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Pultrusion Industry Council Phase II Emission Study

Report

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1. Introduction

> The Pultrusion Industry Council[1] Phase I Emission Study showed that the operating variable with the largest impact on emissions was air flow across wet areas of the pultrusion operation.

> The PIC designed a Phase II Study to better determine emission reductions that may be obtained through managing air flows across wet areas of the pultrusion operation.

> Experimental conditions in the Phase II Study were:
  - > Partial covers over the wet areas
  - > Maximum cover over the wet areas
  - > Covers with exhaust
  - > Proprietary preform injection and direct die injection
  - > Reduction in velocity of the air in contact with wet resin

> Each experimental condition is considered a potentially useful method of reducing air flows (and therefore emissions), or of capturing emissions for possible abatement.

> These methods of minimizing contact of wet resin and plant air are not necessarily feasible for all pultrusion operations. In particular, use of preform or direct die resin injection, or enclosures, will be considerably more difficult, if not impossible using readily available technology, for the pultrusion of very large parts, for parts with complex reinforcement, or for parts requiring certain physical or chemical properties.

> This report summarizes the objectives, experimental design, analytical procedures, data, and conclusions of the Phase II Study.

2. Objectives

- The Pultrusion Industry Council Phase I Emission Study[2] evaluated several manufacturing variables for effect on emission of styrene from the pultrusion process. Of the variables studied, air flow through the test chamber had, by far, the largest effect on emissions.

- Based on this result, the Phase II Study was designed to evaluate the following methods of controlling air flow across areas of wet resin: use of an enclosure around the wet areas[3] of the process line, otherwise minimizing air flow across wet areas, and the use of resin injection.

- The Phase II Study was also designed to determine the effect of withdrawing small quantities of air with high concentrations of styrene from the wet areas of the process line. This determination will be useful in evaluating the practicality of various abatement devices.

3. Experimental design

> The Phase II Study made use of the Reichhold Chemical[4] laboratory pultrusion line inside a Temporary Total Enclosure.

> The Temporary Total Enclosure (TTE) was designed and operated in keeping with EPA criteria.[5] A frame was constructed around the pultrusion machine, and covered with plastic film. The TTE was exhausted via duct and blower to a location outside of the laboratory. For runs where Wet Area Enclosures located within the TTE were to be exhausted (Runs E, G, and G1), a separate blower and duct were employed.

> The Reichhold pultrusion machine is a typical production-scale machine. The die, resin bath and reservoir, preformers, and preform injection device were all designed to produce commercial ladder rail.[6] The direct die injector was a prototype device which had not been used to make commercial product.

> Because pultrusion lines differ in the extent to which they may be practically covered (some products and lines require complex feeds of glass or veil, and frequent manual adjustment by operators), two different WAE designs were evaluated: in Run D, a WAE that was 66% of the length of the wet area; and in Run F, a WAE that maximally covered the wet area.

> Experimental conditions and runs were as follows:[7]

Run	Experimental conditions
A, AA	Covers on resin bath and reservoir.
A1	Only the reservoir covered.
D, DD	Cover on 66% of the wet area (66% Wet Area Enclosure).[8]
E	Air exhausted from the 66% WAE.[9]
F	Maximum WAE.[10]
G	Air exhausted from the maximum WAE.[11]
G1	Air exhausted from the resin bath as well as from the maximum WAE.[12]
H	Proprietary preform injection.
I	Proprietary direct die injection.
J	Plant air flow reduced to 15 ft/min at the wet areas of the pultrusion line.

> The Runs were conducted in the following semi-randomized order:[13]
A, A1, J, G, G1, F, D, E, AA, DD, H, I.

> The following factors were held constant through all experiments and runs:

- Air flow (exhaust) out of the TTE was kept at a level sufficient to meet the EPA TTE design criteria.
- Resin temperature was maintained as appropriate and typical for the part being produced.
- Laboratory temperature and humidity were ambient.
- Pull rate through the pultrusion machine was 23.5 +/- 0.5 in/min for all runs.
- Styrene content in the resin was maintained at the level appropriate and typical for the part being produced and the manufacturing method.
- The product made was a commercial ladder rail profile.
- Plant air flow at wet areas was 100 ft/min, except Run J.[14]
- Sampling started when the styrene concentration in the exhaust achieved a steady level (+/- 10%) for 15 minutes, as measured by the THA.
- The resin reservoir was covered for all runs. The resin bath was covered for all runs except A1 (runs H and I did not employ baths).

4. Analytical procedures

> The Phase I Study employed absorption on charcoal tubes and subsequent desorption with carbon disulfide and analysis by GC-FID (Dow method HEH-IHM-81-30). Phase II employed this same technology. Dow Chemical provided the equipment and analytical services for this procedure.

> Phase II also used a THA (Total Hydrocarbon Analyzer; EPA Method 25A). The THA equipment and operator were provided by the US EPA Office of Research and Development. Quality assurance of THA operation was also provided by EPA.[15]

> The THA provided real-time readings of styrene concentration in the WAE and TTE ducts, which were employed to determine the start time for each run (when the concentration had remained level for 15 minutes), and to set the WAE exhaust flow in Run G.

> Air flow measurements (of TTE and WAE exhaust, plant air flows, and flow through the TTE Natural Draft Opening) were obtained by hot wire anemometer. Anemometer readings of air flow in the TTE duct were within 10% of digital pitot tube readings (checked daily).

> Background styrene concentrations in the laboratory were determined by both THA and carbon tube.

5. THA data summary

Run	A	A1	AA	D	DD	E	F	G	G1	H	I	J
Experimental Condition	Control w/ resin bath covered	Control w/ no cover on resin bath	Replicate of A	66%WAE static	Replicate of D	66%WAE w/ exhaust	Max. WAE static	Max. WAE w/ exhaust	G w/ resin bath exhaust	Preform injection **	Die injection **	15ft/min plant air flow ***
TTE exhaust; cfm	198	198	198	198	198	198	198	198	198	198	198	198
TTE styrene content; ppm *	291	293	283	234	221	82	119	18	12	28	4	154
TTE styrene emitted; lbs/hr (x)	0.92	0.93	0.90	0.74	0.70	0.26	0.38	0.06	0.04	0.09	0.01	0.49
WAE exhaust; cfm	n/a	n/a	n/a	n/a	n/a	84.2	n/a	58	58	n/a	n/a	n/a
WAE styrene content; ppm *	n/a	n/a	n/a	n/a	n/a	366	n/a	643	719	n/a	n/a	j/a
WAE styrene emitted; lbs/hr (y)	n/a	n/a	n/a	n/a	n/a	0.49	n/a	0.60	0.67	n/a	n/a	n/a
Total styrene emitted, lbs/hour[16]	0.92	0.93	0.90	0.74	0.70	0.75	0.38	0.66	0.71	0.09	0.01	0.49

Notes: n/a= not applicable; * less background; ** proprietary technology; *** vs. 100 ft/min for all other runs

6. Carbon tube data summary, and comparison to THA data

Run	Carbon Tube											THA
	Air flow (cfm)	Tube No.	Sampl time (min.)	Conc. (ppm)	Emissions (lbs/hr)	Tube No.	Sampl time (min.)	Conc. (ppm)	Emissions (lbs/hr)	Avg. emis. (lbs/hr)	Stand. Deviation	Emissions (lbs/hr)
A	221	5	60	250	0.881	6	30	160	0.564	0.723	0.159	0.920
A1	221	7	60	240	0.846	9	30	240	0.846	0.846	0.000	0.930
AA	221	22	15	240	0.846	25	30	200	0.705	0.776	0.071	0.900
D	221	19	16	260	0.916					0.916		0.740
DD	221	27	15	58	0.204	30	30	210	0.740	0.472	0.268	0.700
E-TTE	221	20	30	110	0.388	21	15	160	0.564	0.476	0.088	0.260
E-WAE	79	23	30	330	0.414	24	15	320	0.401	0.408	0.007	0.490
F	221	17	16	230	0.811	18	30	130	0.458	0.635	0.177	0.380
G-TTE	221	15	11	110	0.388					0.388		0.060
G-WAE	56	13	15	530	0.470	14	30	520	0.461	0.466	0.005	0.600
G1-WAE	56	16	23	390	0.346					0.346		0.670
H	221	34	30	16	0.056	35	60	35	0.123	0.090	0.034	0.090
I	221	31	34	21	0.074	32	60	12	0.042	0.058	0.016	0.010
J	221	10	30	150	0.529	11	30	130	0.458	0.494	0.036	0.490
					x_1				x_2	$(\Sigma x_i)/2$	$((\Sigma(x_i - avg)^2)/2)^{1/2}$	

7. Measures of Reliability and Validity

> A "mass balance" run was employed to confirm the THA readings. In this run, a known amount of styrene was evaporated in the TTE exhaust duct. At the same time, air flow readings and THA readings were used to calculate the mass of styrene present in the duct. The actual and calculated styrene mass numbers agreed to within 7.5%.[17]

> THA readings were also compared to readings obtained with Matheson Gas Tubes[18], as shown:

	ppm, THA	ppm, Gas tube
Sept. 8 reading of TTE exhaust	150	150
Sept. 13 reading of TTE exhaust	90	100
Sept. 13 reading of WAE exhaust	380	300

> Runs A and D were run in replicate, with results as shown:

	lbs/hour styrene (THA)
Run A (Sept. 12)	0.92
Run AA (Sept. 14)	0.90
Run D (Sept. 13)	0.74
Run DD (Sept. 14)	0.70

> The THA instrument was calibrated with a propane standard prior to each run.

