

Emissions Inventory Help Sheet for Polyester Resin Application

Manufacturing products from polyester resins causes monomers in the resins to be emitted. Styrene, the most common monomer, is a volatile organic compound (VOC). Methyl methacrylate (MMA) is another less common monomer, also a VOC. Emissions (including DMP, MEKP and MEK) from the catalyst are normally very small and may be disregarded for this report.

What processes do I need to report?

- Report usage of resins and gelcoats used for fiberglass and cast polymer products such as cultured marble, statuary and countertops.
- Report cleaning materials used other than acetone. (Do not report acetone.)
- Report dust generated by cutting or sanding wood, fiberglass, and cast polymer products.

What forms do I use?

Use the Evaporative Process Form for resins, gelcoats and cleaning materials, discussed on this Help Sheet. Use the General Process Form for reporting dust emissions (see the Help Sheet for Woodworking). The "Instructions for Reporting 2007 Annual Air Pollution Emissions" has more information and examples of Process Forms.

What are my resin and gelcoat emission factors (EFs)?

Emission factors are given in the table on the next page. Recent EPA studies concluded that calculations using previous emission factors and formulas considerably underestimated emissions. Since many tests to determine emissions rates do NOT meet EPA specifications, most manufacturers' test data which claims emission factors different from those included in this help sheet cannot be accepted.

How do I report my materials on the Evaporative Process Form?

- Line 1 - The description should include the type of product manufactured and the method(s) of application.
- Line 2 - Use Tier Code 080412.
- Column 6 - Report as a separate process (a separate line with a unique process ID number) each EF that applies to your facility.
- Column 8 - Identify the material (resin or gelcoat) and its percentage of styrene (and MMA, if applicable). If you use more than one method of applying resin, report each method separately and identify the method here. Include enough information to verify the EF shown in column 11.
- Column 9 - Enter the number of pounds used (total resin or gelcoat with styrene and MMA but without fillers).
- Column 10 - The pollutant is VOC.
- Column 11 - Select or calculate the appropriate EF from the Emission Factors table on the next page. If the Material Safety Data Sheet (MSDS) for your resin shows a broad range of styrene and MMA content (% by weight), obtain specific values for your resin from a certification sheet or from the supplier or manufacturer. This percentage is as supplied, plus any extra monomer you add (styrene or MMA), but before any glass, powders or fillers are added. If your resin or gelcoat includes MMA, calculate a single VOC emission factor including both styrene and MMA emissions and attach an Emission Factor Calculation Form (see Process #4 in example below).
- Columns 12-14 - Not applicable, leave blank.
- Column 15 - To calculate emissions, multiply column 9 by column 11, and enter the result in column 15.

Examples:

- Process 1:** A spray fiberglass process used 20,000 lb. of resin, the MSDS for which showed 45% styrene content.
- Process 2:** A hand-layup fiberglass process used 5,000 lb. of resin, the MSDS for which showed 42% styrene content.
- Process 3:** An open polymer casting process used 6,000 lb. of a resin, the MSDS for which showed 37.5% styrene content.
- Process 4:** A process used 3,000 lb. of gelcoat, the MSDS for which showed 35% styrene and 10% MMA content. The VOC emission factor is calculated by adding the emission factors for styrene and MMA, $0.168 + 0.075 = 0.243$ lb/lb.

Following is part of the Evaporative Process Form showing these processes:

6	7	8	9		10	11		15
Process ID	Stack ID(s)	Material Type	Annual Usage Input	lb or gal	VOC, HAP&NON or NHx	Emission Factor	EF Units (lbs per)	Estimated Emissions (lb/yr)
1		<i>Spray resin @45% styrene</i>	20,000	1b	VOC	0.141	1b	2820
2		<i>Manual resin @42% styrene</i>	5,000	1b	VOC	0.067	1b	335
3		<i>Cast marble resin @37.5% styrene</i>	6,000	1b	VOC	0.0075	1b	45
4		<i>Gelcoat @35% styrene + 10% MMA</i>	3,000	1b	VOC	0.243	1b	729

Styrene Emission Factors*

Emission Rate in Pounds of Styrene (VOC) Emitted per Pound of Resin or Gelcoat Processed [resin weight is “neat” (without filler), as applied]

