

An Evaluation for the Process-Ability of Composites using Infusion Process

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Introduction

- FRP is widely used in space, aviation, and automobile industries as a high-strength, light-weight material, and has recently been used in shipbuilding.
- In this study evaluated the process-ability of infusion process.(IP)
- The parameters of IP are resin viscosity, permeability coefficient and vacuum pressure.
- A radial flow method was used to measure the permeability coefficient.
- Silicone oil was used the fluid liquid.



Resin

viscosity

Permeability

- The resin front was measured with a camera of the proceed time was calculated.
- Resin flow velocity was calculated by Darcy law.

Experimental

Material

 Carbon fabric : T700, 0/90 Resin : KER 9100/KCA9110, Kumho P&B chemical Co.Ltd. Silicon oil : KF–350CS, Shinetsu Co. Ltd Program : RTMWORX, Polyworx company





Permeability

<Vf 45 % preform resin front >



<Vf 50 % preform resin front >

Darcy`s law



Ū: resin speed K: permeability *p*: pressure μ : viscosity

Injection

pressure

Rheometer condition Dynamic scanning : 5, 10 °C/min, Max 80°⊂ Isothermal scanning : 20, 30, 40, 60 °C

Result and Discussion

Resin viscosity



• Analysis of the lowest viscosity section through dynamic scan Prediction of resin fluidty by temperature through isothermal scal

Preform permeability

< Result of permeability coefficient>

Fiber volume fraction (%)	K1	K2	K1/K2
45	9.35E-09	1.14E-09	1.38E-01
50	2.39E-09	7.40E-10	4.14E-01

Flow simulation of unmanned probe



Interlaminar strength test



< Result of Mechanical properties> Confirmed by fiber volume ratio 45% (68.57 Mpa), 50% (77.90 Mpa)

SEM(Cross-section)



<SEM measurement image>

• Measurement of permeability coefficient by radial flow mehtod

The permeability coefficient was measured for 45 and 50% of the fiber volume fraction, and the measurement results for the K1 and K2 directions were derived

<Simulation result of unmanned probe : hull>

Simulation evaluation results to confirm fluidity of resin

In the case of the speed of the lower part, it is only dependent on the speed because it is transmitted to the lower part after the upper part advances

 Depending on the fiber lamination, the lower part has a lower resin ratio, but the upper part has more resin impregnation



- Perform process design through analysis and simulation of basic characteristics of materials for manufacturing hulls for unmanned probes
- Rheology property analysis was performed to confirm the fluidity of the resin, and the process cycle was determined (30 °C, 1Pa.s, 70 min).
- A radial measuring device was manufactured to measure the permeability coefficient, and the permeability coefficient was measured for 45 and 50% of the fiber volume fraction.
- Flow simulation was performed based on resin analysis and permeability coefficient of 45%. The target impregnation time was set within 65 minutes, and as a result of the simulation, impregnation could be completed within 70 minutes.