> Regression analysis was performed on the duplicate (within-run) carbon tube results, and on the average carbon tube results compared to the THA results. The regression coefficients are as follows:

	All runs	Runs with duplicate tube std. dev. < 0.1lb/hr
Duplicate carbon tubes	0.43	0.90
Avg. carbon tube vs. THA	0.63	0.90

> The regression coefficients calculated with all runs are low enough to suggest that the carbon tube data is not reliable.

> Considering only those runs where there is low variability between the duplicates (standard deviation less than 0.1) yields acceptable coefficients; however, the statistical validity of this analysis is undetermined.

> The carbon tube results are not considered further in this report.

> Physical testing was performed on samples from each run, to confirm that the product made was representative of commercial product. All runs yielded product of acceptable physical quality, except run I. Physical testing data is shown in Appendix D.

8. Conclusions[19]

- Covering the resin bath had no significant impact on emissions.

	total lbs/hour (THA)	
Control (bath covered)	0.91	(Average of Runs A and AA)
Bath not covered	0.93	(Run A1)

- Use of the 66% WAE resulted in a 21% reduction in emissions.

	total lbs/hour (THA)	
Control	0.91	(Average of Runs A and AA)
66% WAE	0.72	(Average of Runs D and DD)

- Exhausting the 66% WAE captured 65% of the emissions, but did not affect total emissions.

	lbs/hour (THA)			
	TTE	WAE	Total	
66% WAE	0.72	n/a	0.72	(Average of Runs D and DD)
66% WAE w/ exhaust	0.26	0.49	0.75	(Run E)

> Use of the Maximum WAE resulted in a 58% reduction in emissions.

	total lbs/hour (THA)	
Control	0.91	(Average of Runs A and AA
Max. WAE	0.38	(Run F)

> Exhausting the Maximum WAE captured 91% of the emissions, but the air flow through the WAE increased total emissions by a factor of 1.74.

	lbs/hour (THA)			
	TTE	WAE	Total	
Max. WAE	0.38	n/a	0.38	(Run F)
Max. WAE w/ exhaust	0.06	0.60	0.66	(Run G)

> Exhausting the resin bath in addition to the Maximum WAE slightly increased total emissions.

	lbs/hour (THA)			
	TTE	WAE	Total	
Max. WAE w/ exhaust	0.06	0.60	0.66	(Run G)
Max. WAE w/ exhaust and resin bath exhaust	0.04	0.67	0.71	(Run G1)

- Use of the proprietary preform injection resulted in a 90% reduction in emissions.

	total lbs/hour (THA)	
Control	0.91	(Average of Runs A and AA)
Preform injection	0.09	(Run H)

- Use of the proprietary die injection resulted in a 99% reduction in emissions.

	total lbs/hour (THA)	
Control	0.91	(Average of Runs A and AA)
Direct die injection	0.01	(Run I)

- Reducing plant air flows at the wet area, from 100 ft/min to 15 ft/min, resulted in a 46% reduction in emissions.

	total lbs/hour (THA)	
Control	0.91	(Average of Runs A and AA)
Reduced plant air flow	0.49	(Run J)

- Of the various methods of minimizing contact of wet resin and plant air evaluated in this study, none are necessarily feasible for all pultrusion operations. In particular, use of resin injection or enclosures will be considerably more difficult, if not impossible using readily available technology, for the pultrusion of very large parts, for parts with complex reinforcement, or for parts requiring certain physical or chemical properties. (Note the unacceptably low physical properties obtained with the direct die injector.)

Notes

1. The Pultrusion Industry Council (PIC) is an activity of the Society of the Plastics Industry's (SPI) Composites Institute. SPI is the national trade association for the plastics industry. The Phase II Study was a program of the PIC Technical Committee's Emission Study Task Group, chaired by Tom Griffiths, Omega Pultrusions. Nelson Douglass and Mike Prysock, Reichhold Chemical, provided pultrusion facilities and operational expertise. Clint Smith and Gary Bridgeman, MMFG, provided tooling and operational assistance. Eloy Martinez and Ellen Lackey, Dow Chemical, provided analytical and industrial hygiene services. John Schweitzer, SPI Composites Institute, designed and coordinated the Phase II Study.

2. Report issued May 3, 1993.

3. The "wet area" is the area where liquid resin is exposed to the atmosphere, and includes the wet glass between the exit of the resin bath and the entrance to the die, and any drip pans in this area. It does not include the resin bath.

4. Research Triangle Park, NC.

5. The Measurement Solution: Using a Temporary Total Enclosure for Capture Efficiency Testing, US EPA OAQPS, August 1991.

6. However, a number of operating conditions were arbitrarily chosen and held constant, and may not be typical for commercial operations. For example, if the size and geometry of the drip pan were optimized to minimize exposed resin, or if the pull-rate were increased, then emissions would change.

7. Planned runs B and C, which were to evaluate a 40% WAE, were not run due to limited availability of the Reichhold laboratory.

8. In Run D, a sheet-metal hood was placed in the wet area (between the exit of the resin bath and the entrance to the die). The enclosure was 21.5 inches long (66% of the length of the wet area), 21.75 inches high, and 20.5 inches wide. The enclosure was completely open at the ends facing the bath and die. See Appendix A.

9. In Run E, the WAE exhaust damper was opened fully. Due to the large size of the WAE openings, and the turbulent plant air flow, it was not possible to accurately measure the air flow into the WAE openings. However, note that the WAE in Run E captured 65% of total styrene emissions.

10. In Run F, a sheet-metal hood was constructed, and sealed with plastic film, to cover the maximum practical area between the exit of the resin bath and the entrance to the die. See Appendix A.

11. In preparation for Run G, the WAE exhaust damper was closed until the styrene concentration in the TTE exhaust started to increase. The damper was then opened slightly to achieve the lowest-possible TTE styrene concentration (the highest capture efficiency for the WAE). Use of a smoke pencil showed air flowing into the WAE through all openings.

12. The conditions for Run G1 were the same as for Run G, except in G1 the damper to the duct attached to the cover of the resin bath was opened very slightly. Use of a smoke pencil showed air flowing into all openings of the resin bath.

13. Some runs were paired to minimize equipment changes.

14. Plant air flow was maintained by placing a fan above the wet area, pointed down. A Variac and the fan speed control were employed to adjust the air flow at the wet area; adjustments were made so that the average of hot wire anemometer readings at the exit of the resin bath, mid-point of the wet area, and entrance to the die was 100 ft/min for all runs except Run J, where the average was 15 ft/min. Air flow was measured and adjusted before any WAE was installed.

15. The following US EPA personnel provided essential guidance and services to the Phase II Study: Jim Berry, Norm Kaplan, Carlos Nunez, Geddes Ramsy, Jeff Ryan, Madeleine Strum, and Shirley Wasson. Mark Bahner, Emery Kong, and Robert Wright, of Research Triangle Institute (under contract to EPA), also provided necessary services and advice.

16. Emissions in pounds per hour were calculated with the formula:

(conc.)ppm x (air flow)ft^3/min. x $1x10^{-6}$(cm^3styrene)/(cm^3air/ppm) x $9.4x10^{-6}$(lbs.styrene)/(cm^3styrene gas) x 28,316 cm^3/ft^3 x 60 min/hour = lbs. styrene/hour

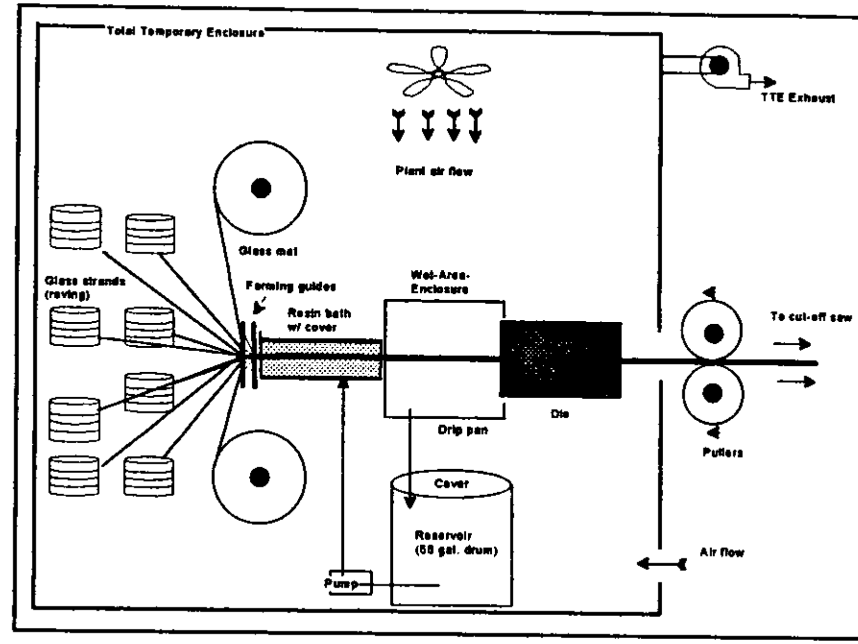
17. A previous mass balance trial resulted in a variance (to THA readings) of 59%, due to errors in weighing the styrene evaporated in the duct.

18. Matheson tube #158S, for determination of styrene concentration in the range of 2.5-300ppm.

19. The conclusions apply only to the specific conditions and circumstances of the Phase II Study. The applicability of the results of the Phase II Study to other pultrusion operations is undetermined, and any such use of the data or conclusions should be based on careful engineering judgement of persons familiar with the operation in question.

Table of Appendices

Experimental set-up



Dimensions

Exit of bath to die entrance - 33in.

