RESIN TRANSFER MOULDING PROCESS FOR COMPOSITE PRODUCT MANUFACTURING

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RESIN TRANSFER MOULDING

COMPOSITE MANUFACTURING PROCESSES

There are two general divisions of Composite Manufacturing Processes

1) Open Moulding (sometimes called Contact Moulding)
2) Closed Moulding

With Open Moulding, the gel coat and laminate are exposed to the atmosphere during the fabrication process

In Closed Moulding, the composite is processed in a two sided mould set, or within a vacuum bag

Open Mould Process

Closed Mould Process

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COMPOSITE MANUFACTURING PROCESSES

Open Moulding Process

Hand Lay-Up
- Manual Resin Application
- Mechanical Resin Application

Chopped Laminate Process
- Atomized Spray-Up
- Non-Atomized Application

Filament Winding

Closed Moulding Process

Compression moulding
- Sheet Moulding Compound (SMC)
- Bulk Moulding Compound (BMC)

Pultrusion

Reinforced Reaction Injection Moulding (RRIM)

Resin Transfer Moulding (RTM)

Vacuum Bag Moulding
- Wet Lay-Up
- Prepreg

Vacuum Infusion Processing

Centrifugal Casting

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COMPOSITE MANUFACTURING PROCESSES

Low Volume Production

Open Moulding

Vacuum Bag Moulding

Vacuum Infusion Moulding

Medium Volume Production

Filament Winding

Resin Transfer Moulding

Centrifugal Casting

High Volume Production

Compression Moulding
SMC / BMC

Pultrusion

Reinforced Reaction Injection Moulding

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HAND LAYUP PROCESS

Hand lay-up is an open moulding method suitable for making a wide variety of composites products including: boats, tanks, bathware, housings, RV / Truck / Buses / Coaches / Auto Components, architectural products, and many other products ranging from very small to very large.

Production volume per mould is low; however, it is feasible to produce substantial production quantities using multiple moulds.

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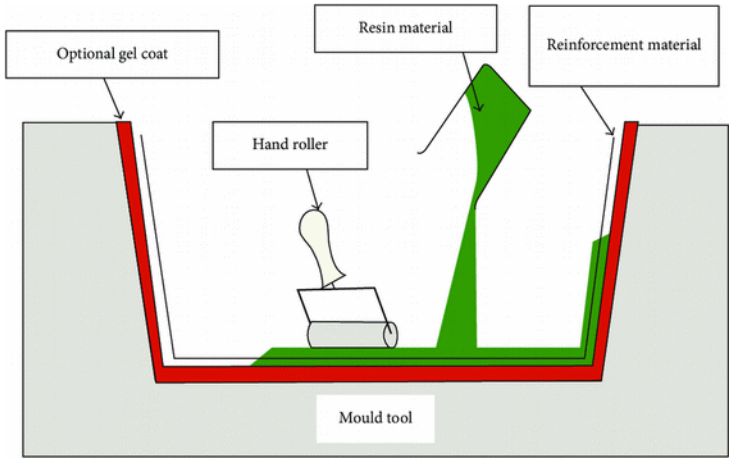
HAND LAYUP PROCESS

Process Description

- Gel coat is first applied to the open mould using a brush or a spray gun for a high quality surface.
- When the gel coat has cured sufficiently, roll stock fiberglass reinforcement is manually placed on the mould.
- The laminating resin is applied by pouring, brushing, spraying, or using a paint roller. FRP rollers, paint rollers, or squeegees are used to consolidate the laminate, thoroughly wetting the reinforcement, and removing entrapped air.
- Subsequent layers of fiberglass reinforcement are added to build laminate thickness.



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HAND LAYUP PROCESS

Moulds

• Simple, single-cavity moulds of fiberglass composites construction are generally used.
• Moulds can range from very small to very large and are low cost in the spectrum of composites moulds

Major Advantages

• Simplest method offering low-cost tooling, simple processing, and a wide range of part sizes.
• Design changes are readily made.
• There is a minimum investment in equipment.
• With skilled operators, good production rates and consistent quality are obtainable.

Limitations

• Operator skill dependent.

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RTM PROCESS

Resin transfer moulding is an intermediate volume moulding process for producing composites. The RTM process is to inject resin *under pressure* into a mould cavity. RTM can use a wide variety of tooling, ranging from low cost composite moulds to temperature controlled metal tooling.

This process can be automated and is capable of producing rapid cycle times. Vacuum assist can be used to enhance resin flow in the mould cavity.

