LIST OF FIGURES

Figure	Title	Page No.
1.1	Classification of composites based on forms	2
1.2	Classification of fibers	3
1.3	Classification of composite based on matrix	4
1.4	Classification of composite manufacturing processes	5
1.5	Classification of liquid compression molding processes	6
1.6	VARTM experimental setup	7
2.1	Schematic of VARTM Control system incorporating computer control pressure and vacuum in-situ vacuum sensing for two individual vents	18
2.2	a) The Schematic of the laser scanner to increase during infusion b) the laser scanner above the mold	21
2.3	Top view of resin infusion behaviour	23
2.4	Schematic diagram of an integrated experimental setup for testing in-plane permeability adopted in the study.	24
2.5	Actual experimental setup for the vacuum infusion process	25
2.6	Cause and Effect diagram for parameters affecting VARTM	32
3.1	process Research methodology	37
4.1	Care and precautions during experiments	42
4.2	Process steps - Stage 1	44
4.3	Process steps - Stage 2	45
4.4	Process steps - Stage 3	46
4.5	Meaning of Experiment	47
4.6	Schematic diagram of VARTM preliminary experiment setup	50
4.7	Developed preliminary experimental setup	50
4.8	Experimental setup.	51
4.9	a) 3D View of experimental setup b).Developed experimental setup	53

4.10	a) slots for spirit level b) Arrangements for inclination c) Arrangement Levelling of table and lights	53
4.11	Preliminary experiment conducted on indigenously developed setup	54
4.12	Schematic diagram of effect of number of layers and degassing experimental set up	55
4.13	Developed experimental setup with degassing	55
4.14	Schematic diagram of effect of number of layers, inclination of table and amount of vacuum supply	56
4.15	Experimental setup with variation in number of layers, inclination of table and amount of vacuum supply	57
4.16	Schematic diagram of experimental setup with peristaltic pump	58
4.17	Experiment set up with variation in GSM, RPM of peristaltic pump and amount of vacuum supply	59
5.1	Fixture to measure thickness variations during the flow	60
5.2	Flow velocity and thickness variation measurement a) before b) during c) after impregnation from front camera	61
5.3	Flow rate measurements	61
5.4	Tensile testing specimens	62
5.5	Flexural testing specimens	63
5.6	Measuring laminate thickness with mechanical comparator	63
5.7	Microscopic examination for jute polyester laminates	64
	a) without degassing b) with degassing	
5.8	 Weight fractions by LOI method for glass fabric. a) Weighing of glass laminate b) putting in muffle furnace c) weighing fabric after keeping in furnace for 2 hours at 565 +/- 28° C 	65
5.9	Weight fractions by solvent method for jute-polyester laminate	65
5.10	Composite density measurements	66
6.1	Effect of parameters on tensile strength	69
6.2	Effect of parameters on flow velocity	69
6.3	Laminate average thickness and thickness variation	70
6.4	Tensile strength with and without degassing	72
6.5	Flexural strength with and without degassing	72

6.6	Average laminate thickness variations (mm) with and without degassing	73
6.7	Air entrapments before and after degassing in laminates	74
6.8	Color of laminate with and without degassing	74
6.9	Main plots for tensile strength (MPa)	76
6.10	Main plots for flexural strength (MPa)	76
6.11	Thickness variations in cured laminate	77
6.12	Main plot for tensile strength (MPa)	80
6.13	Interaction plot for effect of tensile strength (MPa)	80
6.14	Main plot for effect of flexural strength (MPa)	82
6.15	Interaction effect of flexural strength (MPa)	83
6.16	Average thickness and thickness variation of all laminates	84

LIST OF TABLES

Table	Title	Page No.
2.1	Natural fiber volume fraction (FVF) comparisons	12
2.2	Research review on process parameters	13
2.3	Parameters affecting VARTM process	33
4.1	Materials	38
6.1	Effect of number of layers, position of resin supply and location of vacuum supply on tensile strength and flow velocity	68
6.2	Effect of vacuum degassing and number of layers on fraction weight, flow velocity, tensile strength and flexural strength	71
6.3	Effect of varying number of layers, inclination of table and vacuum on tensile strength, flexural strength, thickness variation, fiber weight fraction and flow velocity	75
6.4	Results of full factorial design with varying GSM, RPM and vacuum	79
6.5	Analysis of Variance for Tensile strength (MPa)	81
6.6	Analysis of Variance for flexural strength (MPa)	83