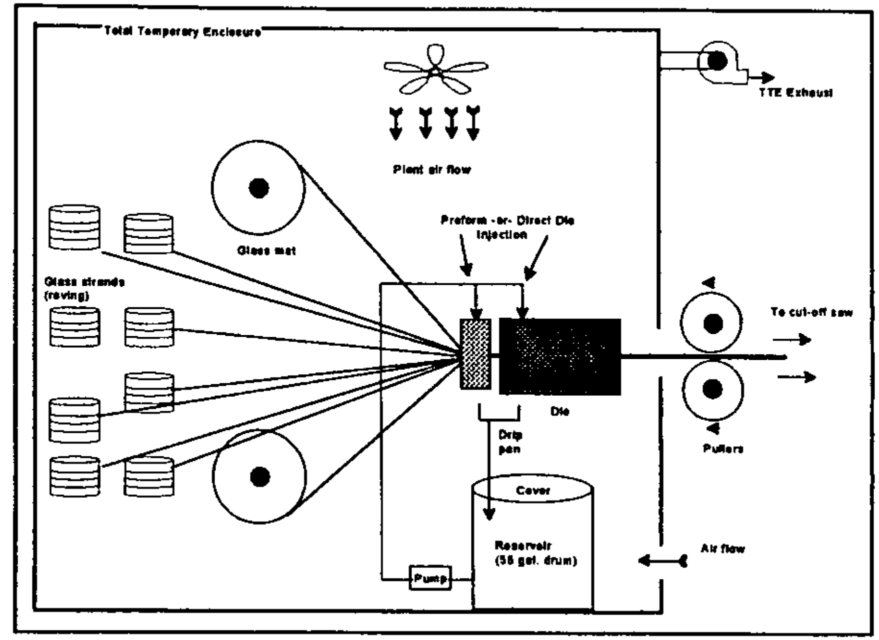
WAE height - 21.75in.

WAE depth - 20.5in.

Length of 66% WAE - 21.5in. The enclosure was left open at the ends. The open area at each end was 21.5 x 20 .5 = 441 sq.in.

Length of Maximum WAE - 32.5in. Ends of Max. WAE were sealed to the resin bath and die with plastic film and tape.

Preform and direct die injection



Method 25A - Total Hydrocarbon Analyzer
DATA ANALYSIS

Mass Balance

Calibration

Calibration Factor

Concentration (ppmv)		Reading (volt)	Calibration Factor (ppmv/volt)
propane	styrene		
0.0	0.0	0.0204	
153.4	57.5	2.8304	20.47
278.0	104.3	5.1168	20.46
453.6	170.1	8.3917	20.32
Average Factor			20.42
Standard Deviation			0.08
Error			0.4%

Accuracy

Concentration	Reading		Error
	Measured	Calculated	
Low	2.8304	2.8514	0.7%
Mid	5.1168	5.1509	0.7%

Styrene Concentration

Two runs were conducted to determine the overall accuracy of the Total Temporary Enclosure (TTA). The evaporated styrene was determined by using the THA and weight losses.

Correction for temperature and pressure were not made for the calculation of weight losses. Standard conditions were assumed.

THA (ppmv)	THA (g)	Weight Loss (g)	Variability (%)
12.9	9.5	6.0	-59.1%
31.6	23.4	21.8	-7.5%

Run A

Calibration

Calibration Factor

Concentration (ppmv)		Reading (volt)	Calibration Factor (ppmv/volt)
propane	styrene		
0.0	0.0	0.0025	
153.4	57.5	0.2865	202.6
278.0	104.3	0.5202	201.4
453.6	170.1	0.8540	199.8

Average Factor	201.2
Standard Deviation	1.40
Error	0.7%

Accuracy

Concentration	Reading		Error
	Measured	Calculated	
Low	0.2865	0.2905	1.4%
High	0.5202	0.5244	0.8%

Styrene Concentration

The pultrusion line was operated with no controls. Only covers were placed on the resin bath resin bath and reservoir.

Total Concentration	297 ppmv
Background Concentration	6 ppmv
Styrene Concentration	291 ppmv

Audit

A quality assurance audit of the calibration and sampling capabilities was conducted at the end of the calibration procedure. Errors of 2.5% and -6.6% were obtained for the calibration and sampling ports, respectively.

Run A1

Calibration

Calibration Factor

Concentration (ppmv)		Reading (volt)	Calibration Factor (ppmv/volt)
propane	styrene		
0.0	0.0	0.0125	
153.4	57.5	0.2947	203.9
278.0	104.3	0.5346	199.7
453.6	170.1	0.8786	196.4
Average Factor			200.0
Standard Deviation			3.74
Error			1.9%

Accuracy

Concentration	Reading		Error
	Measured	Calculated	
Low	0.2947	0.3054	3.5%
High	0.5346	0.5433	1.6%

Styrene Concentration

In this run only the reservior was covered.

Total Concentration	299 ppmv
Background Concentration	6 ppmv
Styrene Concentration	293 ppmv

Run J

Calibration

Calibration Factor

Concentration (ppmv) propane	Concentration (ppmv) styrene	Reading (volt)	Calibration Factor (ppmv/volt)
0.0	0.0	0.0111	
153.4	57.5	0.2939	203.4
278.0	104.3	0.5317	200.3
453.6	170.1	0.8758	196.7
Average Factor			200.1
Standard Deviation			3.33
Error			1.7%

Accuracy

Concentration	Reading Measured	Reading Calculated	Error
Low	0.2939	0.3035	3.2%
High	0.5317	0.5410	1.7%

Styrene Concentration

The plant air velocity was reduced to 15 ft/min at the wet areas of the pultrusion line.

Total Concentration	159 ppmv
Background Concentration	5 ppmv
Styrene Concentration	154 ppmv

Run G

Calibration

Calibration Factor

Concentration (ppmV)		Reading	Calibration Factor
propane	styrene	(volt)	(ppmv/volt)
0.0	0.0	0.0198	
153.4	57.5	0.2908	212.3
278.0	104.3	0.5271	205.5
453.6	170.1	0.8634	201.6

Average Factor	206.5
Standard Deviation	5.40
Error	2.6%

Accuracy

Concentration	Reading		Error
	Measured	Calculated	
Low	0.2908	0.3051	4.7%
High	0.5271	0.5368	1.8%

Styrene Concentration

In this run, the cover was designed to cover the maximum practical area. Small quantities of air were taken from the Wet Area Enclosure and the Total Temporary Enclosure. This run was designed to evaluate the feasibility of using close capture.

The background concentration was already substrated from the styrene reported values.

Background Concentration	7 ppmv
Styrene Concentration - Lower Duc	18 ppmv
Styrene Concentration - Upper Duct	643 ppmv

Run G1

Calibration

Calibration Factor

Concentration (ppmv)		Reading (volt)	Calibration Factor (ppmv/volt)
propane	styrene		
0.0	0.0	0.0198	
153.4	57.5	0.2908	212.3
278.0	104.3	0.5271	205.5
453.6	170.1	0.8634	201.6
Average Factor			206.5
Standard Deviation			5.40
Error			2.6%

Accuracy

Concentration	Reading		Error
	Measured	Calculated	
Low	0.2908	0.3051	4.7%
High	0.5271	0.5368	1.8%

Styrene Concentration

In this run, air was removed from the resin bath and from the maximum Wet Area Enclosure.

The background concentration was already substrated from the styrene reported values.

Background Concentration	7 ppmv
Styrene Concentration - Lower Duc	12 ppmv
Styrene Concentration - Upper Duct	719 ppmv

Run F

Calibration

Calibration Factor

Concentration (ppmv)		Reading (volt)	Calibration Factor (ppmv/volt)
propane	styrene		
0.0	0.0	0.0198	
153.4	57.5	0.2908	212.3
278.0	104.3	0.5271	205.5
453.6	170.1	0.8634	201.6
Average Factor			206.5
Standard Deviation			5.40
Error			2.6%

Accuracy

Concentration	Reading		Error
	Measured	Calculated	
Low	0.2908	0.3051	4.7%
High	0.5271	0.5368	1.8%

Styrene Concentration

In this run, the cover was designed to cover the maximum practical area.

Total Concentration	126 ppmv
Background Concentration	7 ppmv
Styrene Concentration	119 ppmv

Run D

Calibration

Calibration Factor

Concentration (ppmv)		Reading (volt)	Calibration Factor (ppmv/volt)
propane	styrene		
0.0	0.0	0.0134	
153.4	57.5	0.2981	202.1
278.0	104.3	0.5392	198.3
453.6	170.1	0.8863	194.9

Average Factor	198.4
Standard Deviation	3.61
Error	1.8%

Accuracy

Concentration	Reading		Error
	Measured	Calculated	
Low	0.2981	0.3086	3.4%
High	0.5392	0.5484	1.7%

Styrene Concentration

In this run, the wet area was 66% covered.

Total Concentration	244 ppmv
Background Concentration	10 ppmv
Styrene Concentration	234 ppmv

Run E

Calibration

Calibration Factor

Concentration (ppmv)		Reading (volt)	Calibration Factor (ppmv/volt)
propane	styrene		
0.0	0.0	0.0134	
153.4	57.5	0.2981	202.1
278.0	104.3	0.5392	198.3
453.6	170.1	0.8863	194.9
Average Factor			198.4
Standard Deviation			3.61
Error			1.8%

Accuracy

Concentration	Reading		Error
	Measured	Calculated	
Low	0.2981	0.3086	3.4%
High	0.5392	0.5484	1.7%

Styrene Concentration

In this run, the wet area was 66% covered and small quantities of air were taken from the Wet Area Enclosure and the Total Temporary Enclosure. This run was designed to evaluate the feasibility of using close capture.

