

COMPOSITE TECH BRIEF

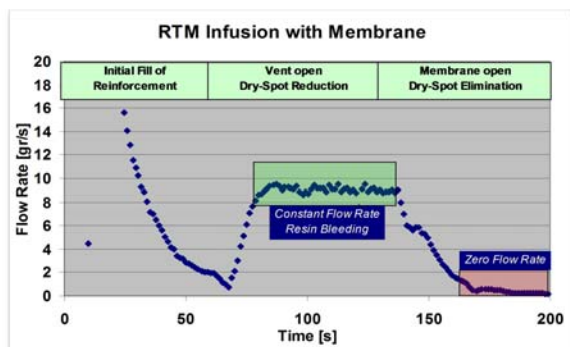
LIQUID COMPOSITE MOLDING INNOVATION: MEMBRANE-BASED RTM AND VIP PROCESSING

The University of Delaware Center for Composite Materials (UD-CCM) has discovered a Liquid Composite Molding (LCM) technique (patent pending) that significantly reduces resin waste while greatly improving robustness and part quality for Resin Transfer Molding (RTM) and Vacuum Infusion Process (VIP)

BENEFITS OF MEMBRANE-BASED LCM

UD-CCM Membrane-based LCM reduces cost and improves quality by:

- ◆ Ensuring resin fill, eliminating dry-spots
- ◆ Providing continuous degassing during mold fill and cure, reducing porosity
- ◆ Minimizing resin waste
- ◆ Reducing cycle time



processes. The method requires integration of an air-permeable, resin-impermeable membrane over all or part of the mold.

The unique membrane eliminates resin bleeding and makes certain that the mold cavity is completely filled with resin.

Because the added membrane prevents resin from entering the vent ports, the infusion process is more repeatable. Once the mold cavity is filled, the flow rate drops to zero, optimizing infusion shut-down and minimizing resin waste and cycle

time—all good news for manufacturers concerned with lowering process costs.

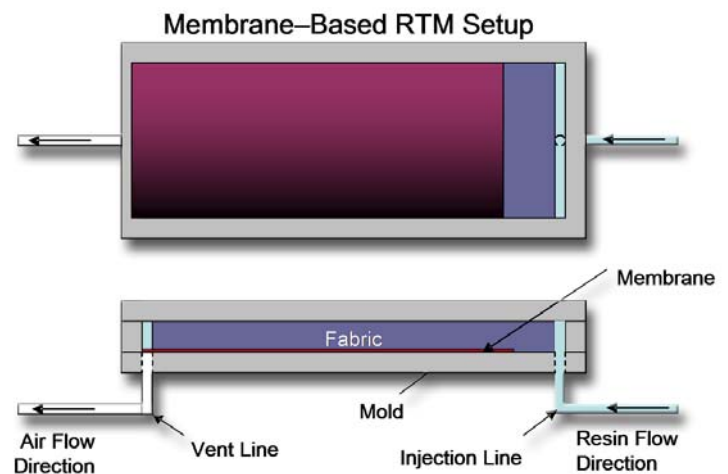
The membrane goes between the low pressure vent port and the reinforcement material, thus ensuring the material is thoroughly saturated with

resin. Because the membrane is air permeable, degassing is continuous through the complete surface area of the membrane reducing overall void content in the final part.

MOLD SETUP WITH MEMBRANE

The setup can be generically applied to all

LCM variants and has been evaluated for the RTM and VIP. The membrane separates the low pressure vent port from the reinforcement and ensures complete resin fill of the reinforcement, reduces material waste by eliminating resin bleeding, and allows continuous degassing of the resin and mold cavity improving overall part quality. The membrane can be integrated via a layer added during material lay-up covering the



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partial or complete surface of the mold creating an area on the mold surface connected to the low-pressure vent line. Thus, any point on this area can be the position of last fill and maintain a leak path of the vent line resulting in complete fill of the mold cavity. The integration of the membrane adds a processing step to the lay-up of the material into the mold. Good membrane properties include adequate peel properties, high in-plane and thru-thickness gas permeability and robust processing capabilities at elevated temperatures and for complex geometries. Multiple membranes from various companies have been successfully tested.

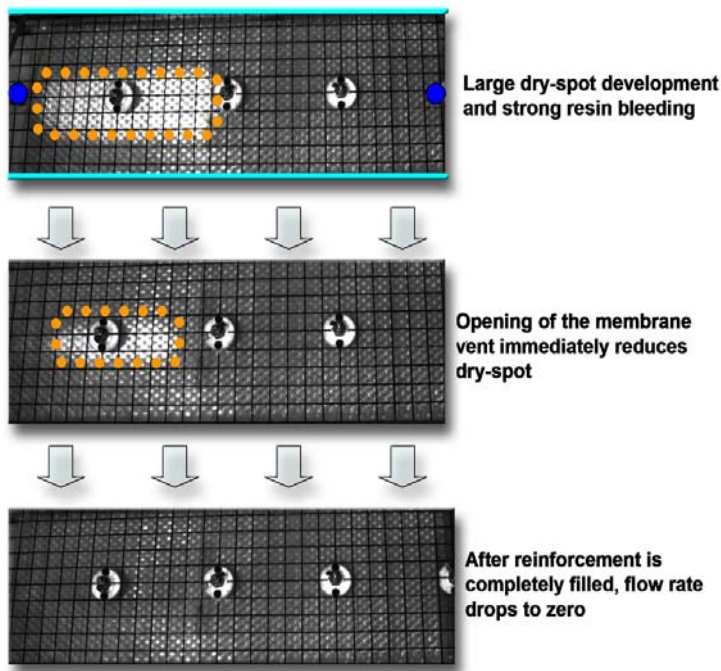
BENEFITING INDUSTRY

During conventional RTM processing, gaps between the mold and the edges of the reinforcement material create race-tracking channels. This irregularity produces dry spots and increases part porosity by letting resin escape through the vent port

before the reinforcement material is fully saturated. The resulting part must be discarded. Tight tolerances on reinforcement placement or on-line process control can sometimes overcome this situation. However, all too frequently processors must undertake costly mold re-engineering or

replacement. By preventing resin from entering the vent port while maintaining continuous venting through the membrane, UD-CCM's system eliminates this need altogether.

This significant improvement in RTM processing promises to be of



great value to manufacturers around the globe. It is yet another example of the UD-CCM's ability to find genuine solutions to difficult problems.

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