Reaction injection molding (RIM)

Description

Process schematic

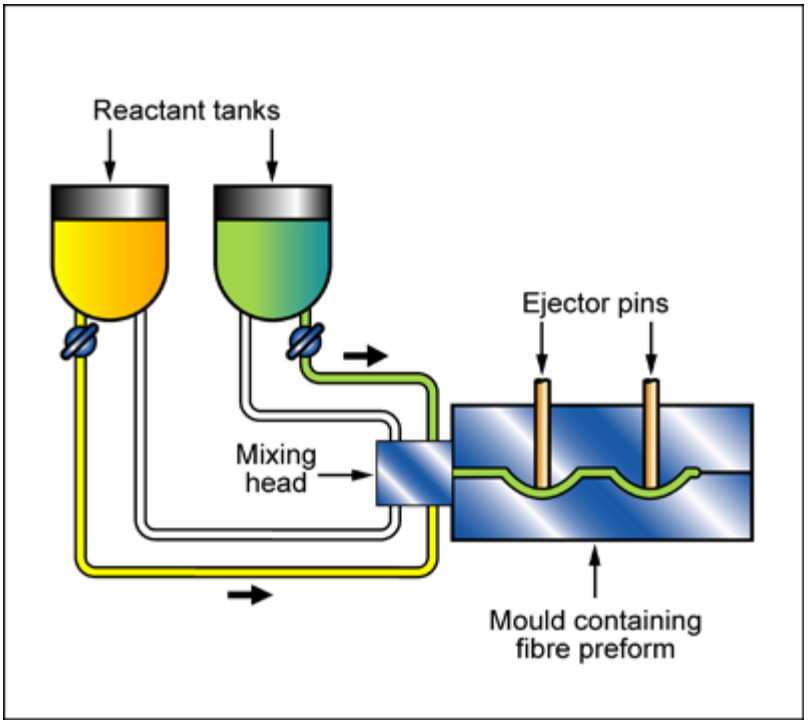


Figure caption

Reaction injection molding.

The process

REACTION INJECTION MOLDING (RIM) is a low pressure (0.35 - 0.7 MPa) process used for the in-situ polymerization of parts. It uses preheated low-viscosity chemicals (e.g. polyol + isocyanate for PUR).
These are fed under pressure to the mixing head, from which they are injected into the mold where polymerization occurs. The process is generally used for large parts that can have complex shapes.
It is most commonly used with thermosetting polyurethane (PUR) but other polymers are also used (e.g. nylon 6, epoxy resins, etc). The process can be adapted to produce fiber-reinforced composites (reinforced RIM - RRIM) and structural foam products (by incorporating a blowing agent). Structural foam parts produced by this technique have a dense skin and a foamed core due to cooling at the mold wall.

Tradenames

RIM, RRIM,

Material compatibility

Polymers - thermosets	✓

Shape

Circular prismatic	✓
Non-circular prismatic	✓
Solid 3-D	✓
Hollow 3-D	✓

Economic compatibility

Relative tooling cost	medium			
Relative equipment cost	high			
Labor intensity	medium			
Economic batch size (units)	100	-	1e4	

Physical and quality attributes

Mass range	1.1	-	55.1	lb
Range of section thickness	78.7	-	984	mil
Tolerance	3.94	-	39.4	mil
Roughness	0.00787	-	0.063	mil
Surface roughness (A=v. smooth)	A			

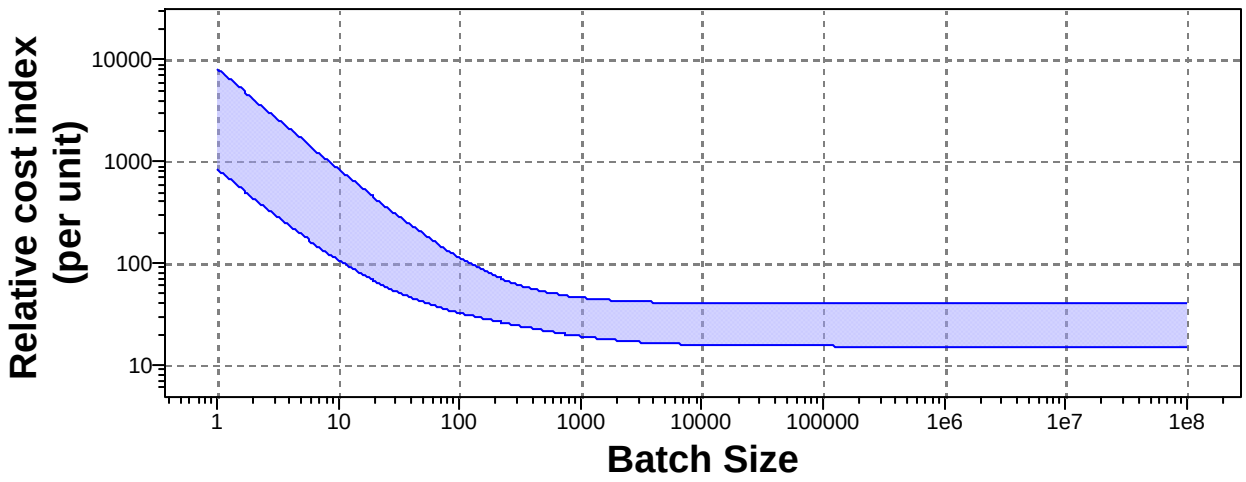
Process characteristics

Primary shaping processes	✓
Discrete	✓

Cost model and defaults

Relative cost index (per unit)	19.1	-	45.9	

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



Material Cost=3.63USD/lb, Component Mass=2.2lb, Overhead Rate=150USD/hr, Capital Write-off Time=5yrs, Load Factor=0.5, Discount Rate=5%

Capital cost	1.64e4	-	3.28e5	USD
Material utilization fraction	0.6	-	0.9	
Production rate (units)	6	-	60	/hr
Tooling cost	820	-	8.2e3	USD
Tool life (units)	1e3	-	1e4	

Supporting information

Design guidelines

Complex shapes are possible. Mold release for thermosets can be problematical.

Technical notes

RIM is mainly used for thermosetting polyurethane, particularly for making structural foam parts, but it can also be used for other thermosets: epoxies, polyester, silicones, phenolics, and for nylon 6. Short fiber and particulate filled composites are also processed (RRIM/SRIM).

Typical uses

Automotive bumpers, thermal insulation for refrigerators, housings, TV cabinets, steering wheels, car seats, window frames, construction panels.

The economics

The mold materials are very cheap; large moldings and small batch sizes are practical, but lay-up methods are labor intensive.

The environment

Energy consumption is relatively low - less than 50% of most thermoplastic-forming

Links

MaterialUniverse