The background concentration was already substrated from the styrene reported values.

Background Concentration	7 ppmv
Styrene Concentration - Lower Duc	82 ppmv
Styrene Concentration - Upper Duct	366 ppmv

Run AA

Calibration

Calibration Factor

Concentration (ppmv)		Reading (volt)	Calibration Factor (ppmv/volt)
propane	styrene		
0.0	0.0	0.0202	
153.4	57.5	0.2933	210.6
278.0	104.3	0.5308	204.2
453.6	170.1	0.8690	200.4

Average Factor	205.1
Standard Deviation	5.17
Error	2.5%

Accuracy

Concentration	Reading		Error
	Measured	Calculated	
Low	0.2933	0.3073	4.5%
High	0.5308	0.5404	1.8%

Styrene Concentration

This run is a replicate of run A.

Total Concentration	292 ppmv
Background Concentration	9 ppmv
Styrene Concentration	283 ppmv

Run DD

Calibration

Calibration Factor

Concentration (ppmV)		Reading (volt)	Calibration Factor (ppmv/volt)
propane	styrene		
0.0	0.0	0.0148	
153.4	57.5	0.2928	206.9
278.0	104.3	0.5307	202.1
453.6	170.1	0.8761	197.5
Average Factor			202.1
Standard Deviation			4.71
Error			2.3%

Accuracy

Concentration	Reading		Error
	Measured	Calculated	
Low	0.2928	0.3060	4.3%
High	0.5307	0.5427	2.2%

Styrene Concentration

This run is a replicate of run D.

Total Concentration	229 ppmv
Background Concentration	8 ppmv
Styrene Concentration	221 ppmv

Run I

Calibration

Calibration Factor

Concentration (ppmv)		Reading (volt)	Calibration Factor (ppmv/volt)
propane	styrene		
0.0	0.0	0.0203	
153.4	57.5	0.3111	197.8
278.0	104.3	0.5511	196.4
453.6	170.1	0.8886	195.9
Average Factor			196.7
Standard Deviation			0.97
Error			0.5%

Accuracy

Concentration	Reading		Error
	Measured	Calculated	
Low	0.3111	0.3139	0.9%
High	0.5511	0.5524	0.2%

Styrene Concentration

This run is direct die injection which eliminates use of resin bath and minimizes exposure of resin to the air.

Total Concentration	9 ppmv
Background Concentration	6 ppmv
Styrene Concentration	4 ppmv

Run H

Calibration

Calibration Factor

Concentration (ppmv)		Reading (volt)	Calibration Factor (ppmv/volt)
propane	styrene		
0.0	0.0	0.0151	
133.4	57.5	0.3091	195.7
278.0	104.3	0.5461	196.3
453.6	170.1	0.8867	195.2

Average Factor	195.7
Standard Deviation	0.59
Error	0.3%

Accuracy

Concentration	Reading		Error
	Measured	Calculated	
Low	0.3091	0.3099	0.3%
High	0.5461	0.5493	0.6%

Styrene Concentration

This run will employ perform injection which eliminates use of resin bath and minimizes exposure of resin to the air.

Total Concentration	33 ppmv
Background Concentration	5 ppmv
Styrene Concentration	28 ppmv

The Dow Chemical Company

DATE

December 21, 1995

INDUSTRIAL HYGIENE REPORT

TITLE

EVALUATION OF EXHAUST STACK EMISSIONS FOR STYRENE DURING PULTRUSION OF LADDER RUNGS AT REICHHOLD CHEMICAL, RALEIGH-DURHAM, NORTH CAROLINA, SEPTEMBER 12-15, 1995.

AUTHOR

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Industrial Hygiene Research & Technology
Health and Environmental Sciences

DISTRIBUTION

Eloy Martinez, Dow Chemical USA, Freeport, B-2009

SUMMARY

An exhaust stack emission survey was conducted on September 12-15, 1995, to determine styrene emission levels during production of ladder rungs at Reichhold Chemical, Raleigh-Durham, North Carolina. Two stacks were monitored over approximately a one hour period each day. The Total Temporary Enclosure (TTE) Stack and the Wet Area Exhaust (WAE) Stacks were tested.

Air flow rates were measured in the emission stacks by Reichhold Chemical personnel using a hotwire anemometer that was checked against a digital pitot tube on a daily basis. Additional make-up air was supplied via other openings in the structure. The ambient temperature averaged 72°F and the relative humidity was 52%. Emission estimates were based on standard conditions as defined by ACGIH[1]

Emission rates of styrene from the TTE stack ranged from 3.2 E-06 pounds per hour (lb/hr) to 6.9E-05 lb/hr, while the WAE stack emission rates ranged from 8.5E-05 lb/hr to 1.4 E-04 lb/hr. Survey results are provided in Table 1. In the appendices, stack calculation datasheets are provided along with a description of exhaust emission calculations. Also included in Table 2 are the TTE and WAE ventilation system design specifications for fan static pressures.

[1]The American Conference of Governmental Industrial Hygienists Industrial Ventilation Manual, 20th Edition, Chapter 5.13, Pages 5-23 to 5-28.

SAMPLING METHODS

Vapors of styrene were collected on commercially available adsorption tubes containing 1 gram of charcoal at an average flow rate of 100 ml/min. Samples were desorbed in carbon disulfide and analyzed using gas chromatography equipped with flame ionization detection by Dow's analytical chemistry laboratory personnel in 1803 Building.

NOTICE

The information and any recommendations contained herein are presented in good faith. However, no guarantee of accuracy or completeness is given. Data presented are believed factual unless otherwise indicated, but conclusions based on such data will not be valid if observed operations change. No representation is made that all existing or potential problems have been identified, or that recommendations made will solve the problem, or that laws or regulations will be construed by government agencies consistent with our understanding of them.

Signature E. A. Lackey (Author)

Date: 1-8-96

Signature W. E. Lafford (Reviewer)

Date: 1-8-96

Table 1. ESTIMATED EMISSION RATES* OF STYRENE IN EXHAUST AIR DURING LADDER RUNG PRODUCTION AT REICHHOLD CHEMICAL, RALEIGH DURHAM, NORTH CAROLINA, SEPTEMBER 12-15, 1995.

Sample Location	Monitoring Period	Sample Duration (min)	Styrene (ppm)	Concentration (lbs/ft^3)	Emission Rate (lbs/hr)	Total Emission (lbs)
TTE RUN	12:15-13:15	60	250	6.6E-05	0.881	1.16
1	12:15-12:45	30	160	4.3E-05	0.564	
TTE RUN	14:10-15:10	60	240	6.4E-05	0.846	1.27
2	14:10-14:40	30	240	6.4E-05	0.846	
TTE RUN	16:00-16:30	30	150	4.0E-05	0.529	0.49
J	16:00-16:30	30	130	3.5E-05	0.458	
TTE RUN G	12:39-12:50	11	110	2.9E-05	0.388	0.07
TTE RUN	14:00-14:16	16	230	6.1E-05	0.811	0.45
F	14:00-14:30	30	130	3.5E-05	0.458	
TTE RUN D	15:51-16:05	16	260	6.9E-05	0.916	0.24
TTE RUN	16:35-17:05	30	110	2.9E-05	0.388	0.33
E	16:35-16:50	15	160	4.3E-05	0.564	
WAE	12:20-12:35	15	530	1.4E-04	0.470	0.48
RUN G	12:20-12:50	30	520	1.4E-04	0.461	
	13:15-13:39	23	390	1.0E-04	0.346	
WAE	16:35-17:05	30	330	8.8E-05	0.414	0.31
RUN E	16:35-16:50	15	320	8.5E-05	0.401	
TTE RUN	11:35-11:50	15	240	6.4E-05	0.846	0.99
AAA	11:35-12:05	30	200	5.3E-05	0.705	
	12:35-12:50	15	58	1.5E-05	0.204	
	12:35-13:05	30	210	5.6E-05	0.740	
TTE RUN	15:00-15:30	30	16	4.3E-06	0.056	0.15
H	15:00-16:00	60	35	9.3E-06	0.123	
TTE RUN	11:00-11:34	34	21	5.6E-06	0.074	0.08
I	11:00-12:00	60	12	3.2E-06	0.042	

*Emission rate estimates based on stack flow rate reported by Reichhold Chemical personnel.

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TABLE 2

TTE VENTILATION SYSTEM

Exhaust from enclosure using an 8 inch duct with three 90° elbows with 2.0 D radius. In line fan to be determined.

	For 750 CFM	*For 1000 CFM*
DUCT SPECIFICATIONS		
G 1-Duct diameter (in.)	8	8
C 2-Duct area (ft.2)	0.3491	0.3491
G 3-Air volume (CFM)	750	1000
C 4-Duct velocity (FPM)	2150	2865
Fig 6-16 5-Velocity pressure (in. H_2O)	0.29 (1)	0.51 (1)
ENTRY LOSS		
Fig 6-10 6-Flanged opening, entry loss (V.P.)	0.49	0.49
7-Hood Suction (V.P.)	1.49	1.49
(7) x (5) 8-Hood Suction (in. H_2O)	0.43	0.76
DUCT RESISTANCE TO FAN		
G 9-Length duct to fan (Ft.)	21.5	21.5
Fig 6-11 10-Elbow equivalent (1x10) (ft.)	10	10
(9) + (10) 11-Total equivalent length	31.5	31.5
Fig 6-15 12-Resistance per 100 Ft. (in. H_2O)	0.90	1.55
$\frac{(11) \times (12)}{100}$ 13-Resistance for run (in. H_2O)	0.28 (2)	0.49 (2)
FAN DISCHARGE RESISTANCE		
G 14-Length duct from fan (ft.)	37	37
Fig 6-11 15-Elbow equivalent (2x10) (ft.)	20	20
(14) + (15) 16-Total equivalent length (ft.)	57	57
Fig 6-15 17-Resistance per 100 ft. (in. H_2O)	0.90	1.55
$\frac{(16)(17)}{100}$ 18-Resistance for run (in. H_2O)	0.51 (3)	0.88 (3)

FAN STATIC PRESSURE

$$\text{Fan SP} = \underset{(3)}{\text{SP out}} - \underset{(2)}{\text{SP in}} - \underset{(1)}{\text{VP in}}$$

$= 0.51 - (-0.28) - 0.29 = 0.50$ (in. H_2O) for 750 CFM

$= 0.88 - (-0.49) - 0.51 = 0.86$ (in. H_2O) for 1000 CFM

Codes:
G = Given
C = Calculated
(n) = line number

TABLE 2

WAE Ventilation System

Exhaust from enclosure using a 6 inch duct with 3 90° elbows and a 2.0 D radius.

