

Description

Image



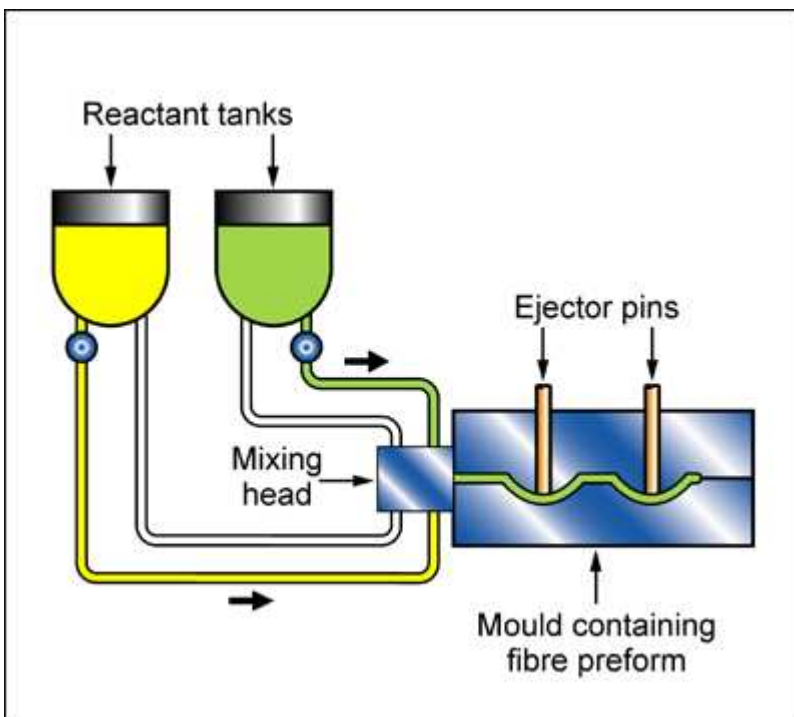
Image caption

(1) Water slide part produced by Resin Transfer Molding (RTM) © Brittany Hagen at Wikimedia Commons (CC BY-SA 3.0) (2) The front view of BMW i3 © Tokumeigakarinooshima at Wikimedia Commons (CC 1.0)

The process

RESIN TRANSFER MOLDING (RTM) allows manufacture of complex shapes in fiber-reinforced composites without high tooling costs. It uses a closed mold, in two or more parts, usually made of glass-reinforced polymers or light metal alloys, with injection points and vents to allow air to escape. Reinforcement is cut to shape and placed in the mold, together with any inserts or fittings. The mold is closed and a low viscosity thermosetting resin (usually polyester) is injected under low pressure (roughly 2MPa) through a mixing head in which hardener is blended with the resin. The mold is allowed to cure at room temperature. The molding is allowed to cure at room temperature. The fluidity of the resin and the low molding pressure allows long tool life at low cost.

Process schematic



Tradenames

RTM

Material compatibility

Composites 

Shape

Circular prismatic 

Non-circular prismatic 

Flat sheet 

Dished sheet 

Solid 3-D 

Hollow 3-D 

Economic compatibility

Relative tooling cost high

Relative equipment cost medium

Labor intensity high

Economic batch size (units) 1e3 - 1e6

Physical and quality attributes

Mass range 1.76 - 110 lb

Range of section thickness 78.7 - 236 mil

Tolerance 9.84 - 39.4 mil

Roughness * 0.00984 - 0.063 mil

Surface roughness (A=v. smooth) A

Process characteristics

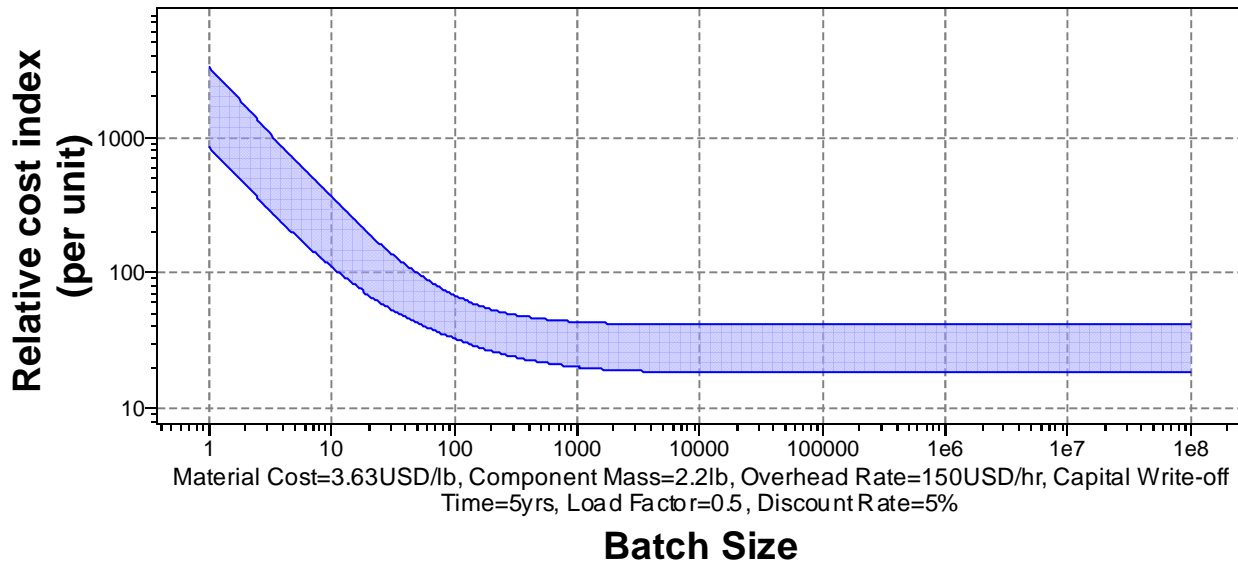
Primary shaping processes 

Discrete 

Cost model and defaults

Relative cost index (per unit) * 20.2 - 43.6

[Parameters:](#) Material Cost = 3.63USD/lb, Component Mass = 2.2lb, Batch Size = 1e3, Overhead Rate = 150USD/hr, Discount Rate = 5%, Capital Write-off Time = 5yrs, Load Factor = 0.5



Capital cost	* 8.2e3	-	4.92e4	USD
Material utilization fraction	* 0.85	-	0.97	
Production rate (units)	* 5	-	20	/hr
Tooling cost	* 820	-	3.28e3	USD
Tool life (units)	* 500	-	5e3	

Supporting information

Design guidelines

Resin transfer molding is increasingly used for large fiber-reinforced polymer components. Shapes can be complex. Ribs, bosses, and inserts are possible. Foam panels can be insert-molded to reduce component weight.

Technical notes

A range of resin systems can be used with RTM: almost any thermosetting resin with a low viscosity is possible, for example, polyester, epoxies, vinyl esters and phenolics. The reinforcement, typically, is a 25-30% volume fraction of glass or carbon in the form of continuous fiber mat.

Typical uses

RTM is used to make large composite structures such as manhole covers, compress soil casings, car doors and side panels, propeller blades, boat building, hulls, canoe paddles, water tanks, bath tubs, roof sections, airplane escape doors.

The economics

The mold costs for VARTM are low, making the process economic for small batch

The environment

It is easy to control emissions from the vented, closed mold with adequate ventilation, so worker exposure to unpleasant chemical vapors is much less than in many other composite-molding processes.

Links

MaterialUniverse

Reference