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RTM PROCESS

Process Description

- The mould set is gel coated conventionally, if required.
- The reinforcement (and core material) is positioned in the mould and the mould is closed and clamped.
- The resin is injected under pressure, using mix/meter injection equipment, and the part is cured in the mould.
- RTM can be done at room temperature; however, heated moulds are required to achieve fast cycle times and product consistency.
- Clamping can be accomplished with perimeter clamping or press clamping.

Image Courtesy : M/s. RTM Composites

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RTM PROCESS

Moulds

• RTM can utilize either "hard" or "soft" tooling, depending upon the expected duration of the run.
• Soft tooling would be either polyester or epoxy moulds, while hard tooling may consist of cast machined aluminum, electroformed nickel shell, or machined steel moulds.
• RTM can take advantage of the broadest range of tooling of any composites process. Tooling can range from very low cost to very high cost, long life moulds.

Major Advantages

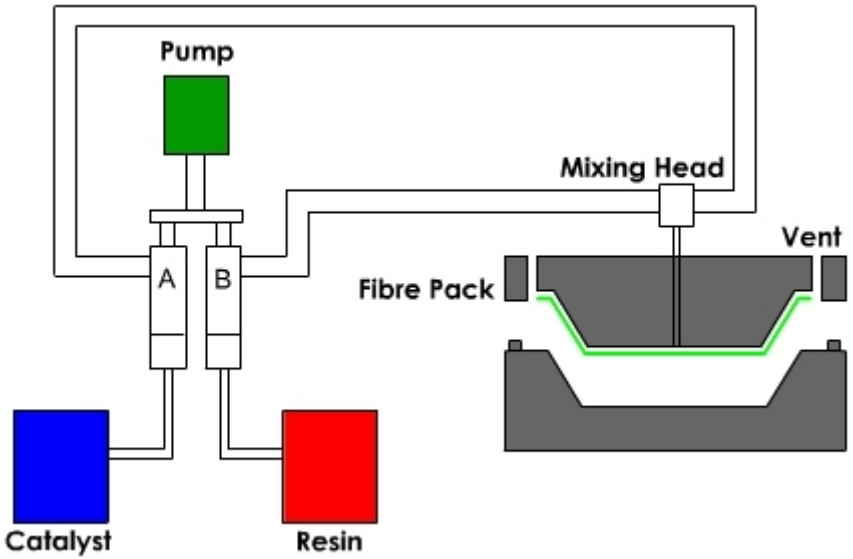
• This closed moulding process produces parts with two finished surfaces.
• Part thickness is determined by the tool cavity.
• Fast cycle times can be achieved in temperature controlled tooling and the process can range from simple to highly automated.

Limitations

• Parts with undercut cannot be manufactured.