DUCT SPECIFICATIONS	For 500 CFM
G 1-Duct diameter (in.)	6
C 2-Duct area (ft.^{2})	0.1964
G 3-Air volume (CFM)	500
C 4-Duct velocity (FPM)	2545
Fig 6-16 5-Velocity pressure (in. H_2O)	0.40 (1)
DUCT RESISTANCE TO FAN	
G 6-Length duct to fan (ft.)	10
Fig 6-11 7-Elbow equivalent (1x7) (ft.)	7
6 + 7 8- Total equivalent length	17
Fig 6-15 9-Resistance per 100 ft run (in. H_2O)	1.8
$\frac{8 \times 9}{100}$ 10-Resistance for run (in. H_2O)	0.31 (2)
FAN DISCHARGE RESISTANCE	
G 11-Length duct from fan (ft)	37
Fig 6-11 12-Elbow equivalent (2x7) ft	14
(11) + (12) 13-Total equivalent length	51
Fig 6-15 14 Resistance per 100 ft (in. H_2O)	1.8
$\frac{(13)\,(14)}{100}$ 15-Resistance for run (in. H_2O)	0.92 (3)

FAN STATIC PRESSURE

$$\text{Fan SP} = \overset{(3)}{\text{SP out}} - \overset{(2)}{\text{SP in}} - \overset{(1)}{\text{VP in}}$$

$$= 0.92 - (-0.31) - 0.40 = 0.83 \text{ (in. } H_2O\text{) for 500 CFM}$$

Codes:
G = Given
C = Calculated
(n) = line number

EXHAUST EMISSION CALCULATIONS

1. Conversions for Weight or Volume

   A. mg = (lbs) x (2.20462×10^{-6})

   B. $m^3 = (ft^3) \times (35.31)$

   C. One gram-mole of an ideal gas will occupy 24.45 liters of volume at 70° F (room temperature), most vapors exhibit the properties of an ideal gas at low concentrations in air.

2. Conversions for Emission Concentration (EC)

   A. To convert EC in mg/m^3 to EC in lbs/ft^3:

$$EC\ (lbs/ft^3) = \left(\frac{mg}{m^3}\right) \times \left(\frac{2.2 \times 10^{-6}\ lbs}{mg}\right) \times \left(\frac{m^3}{35.31\ ft^3}\right)$$

   B. To convert EC in PPM to EC lbs/ft^3:

$$PPM \times \left(\frac{\text{Molecular Weight}}{24.45}\right) = \left(\frac{mg}{m^3}\right)$$

$$EC\ (lbs/ft^3) = \left(\frac{mg}{m^3}\right) \times \left(\frac{2.2 \times 10^{-6}\ lbs}{mg}\right) \times \left(\frac{m^3}{35.31\ ft^3}\right)$$

3. Emission Rate (ER) in lbs/hr

$$ER\ (lbs/hr) = EC\ (lb/ft^3) \times \text{Air Flow Rate}\ (ft^3/min) \times 60\ (min/hr)$$

4 Emission (E) in lbs (per source or vent)

   A. Amount of material emitted from a source per given air sample time or monitoring period.

$$E\ (lbs) = ER\ (lbs/hr) \times \left(\frac{\text{Sample Duration (min)}}{60\ (min/hr)}\right)$$

5. Total Emission over a given time period (lbs)

$$\sum E = E_1 + E_2 \cdots E_n \text{ (sum of all sources and vents monitored)}$$

Appendix I

STACK CALCULATION DATA SHEET (ppm)

LOCATION: REICHHOLD CHEMICAL, RALEIGH, NORTH CAROLINA, SEPTEMBER 12-15, 1995
SURVEY DATE: 12-Sep-95 **INDUSTRIAL HYGIENIST:** E. A. LACKEY

Dry Bulb Temp. : 72 F
Wet Bulb Temp. : 61 F
Rel. Humidity : 52 %

Duct Diameter (inches) = 8
Duct Area (ft2) = 0.35

Sample Point	Traverse 1		Traverse 2	
	VP (" wg)	V (fpm)	VP (" wg)	V (fpm)
1	0.03	633	0.03	633
2	0.00		0.00	
3	0.00		0.00	
4	0.00		0.00	
5	0.00		0.00	
6	0.00		0.00	
7	0.00		0.00	
8	0.00		0.00	
9	0.00		0.00	
10	0.00		0.00	
		AVERAGE (1) 633 fpm		AVERAGE (2) 633 fpm

Average Velocity 633 fpm
Flow Rate 221 acfm

Compound = STYRENE
Molecular Wt. = 104.1

Exhaust Emission Calculations :

Sample Description (# / Monitoring Period)	Concentration (ppm)	Sample Duration (min)	Emission Conc. (lbs/ft3)	Emission Rate (lbs/hr)	Amount Emitted (lbs/Sample)
5/(12:15-13:15)	250.00	60	6.6E-05	0.881	0.881
6/12:15-12:45)	160.00	30	4.3E-05	0.564	0.282
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000

Duration of Monitoring	90 min

Total Emission During Monitoring Period (lbs)	1.16 lbs

NOTES : TTE EXHAUST-RUN#1

Appendix I

STACK CALCULATION DATA SHEET (ppm)

LOCATION: REICHHOLD CHEMICAL, RALEIGH, NORTH CAROLINA, SEPTEMBER 12-15, 1995
SURVEY DATE: 12-Sep-95 **INDUSTRIAL HYGIENIST:** E. A. LACKEY

Dry Bulb Temp. : 72 F
Wet Bulb Temp. : 61 F
Rel. Humidity : 52 %

Duct Diameter (inches) = 8
Duct Area (ft2) = 0.35

Sample Point	Traverse 1		Traverse 2	
	VP (" wg)	V (fpm)	VP (" wg)	V (fpm)
1	0.03	633	0.03	633
2	0.00		0.00	
3	0.00		0.00	
4	0.00		0.00	
5	0.00		0.00	
6	0.00		0.00	
7	0.00		0.00	
8	0.00		0.00	
9	0.00		0.00	
10	0.00		0.00	
		AVERAGE (1) 633 fpm		AVERAGE (2) 633 fpm

Average Velocity 633 fpm
Flow Rate 221 acfm

Compound = STYRENE
Molecular Wt. = 104.1

Exhaust Emission Calculations :

Sample Description (# / Monitoring Period)	Concentration (ppm)	Sample Duration (min)	Emission Conc. (lbs/ft3)	Emission Rate (lbs/hr)	Amount Emitted (lbs/Sample)
7/(14:10-15:10)	240.00	60	6.4E-05	0.846	0.846
9/(14:10-14:40)	240.00	30	6.4E-05	0.846	0.423
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000

Duration of Monitoring	90 min

Total Emission During Monitoring Period (lbs)	1.27 lbs

NOTES : TTE EXHAUST RUN #2)

Appendix I

STACK CALCULATION DATA SHEET (ppm)

LOCATION: REICHHOLD CHEMICAL, RALEIGH, NORTH CAROLINA, SEPTEMBER 12-15, 1995

SURVEY DATE: 12-Sep-95 **INDUSTRIAL HYGIENIST:** E. A. LACKEY

Dry Bulb Temp. : 72 F
Wet Bulb Temp. : 61 F
Rel. Humidity : 52 %

Duct Diameter (inches) = 8
Duct Area (ft2) = 0.35

Sample Point	Traverse 1 VP (" wg)	Traverse 1 V (fpm)	Traverse 2 VP (" wg)	Traverse 2 V (fpm)
1	0.03	633	0.03	633
2	0.00		0.00	
3	0.00		0.00	
4	0.00		0.00	
5	0.00		0.00	
6	0.00		0.00	
7	0.00		0.00	
8	0.00		0.00	
9	0.00		0.00	
10	0.00		0.00	

AVERAGE (1): 633 fpm
AVERAGE (2): 633 fpm

Average Velocity 633 fpm
Flow Rate 221 acfm

Compound = STYRENE
Molecular Wt. = 104.1

Exhaust Emission Calculations :

Sample Description (# / Monitoring Period)	Concentration (ppm)	Sample Duration (min)	Emission Conc. (lbs/ft3)	Emission Rate (lbs/hr)	Amount Emitted (lbs/Sample)
10/(16:00-16:30)	150.00	30	4.0E-05	0.529	0.264
11/(16:00-16:30)	130.00	30	3.5E-05	0.458	0.229
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000

Duration of Monitoring 60 min

Total Emission During Monitoring Period (lbs) 0.49 lbs

NOTES : TTE EXHAUST RUN J

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Appendix 1

STACK CALCULATION DATA SHEET (ppm)

