

Assignment - Sheet Molding Compound Manufacture Pollution Prevention

Sheet Molding Compound (SMC) is a fiberglass-resin compound that is molded into products ranging from Jet-Ski hulls to valve covers and micro-wave dishes.

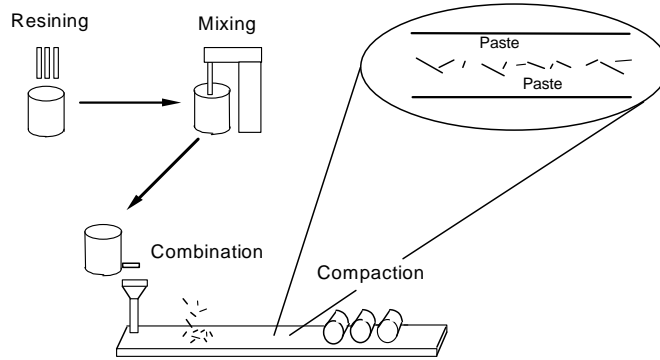


Figure 2.1 - SMC Manufacturing Process

SMC is manufactured by placing a layer of paste on a sheet of carrier film, dropping a layer of randomly oriented glass fibers one to two inches in length on this layer of paste, and adding a layer of paste on top of this (Figure 2.2). This paste-glass combination then passes through a compaction section to ensure that the fibers are "wetted out", or covered with paste. The SMC is then stored for two days to cure the plastic. At this point it is cut into charges, or shaped pieces of the sheet, and placed in a heated mold. Pressure is applied, hardening the SMC into the desired shape.

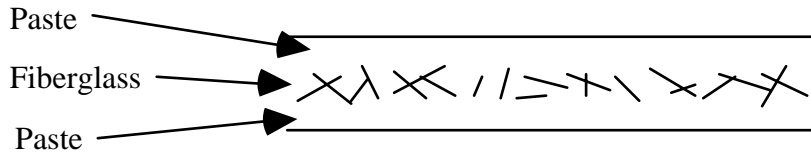


Figure 2.2 - Pre-compaction SMC

While the fiberglass is simply bought from a supplier in roll form, the paste is manufactured in the plant, and can have many different formulations. The paste formulations are based on liquid resins to which filler and other materials are added. These resins are manufactured elsewhere, brought to the plant, and stored in large holding tanks. These tanks are connected through pumps to a *resining station*. Portable tanks are brought to this station, filled with resin or with styrene, and taken elsewhere in the plant for the mixing process (Figure 2.3).

ME 4171 – Environmentally Conscious Design & Manufacturing (Bras)

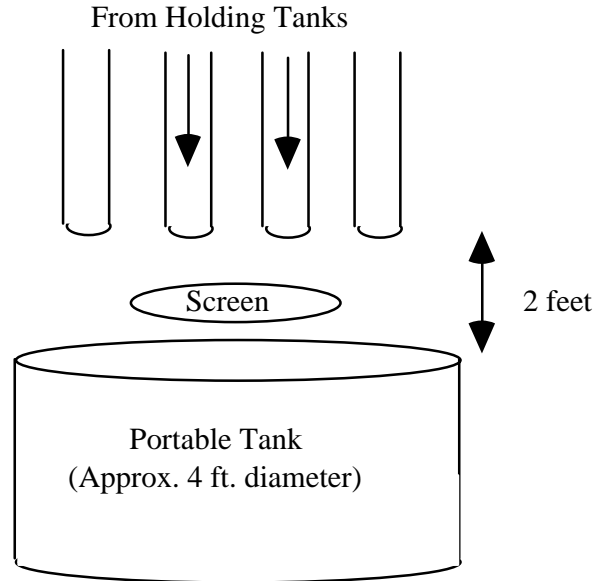


Figure 2.3 - Resining Station

During the mixing process fillers (such as silica) are added to the paste to increase its volume, essentially cutting the strength of the resin. After mixing, the tank is taken to a pumping station. Here the paste mixture is emptied from the tank into a pumping system that mixes the paste with a catalyst. This begins the SMC “curing” process, and the paste must quickly be laid down with fiberglass as discussed before.

Styrene is a monomer that is an integral component of the resins. It is also stored in pure form in these tanks since it is used as an inert ingredient to reduce the potency of the resins. Evaporation of styrene occurs at room temperature and atmospheric pressure from the paste or resin at all stages of the SMC manufacturing process. Since the tanks are not covered, styrene escapes into the plant workers environment whenever a tank contains resin or paste. Inhalation of styrene in sufficient quantities can cause central nervous system damage, and aspiration of styrene can be fatal. Assume that short term exposure limit for styrene exposure as set by OSHA is 100 parts per million of styrene. The highest allowable time weighted average (average exposure over an eight hour day) is 50 ppm.

- Draw a process diagram for the preceding process. (5 points)
- Create a mass balance for each of the production stages. (10 points)
- Identify pollutants. (5 points)
- Where would you find the exposure limits for styrene, if it was not given? (3 points)
- Identify equipment design options for reducing the release of styrene to the atmosphere from the process stages and discuss their pros and cons. (10 points)
- Identify and discuss options for pollution prevention specifically for this process. (10 points)