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Topic Hub: Fiberglass Fabrication Subsection : Operations

The following discussion and additional references provide information on the mold and fiberglass/composite preparation, and open and closed molding processes, along with environmental inputs and outputs associated with these activities.

There are two general divisions of molded composites manufacturing processes: open and closed molding. With **open molding**, the gel coat resin and laminate are left open and curing takes place via exposed to ambient or heated air. **Closed molding** uses a two-part mold, and is suitable for almost any shape that is conventionally open-molded. In closed molding, the composite is processed in a two-sided mold set, a rotational mold, or within a vacuum bag. Closed molding can be completed via several different methods, including compression, pultrusion, vacuum molding, infusion molding, resin transfer molding (RTM), centrifugal casting, and Seemann Composite Resin Infusion Molding Process (SCRIMP) (a vacuum infusion molding process).

Refer to the American Composites Manufacturers Association (ACMA)'s Technical Resources for additional discussion on these processes.

There are a variety of common processing methods within the open and closed molding processes:

- Prepare mold, including mold release agents.
- Apply gel coat and allow to cure.
- Mix resin (and potential additives such as catalyst, fire retardant
- Apply resin and fibers (spray or manual lay-up)
- Cure (for closed molding, this may require mold closure and a vacuum seal or rotation) at varying time and temperature, depending on the workpiece size and shape, throughput rates, and resin cure requirements. (Most poly-based resins cure at ambient temperature, while epoxy-based resins cure at elevated temperatures that usually require an autoclave or oven).
- Demold.
- Clean mold, tooling, rollers, transfer hoses, drums, spray guns, and other tools and equipment that come in contact with resins.
- Trim the molded piece.
- Finish the product (e.g., add foam for insulation or structural support, upholstering, coating, painting, padding and carpeting, etc.).

In general, best management practices are important in other facets of operations, such as resin and chemical management and storage, air filtration and ventilation, employee healthy and safety, and solid waste management and recycling,

Typical inputs to fiberglass fabrication can include (but are not limited to):

- Energy
- Cleaning cloths or rags
- Mold release agents, typically wax- or polymer-based
- Gel coatings
- Solvated resins which surround and hold fibers to create the composite material
- Initiators and catalysts
- Chopped fibers, fiber sheets, mats, or roving
- Styrene (a solvent and co-reactant in the polymerization process, recently listed as a "reasonably anticipated human carcinogen")
- Vapor suppressants
- Emulsifiers
- Inert fillers
- Foaming agents (typically polyester-based, although isocyanate-based foams which are more toxic are still used)
- Mold cleaning chemicals and solvents (may include acetone, toluene, xylene, various alcohols, other chlorinated compounds, or citrus extracts)
- Paints and thinners
- Adhesives

Typical outputs of fiberglass fabrication can include the following, some of which are hazardous depending on the nature of the raw material:

- Solvent or resin-laden cleaning cloths or rags
- Spent or residual mold release agents
- Solvated or residual resin, including gels that have cured before they could be used

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- Scrap and waste reinforcement fibers, mat, cured trim ends and cut-outs, foam, other
- Air emissions
  - Styrene (from resins and gel coats)
  - Toluene (from some mold release agents)
  - Dimethyl phthalate (from some catalysts)
  - Other volatile organic compounds (VOCs) and hazardous air pollutants from solvents, catalysts, resins, foams, paints, and other raw materials
- Surplus, waste and/or expired chemicals: solvents, initiators, catalysts, resins, paints, stains, foams, adhesives, etc.
- Overspray solids
- Spent solvents and still bottoms
- Spent filters
- Stormwater

A number of alternative processes and materials can minimize environmental impact and worker exposure during fiberglass manufacturing. See Pollution Prevention Opportunities for a list.

Last Updated: 07/01/2008

The Topic Hub™ is a product of the Pollution Prevention Resource Exchange (P2RX™)

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