LOCATION: REICHHOLD CHEMICAL RALEIGH, NORTH CAROLINA, SEPTEMBER 12-15, 1995
SURVEY DATE : SEPT 13 95 **INDUSTRIAL HYGIENIST :** E A LACKEY

Dry Bulb Temp. : 72 F
Wet Bulb Temp. : 63 F
Rel. Humidity : 60 %

Duct Diameter (inches) = 8
Duct Area (ft2) = 0.35

Sample Point	Traverse 1		Traverse 2	
	VP (" wg)	V (fpm)	VP (" wg)	V (fpm)
1	0.03	633	0.03	633
2	0.00		0.00	
3	0.00		0.00	
4	0.00		0.00	
5	0.00		0.00	
6	0.00		0.00	
7	0.00		0.00	
8	0.00		0.00	
9	0.00		0.00	
10	0.00		0.00	

AVERAGE (1): 633 fpm
AVERAGE (2): 633 fpm

Average Velocity 633 fpm
Flow Rate 221 acfm

Compound = STYRENE
Molecular Wt. = 104.1

Exhaust Emission Calculations :

Sample Description (# / Monitoring Period)	Concentration (ppm)	Sample Duration (min)	Emission Conc. (lbs/ft3)	Emission Rate (lbs/hr)	Amount Emitted (lbs/Sample)
15/(12:39-12:50)	110.00	11	2.9E-05	0.388	0.071
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000

Duration of Monitoring	11 min

Total Emission During Monitoring Period (lbs)	0.07 lbs

NOTES : TTE EXHAUST RUN G

Appendix 1

STACK CALCULATION DATA SHEET (ppm)

LOCATION: REICHHOLD CHEMICAL, RALEIGH, NORTH CAROLINA, SEPTEMBER 12-15, 1995

SURVEY DATE: SEPT 13 95 **INDUSTRIAL HYGIENIST:** E. A. LACKEY

Dry Bulb Temp. : 72 F
Wet Bulb Temp. : 63 F
Rel. Humidity : 60 %

Duct Diameter (Inches) = 8
Duct Area (ft2) = 0.35

Sample Point	Traverse 1		Traverse 2	
	VP (" wg)	V (fpm)	VP (" wg)	V (fpm)
1	0.03	633	0.03	633
2	0.00		0.00	
3	0.00		0.00	
4	0.00		0.00	
5	0.00		0.00	
6	0.00		0.00	
7	0.00		0.00	
8	0.00		0.00	
9	0.00		0.00	
10	0.00		0.00	

AVERAGE (1): 633 fpm
AVERAGE (2): 633 fpm

Average Velocity 633 fpm
Flow Rate 221 acfm

Compound = STYRENE
Molecular Wt. = 104.1

Exhaust Emission Calculations :

Sample Description (# / Monitoring Period)	Concentration (ppm)	Sample Duration (min)	Emission Conc. (lbs/ft3)	Emission Rate (lbs/hr)	Amount Emitted (lbs/Sample)
17/(14:00-14:16)	230.00	16	6.1E-05	0.811	0.216
18/(14:00-14:30)	130.00	30	3.5E-05	0.458	0.229
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000

Duration of Monitoring	46 min

Total Emission During Monitoring Period (lbs)	0.45 lbs

NOTES :	TTE EXHAUST RUN F

Appendix I

STACK CALCULATION DATA SHEET (ppm)

LOCATION: REICHHOLD CHEMICAL, RALEIGH, NORTH CAROLINA, SEPTEMBER 12-15, 1995
SURVEY DATE : SEPT 15 95 **INDUSTRIAL HYGIENIST :** E. A. LACKEY

Dry Bulb Temp. : 72 F
Wet Bulb Temp. : 63 F
Rel. Humidity : 60 %

Duct Diameter (inches) = 8
Duct Area (ft2) = 0.35

Sample Point	Traverse 1		Traverse 2	
	VP (" wg)	V (fpm)	VP (" wg)	V (fpm)
1	0.03	633	0.03	633
2	0.00		0.00	
3	0.00		0.00	
4	0.00		0.00	
5	0.00		0.00	
6	0.00		0.00	
7	0.00		0.00	
8	0.00		0.00	
9	0.00		0.00	
10	0.00		0.00	
		AVERAGE (1) 633 fpm		AVERAGE (2) 633 fpm

Average Velocity 633 fpm
Flow Rate 221 acfm

Compound = STYRENE
Molecular Wt. = 104.1

Exhaust Emission Calculations :

Sample Description (# / Monitoring Period)	Concentration (ppm)	Sample Duration (min)	Emission Conc. (lbs/ft3)	Emission Rate (lbs/hr)	Amount Emitted (lbs/Sample)
19/(15:51-16:05)	260.00	16	6.9E-05	0.916	0.244
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000

Duration of Monitoring	16 min

Total Emission During Monitoring Period (lbs)	0.24 lbs

NOTES :	TTE EXHAUST RUN D

Appendix I

STACK CALCULATION DATA SHEET (ppm)

LOCATION: REICHHOLD CHEMICAL, RALEIGH, NORTH CAROLINA, SEPTEMBER 12-15, 1995
SURVEY DATE : SEPT 13 95 **INDUSTRIAL HYGIENIST :** E A LACKEY

Dry Bulb Temp. : 72 F
Wet Bulb Temp. : 63 F
Rel. Humidity : 60 %

Duct Diameter (inches) = 8
Duct Area (ft2) = 0.35

Sample Point	Traverse 1 VP (" wg)	Traverse 1 V (fpm)	Traverse 2 VP (" wg)	Traverse 2 V (fpm)
1	0.03	633	0.03	633
2	0.00		0.00	
3	0.00		0.00	
4	0.00		0.00	
5	0.00		0.00	
6	0.00		0.00	
7	0.00		0.00	
8	0.00		0.00	
9	0.00		0.00	
10	0.00		0.00	
		AVERAGE (1) 633 fpm		AVERAGE (2) 633 fpm

Average Velocity 633 fpm
Flow Rate 221 acfm

Compound = STYRENE
Molecular Wt. = 104.1

Exhaust Emission Calculations :

Sample Description (# / Monitoring Period)	Concentration (ppm)	Sample Duration (min)	Emission Conc. (lbs/ft3)	Emission Rate (lbs/hr)	Amount Emitted (lbs/Sample)
#20/(16:35-17:05)	110.00	30	2.9E-05	0.388	0.194
#21/(16:35-16:50)	160.00	15	4.3E-05	0.564	0.141
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000

Duration of Monitoring	45 min

Total Emission During Monitoring Period (lbs)	0.33 lbs

NOTES : TTE EXHAUST RUN E

C14

Appendix I

STACK CALCULATION DATA SHEET (ppm)

LOCATION: REICHHOLD CHEMICAL, RALEIGH, NORTH CAROLINA, SEPTEMBER 12-15, 1995
SURVEY DATE : SEPT 13-95 **INDUSTRIAL HYGIENIST :** E. A. LACKEY

Dry Bulb Temp. : 72 F
Wet Bulb Temp. : 63 F
Rel. Humidity : 60 %

Duct Diameter (inches) = 6
Duct Area (ft2) = 0.20

Sample Point	Traverse 1		Traverse 2	
	VP (" wg)	V (fpm)	VP (" wg)	V (fpm)
1	0.01	283	0.01	283
2	0.00		0.00	
3	0.00		0.00	
4	0.00		0.00	
5	0.00		0.00	
6	0.00		0.00	
7	0.00		0.00	
8	0.00		0.00	
9	0.00		0.00	
10	0.00		0.00	
		AVERAGE (1) 283 fpm		AVERAGE (2) 283 fpm

Average Velocity 283 fpm
Flow Rate 56 acfm

Compound = STYRENE
Molecular Wt. = 104.1

Exhaust Emission Calculations :

Sample Description (# / Monitoring Period)	Concentration (ppm)	Sample Duration (min)	Emission Conc. (lbs/ft3)	Emission Rate (lbs/hr)	Amount Emitted (lbs/Sample)
13/(12:20-12:35)	530.00	15	1.4E-04	0.470	0.117
14/(12:20-12:50)	520.00	30	1.4E-04	0.461	0.231
16/(19:15-19:39)	390.00	23	1.0E-04	0.346	0.133
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000

Duration of Monitoring 68 min

Total Emission During Monitoring Period (lbs) 0.48 lbs

NOTES : WAE EXHAUST RUN G

Appendix I

STACK CALCULATION DATA SHEET (ppm)

LOCATION: REICHHOLD CHEMICAL, RALEIGH, NORTH CAROLINA, SEPTEMBER 12-15, 1995
SURVEY DATE: SEPT 13 95 **INDUSTRIAL HYGIENIST:** E.A. LACKEY

Dry Bulb Temp. : 72 F
Wet Bulb Temp. : 63 F
Rel. Humidity : 60 %

Duct Diameter (inches) = 6
Duct Area (ft2) = 0.20

Sample Point	Traverse 1		Traverse 2	
	VP (" wg)	V (fpm)	VP (" wg)	V (fpm)
1	0.01	401	0.01	401
2	0.00		0.00	
3	0.00		0.00	
4	0.00		0.00	
5	0.00		0.00	
6	0.00		0.00	
7	0.00		0.00	
8	0.00		0.00	
9	0.00		0.00	
10	0.00		0.00	

AVERAGE (1) 401 fpm **AVERAGE (2)** 401 fpm

Average Velocity 401 fpm
Flow Rate 79 acfm

Compound = STYRENE
Molecular Wt. = 104.1

Exhaust Emission Calculations :