Styrene content in resin/gelcoat, % ⁽¹⁾	<33 ⁽²⁾	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	>50 ⁽²⁾
Manual (hand layup)	$0.126 \times \% \text{ styrene}$	0.041	0.044	0.047	0.05	0.053	0.056	0.059	0.062	0.064	0.067	0.07	0.073	0.076	0.079	0.082	0.084	0.087	0.09	$(0.286 \times \% \text{ styrene}) - 0.0529$
Manual w/ Vapor Suppressed Resin (VSR)	Manual emission factor listed above $\times 1 - (0.50 \times \text{specific VSR reduction factor for each resin/suppressant formulation})$																			
Mechanical atomized (spray layup)	$0.169 \times \% \text{ styrene}$	0.056	0.063	0.07	0.077	0.084	0.091	0.098	0.106	0.113	0.12	0.127	0.134	0.141	0.148	0.156	0.163	0.17	0.177	$(0.714 \times \% \text{ styrene}) - 0.18$
Mechanical atomized with VSR	Mechanical atomized emission factor listed above $\times 1 - (0.45 \times \text{specific VSR reduction factor for each resin/suppressant formulation})$																			
Mechanical atomized controlled spray	$0.130 \times \% \text{ styrene}$	0.043	0.049	0.054	0.060	0.065	0.071	0.076	0.082	0.087	0.093	0.098	0.104	0.109	0.115	0.120	0.126	0.131	0.137	$0.77 \times (0.714 \times \% \text{ styrene}) - 0.18$
Mech. atomized controlled spray with VSR	Mechanical atomized controlled spray emission factor listed above $\times 1 - (0.45 \times \text{specific VSR reduction factor for each resin/suppressant formulation})$																			
Mechanical non-atomized	$0.107 \times \% \text{ styrene}$	0.036	0.037	0.039	0.04	0.042	0.043	0.045	0.047	0.048	0.05	0.051	0.053	0.054	0.056	0.058	0.059	0.061	0.062	$(0.157 \times \% \text{ styrene}) - 0.0165$
Mechanical non-atomized with VSR	Mechanical non-atomized emission factor listed above $\times 1 - (0.45 \times \text{specific VSR reduction factor for each resin/suppressant formulation})$																			
Filament application	$0.184 \times \% \text{ styrene}$	0.061	0.064	0.066	0.069	0.072	0.075	0.077	0.08	0.083	0.086	0.088	0.091	0.094	0.097	0.099	0.102	0.105	0.108	$(0.2746 \times \% \text{ styrene}) - 0.0298$
Gelcoat application	$0.445 \times \% \text{ styrene}$	0.147	0.157	0.168	0.178	0.188	0.199	0.209	0.219	0.23	0.24	0.25	0.261	0.271	0.282	0.292	0.302	0.313	0.323	$(1.03646 \times \% \text{ styrene}) - 0.195$
Gelcoat non-atomized application	See Note (3) below	0.098	0.103	0.107	0.112	0.116	0.121	0.125	0.13	0.134	0.139	0.143	0.148	0.152	0.157	0.161	0.166	0.17	0.175	$(0.4506 \times \% \text{ styrene}) - 0.0505$
Covered-cure after roll-out	Non-VSR emission factor listed above $\times (0.80 \text{ for manual or } 0.85 \text{ for mechanical application})$																			
Covered-cure without roll-out	Non-VSR emission factor listed above $\times (0.50 \text{ for manual or } 0.55 \text{ for mechanical application})$																			
Polymer Casting ⁽²⁾	Open Casting										Machine-Enclosed Casting									
	0.02 x % styrene										0.01 x % styrene									

Methyl Methacrylate (MMA) Emission Factors*

Emission Rate in Pounds of MMA (VOC) Emitted per Pound of Gelcoat Processed

MMA content in gelcoat, % ⁽⁴⁾	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	≥ 20 ⁽²⁾	
Spray Application	0.0075	0.015	0.023	0.03	0.038	0.045	0.053	0.06	0.068	0.075	0.083	0.09	0.098	0.105	0.113	0.12	0.128	0.135	0.143	0.143	$0.75 \times \% \text{ MMA}$
Polymer Casting ^(2, 5)	Open Casting										Machine-Enclosed Casting										
	0.16 x % MMA										0.08 x % MMA										

*Except where otherwise noted, this table was adapted from the “Technical Discussion of the Unified Emission Factors for Open Molding of Composites” (Haberlein, April 1999), available at <http://www.acmanet.org/ga/ueftext.pdf>. Maricopa County converted the data to pounds of VOC emitted per pound instead of per ton of resin/gelcoat.

Notes:

- (1) Including styrene monomer content as supplied, plus any extra styrene monomer added by the molder, but before addition of other additives such as powders, fillers, glass, etc.
- (2) The value for “% styrene” or “% MMA” in the formulas should be input as a fraction. For example, use the input value **0.30** for a resin with 30% styrene content by weight.
- (3) For styrene contents between 19% and 32%, use the equation: $(0.4506 \times \% \text{ styrene}) - 0.0505$. For <19% styrene content by weight, use the equation: $0.185 \times \% \text{ styrene}$.
- (4) Including MMA monomer content as supplied, plus any extra MMA monomer added by the molder, but before addition of other additives such as powders, fillers, glass, etc.
- (5) Maricopa County adopted this emission factor based on MMA having a vapor pressure 8 times greater than styrene’s. At 25.5 degrees C, the vapor pressure of MMA is 40 mm of Hg and the vapor pressure of styrene is 5 mm of Hg. To get an emission rate for MMA, this ratio was applied to the emission factor for styrene in marble casting: $0.02 \times 8 \times \% \text{ MMA}$.