VACUUM ASSISTED RESIN TRANSFER MODLING FOR RT-ET CURED COMPOSITES

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Objectives of the Research

Develop a vacuum assisted resin transfer molding (VARTM) process for manufacturing room-temperature (RT) and elevated-Temperature (ET) cure laminated and sandwich composite panels. Specifically, E-glass/Vinyl ester and carbon/epoxy laminates and foam core sandwich panels.

Approach

Resin transfer molding (RTM) has been established as a cost efficient method for large volume production of high-performance composite components. High pressure and temperature and the matched tooling preclude RTM's use for large or one-of-a-kind components. Vacuum assisted resin transfer molding alleviates these cost concerns and can be used to fabricate large components of acceptable quality where specific dimensional tolerances are not critical. The VARTM process has been established for ship and civil infra-structural components. The current process employs room-temperature curable resins and vacuum pressure. In this research, a table-top (3'x2' component size) VARTM processing facility was established which has the functionality to operate at room-temperature or elevated temperatures up to 300° F. Electric strip-heaters in the base in combination with a heating blanket provide the elevated temperature capability. A programmable (PID) controller allows the reproduction and automation of necessary cure cycles. The complete setup is shown in the attached figure. The critical elements in the process are the carrier cloth, resin viscosity, and temperature control. Laminated panels of woven E-glass/vinyl ester (BGF 2532/Derakane 411-350) and carbon/vinyl ester (Fiberite W-5-322/Derakane 411-350) were successfully processed. A sandwich panel with face-sheets of glass/vinyl ester (BGF 2532/Derakane 411-350) and a PVC (DIAB H130) foam core was also fabricated.

Accomplishment Description

Fiber volumes for the glass and carbon laminates were determined to be 42% and 50%, respectively. Measured Tensile; Compressive and in-plane Shear properties are listed in Table 1. The glass values are in close agreement with those reported in literature. The low fiber volume can be attributed to the plain-weave architecture of the fabrics used. Fiber volume can be improved through the use of heavy woven roving or satin-weave fabrics. Details of the process are presented in reference 1.

Significance

Sandwich panels of varying architecture and material types produced using the table-top VARTM facility will be used to measure mixed-mode fracture toughness. Analytical study of the stress-states in delaminated sandwich panels is presented in another tech high-light.

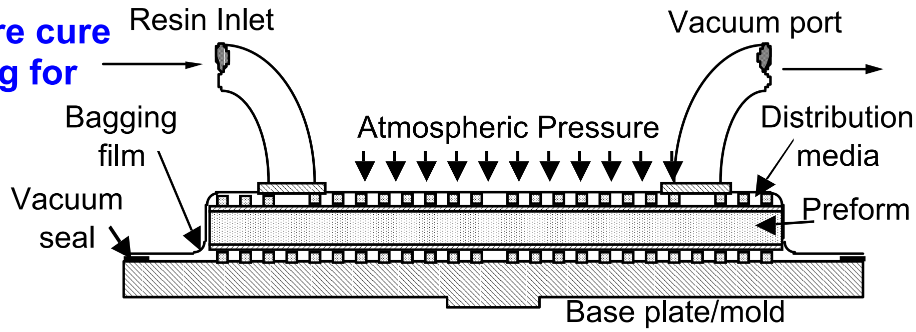
References

1. S.A. Smith, L.L. Emmanwori, K.N. Shivakumar, and R.L. Sadler, Proc. of SAMPE 2000, 3-6 May 2000, LongBeach CA

RT & ET Cure Vacuum Assisted Resin Transfer Molding

Objectives

Develop room and elevated temperature cure vacuum assisted resin transfer molding for glass and carbon fabric composites.



Principals

- **Evacuate preform**
- **Distribute resin on preform**
- **Infiltrate through-the-thickness**
- **Cure at room or elevated temperature**

	Vinyl ester resin	
Fabric	**E-glass**	**Carbon**
Tensile		
Modulus, Msi	3.34	7.00
Poisson ratio	0.11	0.05
Strength, ksi	47.1	63.4
Compression		
Strength, ksi	51.6	38.0
Shear		
Modulus, Msi	0.58	0.51
Strength, ksi	12.2	11.2