Sample Description (# / Monitoring Period)	Concentration (ppm)	Sample Duration (min)	Emission Conc. (lbs/ft3)	Emission Rate (lbs/hr)	Amount Emitted (lbs/Sample)
23/(16:35-17:05)	330.00	30	8.8E-05	0.414	0.207
24/(16:35-16:50)	320.00	15	8.5E-05	0.401	0.100
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000

Duration of Monitoring	45 min

Total Emission During Monitoring Period (lbs)	0.31 lbs

NOTES : WAE EXHAUST RUN E

C16

Appendix I

STACK CALCULATION DATA SHEET (ppm)

LOCATION: REICHHOLD CHEMICAL, RALEIGH, NORTH CAROLINA, SEPTEMBER 12-15, 1995
SURVEY DATE : SEPT 14-95 **INDUSTRIAL HYGIENIST :** E. A. LACKEY

Dry Bulb Temp. : 71 F
Wet Bulb Temp. : 63 F
Rel. Humidity : 64 %

Duct Diameter (inches) = 8
Duct Area (ft2) = 0.35

Sample Point	Traverse 1		Traverse 2	
	VP (" wg)	V (fpm)	VP (" wg)	V (fpm)
1	0.03	633	0.03	633
2	0.00		0.00	
3	0.00		0.00	
4	0.00		0.00	
5	0.00		0.00	
6	0.00		0.00	
7	0.00		0.00	
8	0.00		0.00	
9	0.00		0.00	
10	0.00		0.00	
		AVERAGE (1) 633 fpm		AVERAGE (2) 633 fpm

Average Velocity 633 fpm
Flow Rate 221 acfm

Compound = STYRENE
Molecular Wt. = 104.1

Exhaust Emission Calculations :

Sample Description (# / Monitoring Period)	Concentration (ppm)	Sample Duration (min)	Emission Conc. (lbs/ft3)	Emission Rate (lbs/hr)	Amount Emitted (lbs/Sample)
22/(11:35-11:50)	240.00	15	6.4E-05	0.846	0.211
25/(11:35-12:05)	200.00	30	5.3E-05	0.705	0.352
27/(12:35-12:50)	58.00	15	1.5E-05	0.204	0.051
30/(12:35-13:05)	210.00	30	5.6E-05	0.740	0.370
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000

Duration of Monitoring	90 min

Total Emission During Monitoring Period (lbs)	0.99 lbs

NOTES : TTE EXHAUST RUN AAA

Appendix I

STACK CALCULATION DATA SHEET (ppm)

LOCATION: REICHHOLD CHEMICAL, RALEIGH, NORTH CAROLINA, SEPTEMBER 12-15, 1995
SURVEY DATE : SEPT-15-95 **INDUSTRIAL HYGIENIST :** E. A. LACKEY

Dry Bulb Temp. : 71 F
Wet Bulb Temp. : 62 F **Duct Diameter (inches) =** 8
Rel. Humidity : 60 % **Duct Area (ft2) =** 0.35

Sample Point	Traverse 1 VP (" wg)	Traverse 1 V (fpm)	Traverse 2 VP (" wg)	Traverse 2 V (fpm)
1	0.03	633	0.03	633
2	0.00		0.00	
3	0.00		0.00	
4	0.00		0.00	
5	0.00		0.00	
6	0.00		0.00	
7	0.00		0.00	
8	0.00		0.00	
9	0.00		0.00	
10	0.00		0.00	
		AVERAGE (1) 633 fpm		AVERAGE (2) 633 fpm

Average Velocity 633 fpm
Flow Rate 221 acfm

Compound = STYRENE
Molecular Wt. = 104.1

Exhaust Emission Calculations :

Sample Description (# / Monitoring Period)	Concentration (ppm)	Sample Duration (min)	Emission Conc. (lbs/ft3)	Emission Rate (lbs/hr)	Amount Emitted (lbs/Sample)
#34/(15:00-15:30)	16.00	30	4.3E-06	0.056	0.028
#35/(15:00-16:00)	35.00	60	9.3E-06	0.123	0.123
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000

Duration of Monitoring	90 min

Total Emission During Monitoring Period (lbs)	0.15 lbs

NOTES : TTE EXHAUST RUN H

C/8

Appendix I

STACK CALCULATION DATA SHEET (ppm)

LOCATION: REICHHOLD CHEMICAL, RALEIGH, NORTH CAROLINA, SEPTEMBER 12-15, 1995
SURVEY DATE : SEPT 15 95 **INDUSTRIAL HYGIENIST :** E A LACKEY

Dry Bulb Temp. : 71 F
Wet Bulb Temp. : 62 F
Rel. Humidity : 60 %

Duct Diameter (inches) = 8
Duct Area (ft2) = 0.35

Sample Point	Traverse 1 VP (" wg)	Traverse 1 V (fpm)	Traverse 2 VP (" wg)	Traverse 2 V (fpm)
1	0.03	633	0.03	633
2	0.00		0.00	
3	0.00		0.00	
4	0.00		0.00	
5	0.00		0.00	
6	0.00		0.00	
7	0.00		0.00	
8	0.00		0.00	
9	0.00		0.00	
10	0.00		0.00	
		AVERAGE (1) 633 fpm		AVERAGE (2) 633 fpm

Average Velocity 633 fpm
Flow Rate 221 acfm

Compound = STYRENE
Molecular Wt. = 104.1

Exhaust Emission Calculations :

Sample Description (# / Monitoring Period)	Concentration (ppm)	Sample Duration (min)	Emission Conc. (lbs/ft3)	Emission Rate (lbs/hr)	Amount Emitted (lbs/Sample)
S1/(11:00-11:34)	21.00	34	5.6E-06	0.074	0.042
S2/(11:00-12:00)	12.00	60	3.2E-06	0.042	0.042
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000
			0.0E+00	0.000	0.000

Duration of Monitoring	94 min
Total Emission During Monitoring Period (lbs)	0.08 lbs

NOTES : TTE EXHAUST RUN I

MMFG

Morrison Molded Fiber Glass Company

October 25, 1995

Mr. Tom Griffiths
Omega Pultrusions
1262 Chillicothe
Aurora, OH 44202

Dear Tom:

Please find attached the mechanical property analysis from the Phase II styrene emissions study at Reichhold. There appears to be some potential for roving shifting using composite (H) which is the preformer injection but there may not be a net property reduction. However, composite (I) which was the direct die injection had a definite reduction in mechanical property performance.

Sincerely yours,

C Clint

Clinton B. Smith
Technical Director

CBS/kbf

Attachment

cy: Gary Bridgeman w/attachment
Stacey McEwen w/attachment

400 Commonwealth Ave./Box 580/Bristol, VA 24203-0580/(703) 645-8000/FAX # (703) 645-8132/Telex:829-327

COMPOSITE	A	A-1	AA	D	DD	E	F	G	G-1	H	I	J
FLEXURAL												
0° F. STRENGTH (ksi)	89.2	90.9	91.2	95.3	98.7	92.2	94.2	94.6	95.0	83.3	77.0	89.6
0° F. MODULUS (ksi)	3531	3441	3453	3748	3854	3749	3590	3709	3828	3300	2792	3576
0° W. STRENGTH (ksi)	51.4	58.7	57.9	51.7	52.5	63.1	56.7	53.9	59.3	68.8	75.2	58.8
0° W. MODULUS (ksi)	2070	2343	2316	2190	2201	2490	2413	2169	2448	2533	2864	2460
1.5" COMPRESSIVE												
0° F. STRENGTH (ksi)	67.5	72.0	67.4	70.7	71.2	69.7	66.7	67.8	66.4	63.4	48.2	70.2
0° W. STRENGTH (ksi)	54.0	57.3	56.9	54.2	53.5	57.1	46.6	54.8	52.1	67.4	45.2	56.4
SHORT BEAM SHEAR												
0° F. (ksi)	5.52	5.77	5.87	5.83	5.42	5.88	6.10	5.63	6.24	5.99	4.23	5.60
0° W. (ksi)	4.92	5.22	5.22	5.19	5.00	5.13	5.38	5.17	5.42	5.05	4.38	5.20
COMPRESSIVE												
0° F. STRENGTH (ksi)	66.3	72.8	68.7	74.1	73.0	73.8	68.4	62.9	67.3	61.4	47.2	66.5
0° F. MODULUS (ksi)	4925	4777	4430	4978	4730	4795	4752	4830	4697	4322	4067	4703
0° W. STRENGTH (ksi)	51.7	53.1	56.7	56.1	47.8	55.1	46.9	45.9	46.3	54.2	41.8	55.2
0° W. MODULUS (ksi)	3260	3355	3427	3512	3350	3407	3565	3345	3407	4382	4255	3550
24 HOUR WATER ABSORPTION	0.54%	0.45%	0.49%	0.45%	0.44%	0.37%	0.47%	0.51%	0.47%	0.45%	0.50%	0.39%

D2

July 29, 1996
To: Madeleine Strum, US EPA
Fr: John Schweitzer
Re: Pultrusion Industry Council Phase II Emission Study

In response to your request, the Pultrusion Industry Council is pleased to provide the information shown below.

As you know, this information was not included in the report of the Phase II study, and its omission was not an oversight. Rather, the PIC was concerned that the data would be misused. The Phase II study was designed to determine the *relative* effectiveness of various source reduction technologies, and to determine what concentration and quantity of styrene might be collected in a close capture device.

The Phase II data is not suitable for use in calculating emission factors for pultrusion. To generate data for calculation of emission factors, the study would have included consideration of air flow conditions typical of a commercial pultrusion operation, changes in line speed, part geometry, configuration of the wet reinforcement, and the drip pan of exposed resin. The processing experience of our member companies also indicates that styrene evaporates from the system on a regressively sliding scale and an extension of the time period would definitely be required. We know from this study and again from the experience of our members that these factors could have a significant impact on the total time weighted emissions of a facility and the emission factors derived from same.

