ABSTRACT

***Key words**: Fiber Reinforcement Composites, Vacuum Assisted Resin Transfer Molding, Natural Fabric Jute, Parameter Study, Taguchi Method and Full factorial design*

Vacuum Assisted Resin Transfer Molding (VARTM) is considered as vacuum infusion process. This process is used to manufacture parts of Fiber Reinforced Plastic (FRP) Composites. The process works on pressure difference to impregnate resin inside the fabric which is covered by vacuum bag and sealed by sealant tape. This process has many advantages such as less cost due to use of one side tool to manufacture complicated shapes, eco-friendly, clean, safe and an out of autoclave process. The process is used for large structure manufacturing like wing blade, boat hull, automobile parts etc. The challenges which this process faces are, part thickness variation and variation in volume fraction, which restricts this process from high end applications like aerospace. Research review was performed to identify critical parameters affecting VARTM process. The parameters were divided in three categories; input, in-process and output parameters. From all these parameters, important parameters, which have not been studied considerably by other researchers, were selected for research investigation.

Indigenous experimental setup facility was developed for VARTM process and modifications were incorporated in the setup to study effect of selected process parameters in VARTM process. Untreated plain weave jute and plain weave glass fabric was used as reinforcement and general purpose polyester resin was used as matrix while conducting different sets of experiments. Preliminary experiments were also performed to identify process requirement for conducting different set of experiments. Four sets of experiments were conducted after performing preliminary experiments to identify effect of various parameters like number of layers, location of resin supply, position of vacuum supply, effect of degassing, inclination angle of table, effect of vacuum, Revolution per Minute (RPM) of peristaltic pump and Gram per Square Meter (GSM) of fabric. Taguchi orthogonal L_9 Array and full factorial design approach was selected to design experiments with three parameters and three levels. Minitab 17 was used to analyze the results.

The response measurement was performed in two ways: a) in-process b) post-process measurement and testing. During in-process measurement flow velocity, flow rate and thickness variation during flow was measured. For post-process tensile strength, flexural strength, thickness variation of cured laminate, microscopic examination, density measurement and fiber volume fraction tests were performed with applicable ASTM standards. ANOVA and Regression models have been developed for mechanical characterization with factors affecting VARTM process and important conclusions have been derived on effect of various parameters on VARTM process.