antonio, Texas 78216
Phone: (210) 349-4069
FAX:(210) 349-8512
E-mail: info@BORAL.com

Classification: Calcium Aluminum Silicate

Identity (as used on label and list)
Boral Celceram^{TM} PV20A

Section I – Identity Information

Chemical Name NA		**Emergency Telephone Number** 1(800)424-9300 **(CHEMTREC)**
Chemical Family Calcium Alumina Silica Glass Spheres	**CAS#** 68131-74-8	**Telephone Number for Information** (210)349-4069
Date Prepared 2/15/93		**Date Revised** 6/24/05

Section II Hazardous Ingredients

Ingredients	**CAS#**	**%Weight**	**Exposure limits** **OSHA PEL** mg/m^3	 **ACGIH TLV** mg/m^3
Calcium Aluminum Silicates	Various	>80%	15	10
Quartz (Respirable)	14808-60-7	Varies	10/(%SiO2+2)	0.05
Iron Compounds	Various	Varies	Not available	Not available
Calcium Oxide	1305-78-8	<2%	5	2

The above chemistries are provided for industrial hygiene and environmental purposes and are not intended to represent product specifications. Composition can be variable. This data has been compiled from data believed to be reliable. Elements such as aluminum, arsenic, boron, calcium, chromium, cobalt, copper, gold, lead, molybdenum, nickel, silver, tin, titanium, vanadium, and zirconium may be present in trace amounts.

Section III – Physical/Chemical Characteristics

Boiling Point (°F) Not Applicable	**Specific Gravity(H2O=1)** Not Applicable
Vapor Pressure (mm Hg.) Not Applicable	**Percent Volatile by Volume(%)** Not Applicable
Vapor Density (Air=1) Not Applicable	**Evaporation Rate** (Butyl Acetate=1) Not Applicable
Solubility in water Not Applicable	**pH** 4-12 (1%w/w)

Appearance and Odor
Dark Gray to Light Brown Powder, Odorless.

Section IV – Fire and Explosion Hazard Data

Flash Point Not Applicable	**Flammable Limits:** **LEL** Not Applicable **UEL** Not Applicable

Extinguishing Media
Not Applicable
Special Fire Fighting Procedures
Not Applicable
Unusual Fire and Explosion Hazards
Not Applicable

Section V - Reactivity Data

Material as shipped is not reactive

Section VI - Health Hazard Data

ACUTE EFFECTS OF OVEREXPOSURE:
Eye: May cause irritation by abrasion with dust.
Skin: Dust may cause irritation in hypersensitive individuals.
Inhalation: Dust may cause congestion and irritation in nasal and respiratory passages.
Ingestion: No known acute effects.
CHRONIC EFFECTS OF OVEREXPOSURE:
Excessive exposures to respirable particulate (dust) over an extended period of time may result in the development of pulmonary diseases such as silicosis.
CARCINOGENICITY:
The following carcinogenicity classifications for crystalline silica have been established by the following agencies:
OSHA: Not regulated as a carcinogen
IARC: Group 1 carcinogenic in humans
NIOSH: Carcinogen, with no further categorization
NTP: Known Human Carcinogen

WARNING: Material may contain crystalline silica. Inhalation of dust above established or recommended exposure levels should be avoided by use of proper ventilation and/or use of a NIOSH approved respirator.

Section VII – Precautions for Safe Handling and Use

VENTILATION: Provide adequate ventilation to maintain exposures below the OSHA PEL and ACGIH TLV for quartz and nuisance dust.

RESPIRATORY PROTECTION: None required under PEL. IF PEL is exceeded, use a NIOSH approved half or full-face air purifying respirator with high efficiency particulate air filters.

PROTECTIVE GLOVES: Work gloves as needed

EYE PORTECTION: Recommend Safety goggles or safety glasses. Eye wash stations should be readily accessible.

OTHER PROTECTIVE CLOTHING OR EQUIPMENT: As needed.

Steps to be taken in case Material is Released or Spilled: Clean up for use or disposal. Dampen with water mist to control dust (airborne dust) before removal. Do not use compressed air. If loaded on trucks wet down material to prevent dusting during transport. Observe local, state, and federal regulations pertinent to reporting requirements.

Waste Disposal Method: Dispose of in a landfill or coal ash disposal pond. Observe local, state and federal regulations. This material is not a RCRA hazardous waste.

Precautions to Be Taken in Handling and Storing: Store in dry conditions. Minimize dust. Avoid creating dust.

Section VIII – First Aid and Medical

SKIN: Wash with soap and water. If an allergic reaction causes a rash that does not heal within a few days, consult a physician
EYES: Flush with running water. Obtain medical assistance if irritation continues.
INGESTION: Do not induce vomiting. See a physician
INHALATION: Remove from exposure to airborne particulates.
Medical Conditions Aggravated by Exposure: Excessive dust exposure may aggravate any existing respiratory disorders or diseases. Possible complications or allergies resulting in irritation to skin, eyes, and respiratory tract may occur from excessive exposure to dusts.

Section IX – Other Regulations

RCRA: This material is not a RCRA hazardous waste.
EPCRA Section 311/312: Material as shipped is subject to Section 311/312 reporting.
EPCRA Section 313: Material as shipped is not subject to Section 313, Toxic Chemical Release Inventory reporting requirements.
DOT: Material as shipped is not a hazardous material as per DOT regulations
TSCA: This material is listed in the TSCA Chemical Substance Inventory.
UN/NA Code: None
Placard Required: None
Labeling Requirement: None

The information and recommendations set forth herein are based on data we have in our possession and we have reason to believe is accurate. It is, however, the user's responsibility to determine the safety, toxicity, and suitability for his own use of the herein described product. Because the actual utilization of this product by others is beyond our control, Boral Materials Technologies Inc. makes no warranty expressed or implied regarding accuracy of the data or the results to be obtained from the use thereof.

Modular Olefin Tile Coater (MOTC) Flow Diagram