The reporting period being discussed for the MACT standard regarding the Pultrusion Emission Control Status is monthly. This timeframe may result in lower emission factors than were experienced during this controlled experiment. We also know from this study that these control factors have very significant impacts on emissions and emission factor calculations.

No single study can replicate the wide variability of commercial pultrusion operations. The Phase II study nevertheless does give us some useful information about the relative effects of several source reduction technologies. In reality there is no "typical" pultrusion line, because of wide variability in the speed, air flow, part geometry, wet-glass configuration, etc. Because of this fact, emission factors must be determined on a per site basis.

The PIC is providing this data in the spirit of cooperation with you in the preparation of a MACT standard. We respectfully request that you do not distribute this data beyond those at EPA who are directly involved in the MACT development process for pultrusion. The PIC hopes that you understand their concern that this data cannot accurately be used to determine an emission factor for the purpose of ascertaining whether or not a pultrusion facility is subject to Title V permitting.

From the report of the Phase II study:

PIC Phase II Run	Styrene emitted – lbs/hr
A,AA (avg.)	0.91
D,DD (avg.)	0.72
F	0.38
G	0.66
H	0.09
I	0.01
J	0.49

PIC Phase II Emission Study – Styrene Calculation

MMFG -- Ladder rail profile
Measured weight/ft.: 0.6447 lbs

Calculation of fiber content by weight:
100 (113 yield roving) x 0.00295 lbs. (wt. of 1-113 yield roving - 1 foot long) = 0.295 lbs/ft
Continuous strand mats: 5.75 in. + 5.25 in. + 5.25 in. widths = 16.25 total width
16.25 in. x 0.0052 lbs (wt. 1 oz csm 1in x 12in) = 0.0845 lbs/ft
Total fiber weight/foot = 0.3795 lbs

Calculation of resin mix content by weight:
0.6447 (profile wt/foot) - 0.3795 = 0.2652 lbs.

Calculation of styrene content by weight:
Total weight of resin mix = 124.5 lbs.
Base resin = 99 lbs @ 32.6% styrene + 1 lb additional styrene (to dissolve Percadox 16)
99 lbs / 124.5 lbs. = 79.52% (resin in mix)
79.52% x 0.2652 (resin wt) = 0.211 lbs (polyester resin per foot)
0.211 lbs x 32.6% (styrene in base resin) = 0.068786 lbs/ft
1 lb / 124.5 lbs = 0.8%styrene
0.8% x 0.2652 (resin wt.) = 0.00212 lbs. additional styrene (to dissolve P-16)
0.068786 lbs/ft + 0.00212 lbs/ft = 0.070906 lbs/ft (total styrene per 1 ft length of profile)
0.070906 lbs/ft x 2 ft/minute pull rate = 0.1418 lbs/min
0.1418 lbs/min x 60 minutes/hr = 8.51 lbs (styrene processed per hour)

Base on the above calculations, the estimated styrene processed per hour is 8.5 pounds. This calculation is by no means exact and may be subject to error of ± 10% or more.

CBI

SUMMARY - EMISSIONS AND EMISSION RATES

Condition	Run	% HAP (neat resin plus)	Target Line Speed (feet/min)	Target Thickness (mils)	Air Flow Condition	Is Filler Added?	Does resin Contain MMA?	Was edge trim applied?	Available HAP (lbs/hr)	Resin and Added HAP (lbs/hr)	Emissions (lbs/hr) Wet Area	Emissions (lbs/hr) Oven	Emissions (lbs/hr) Total	Emission Rate (% of available. HAP) Individual Runs	Emission Rate (% of available. HAP) Average	Emission Rate (lbs/ton of resin and added HAP) Individual Runs	Emission Rate (lbs/ton of resin and added HAP) Average
Gel Coat Runs																	
1	1	38.5%		60	Current	N	Y	N			83.17	0.45	83.62				
1	2	38.5%		60	Current	N	Y	N			70.11	0.43	70.54				
1	3	38.5%		60	Current	N	Y	N			67.75	0.39	68.14				
2	1	38.8%		45	Current	N	Y	N			66.79	0.18	66.97				
2	2	38.8%		45	Current	N	Y	N			69.95	0.07	70.02				
2	3	38.8%		45	Current	N	Y	N			69.50	0.27	69.77				
Non-Gel Coat Runs																	
3	1	45.2%		90	Current	Y	N	N	971.9	2148.2	21.45	2.67	24.12	2.48%		22.46	
3	2	45.2%		90	Current	Y	N	N	989.5	2187.0	21.45	2.50	23.95	2.42%		21.90	
3	3	45.2%		90	Current	Y	N	N	986.6	2180.6	20.52	2.74	23.26	2.36%	2.42%	21.33	21.89
4	1	45.2%		90	Current	Y	N	N	1114.8	2464.1	21.23	3.06	24.29	2.18%		19.72	
4	2	45.2%		90	Current	Y	N	N	1120.8	2477.4	21.61	2.99	24.60	2.19%	2.19%	19.86	19.79
5	1	40.5%		60	Open	N	Y	N	603.3	1489.7	19.61	1.86	21.47	3.56%		28.83	
5	2	40.5%		60	Open	N	Y	N	592.2	1462.3	18.51	2.07	20.58	3.48%		28.15	
5	3	40.5%		60	Open	N	Y	N	601.8	1485.9	18.32	2.03	20.35	3.38%	3.47%	27.39	28.12
6	1	40.5%		60	Current	N	Y	N	598.0	1476.5	26.62	2.37	28.99	4.85%		39.27	
6	2	40.5%		60	Current	N	Y	N	607.2	1499.2	26.03	2.39	28.42	4.68%		37.91	
6	3	40.5%		60	Current	N	Y	N	594.3	1467.3	25.33	2.41	27.74	4.67%	4.73%	37.81	38.33
7	1	40.5%		75	Current	N	Y	N	718.7	1774.4	21.26	2.34	23.60	3.28%		26.60	
7	2	40.5%		75	Current	N	Y	Y	866.6	2139.8	25.18	2.64	27.82	3.21%		26.00	
7	3	40.5%		75	Current	N	Y	Y	866.6	2139.8	25.44	2.50	27.94	3.22%	3.24%	26.11	26.22
8	1	42.4%		60	Current	Y	N	N	526.7	1242.7	22.17	0.55	22.72	4.31%		36.57	
8	2	42.4%		60	Current	Y	N	N	548.2	1293.4	22.06	0.79	22.85	4.17%		35.33	
8	3	42.4%		60	Current	Y	N	N	557.4	1315.2	21.73	1.22	22.95	4.12%	4.20%	34.90	35.58
9	1	42.4%		90	Current	Y	N	N	902.5	2129.3	17.96	3.00	20.96	2.32%	2.32%	19.69	19.69
10	1	39.5%		120	Current	Y	N	N	998.3	2528.7	17.19	2.74	19.93	2.00%	2.00%	15.76	15.76
11	1	39.5%		90	Current	Y	N	N	812.0	2056.8	17.64	3.21	20.85	2.57%		20.27	
11	2	39.5%		90	Current	Y	N	N	848.4	2148.9	17.11	3.59	20.70	2.44%		19.27	
11	3	39.5%		90	Current	Y	N	N	817.9	2071.8	16.84	3.40	20.24	2.47%	2.49%	19.54	19.69
12	1	45.2%		90	Open	Y	N	N	1153.9	2550.4	18.98	3.70	22.68	1.97%		17.79	
12	3	45.2%		90	Open	Y	N	N	1159.0	2561.8	15.75	4.18	19.93	1.72%		15.56	
12	4	45.2%		90	Open	Y	N	N	1155.1	2553.2	14.88	3.94	18.82	1.63%	1.77%	14.74	16.03
13	1	45.2%		90	Closed	Y	N	N	1169.9	2585.8	11.08	4.68	15.76	1.35%		12.19	
13	2	45.2%		90	Closed	Y	N	N	1169.3	2584.6	10.72	4.80	15.52	1.33%		12.01	
13	3	45.2%		90	Closed	Y	N	N	1183.7	2616.3	11.11	5.05	16.16	1.37%	1.35%	12.35	12.18

NOTE 1: The "% HAP Content (neat resin plus)" is the amount of HAP in the resin plus the amount of added HAP divided by the amount of resin and added HAP.

PLANT COMMENTS

Current - their typical operation: venting emissions at various points in process to outside

Open - No active venting shut off vents

closed - Emission reduction technique involving closing off as much as possible wet areas of machine.

05/14/98

1185-C1S-03 H

97185-C18-03H

LASCO

PANEL PRODUCTS

8015 Dixon Drive
Florence, KY 41042
TEL (606) 371-7720
FAX (606) 371-8466

PLANT COMMENTS

Ms. Melva Toomer
Office of Air Quality Planning and Standards
CBI Manager
Mail Drop 13
Research Triangle Park, NC 27711

May 27, 1998

Dear Ms. Toomer,

Enclosed is a copy of the summary of information collected during the source testing that was conducted by the USEPA and your contractor, PES in May, 1997.

Lasco Panel Products requests that the column headed "Target Line Speed, (feet/min)" and all of the data shown in this column be considered CBI. All other data may be released as non-CBI.

If you have any questions, please contact me at the address or telephone number shown above.

Sincerely,

Hilary V. North
Health, Safety and Environmental Quality Manager
Lasco Panel Products

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EPA. OAQPS CBIO
RTP, NC 27711
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