RESIN TRANSFER MOULDING

RTM PROCESS

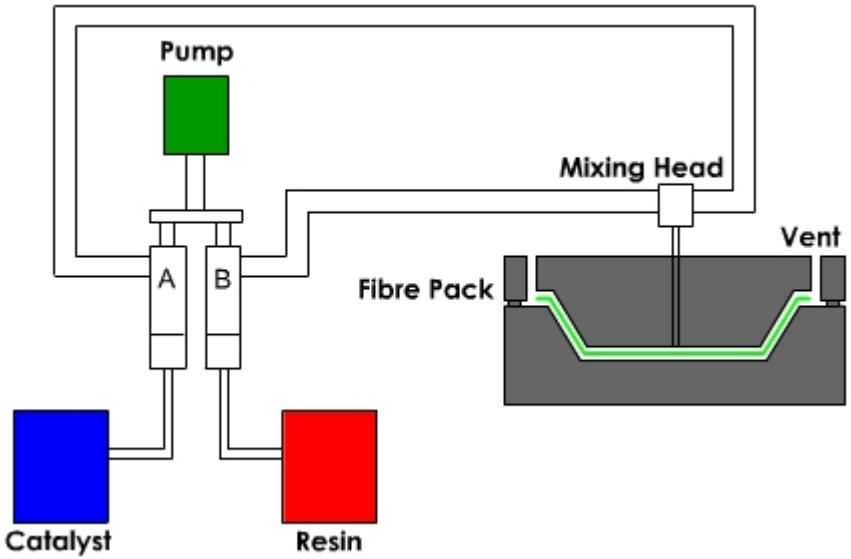


A. FIBRE LOADING AND MOULD SETUP

Image Courtesy : M/s. Plastech

RESIN TRANSFER MOULDING

RTM PROCESS

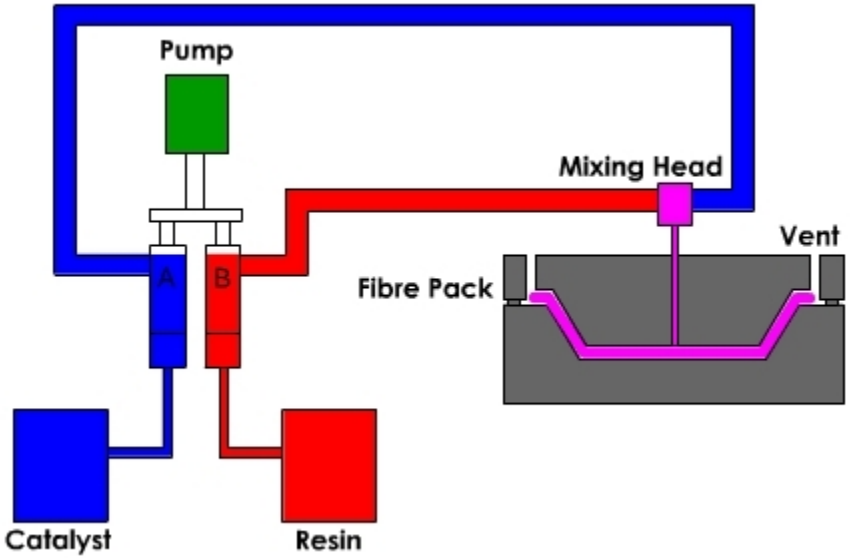


B. MOULD CLAMPING

Image Courtesy : M/s. Plastech

RESIN TRANSFER MOULDING

RTM PROCESS



C. RESIN INJECTION

Image Courtesy : M/s. Plastech

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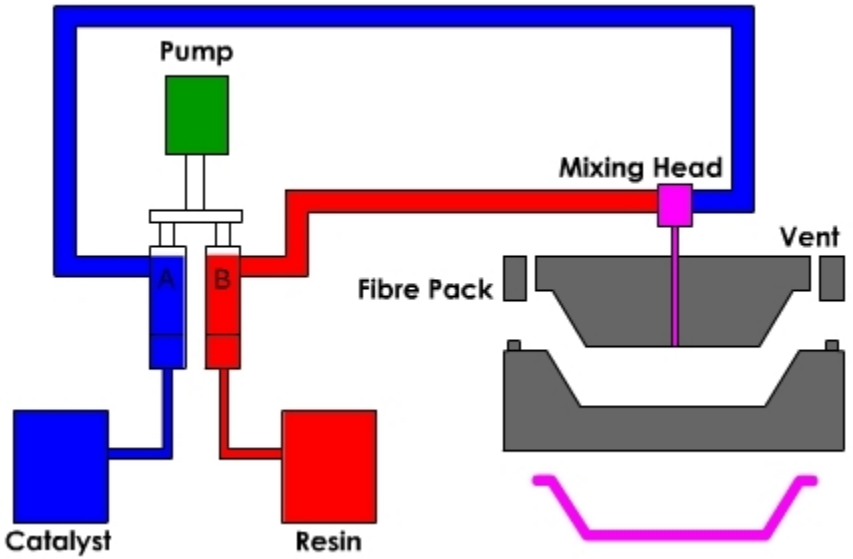
RTM PROCESS



D. PART DEMOULDING

Image Courtesy : M/s. Plastech

RESIN TRANSFER MOULDING

RTM PROCESS

TYPICAL RTM MOULD

Image Courtesy : M/s. Plastech

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RTM PROCESS

SURFACE PREPARATION

Image Courtesy : M/s. Plastech

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RTM PROCESS

FIBRE LOADING

Image Courtesy : M/s. Plastech

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RTM PROCESS

MOULD OPENED AFTER RESIN INJECTION

Image Courtesy : M/s. Plastech

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RTM PROCESS

DEMOULDED PART

Image Courtesy : M/s. Plastech

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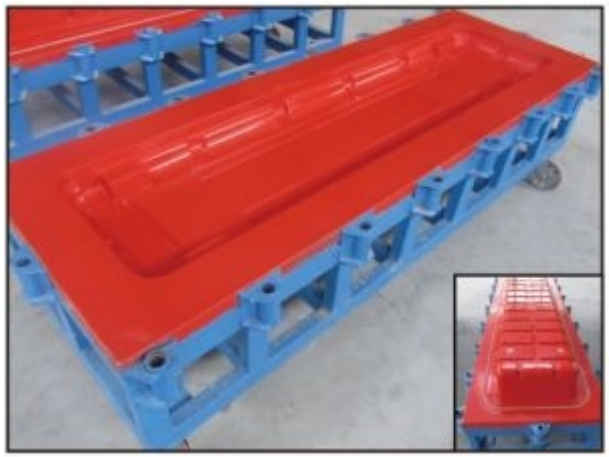
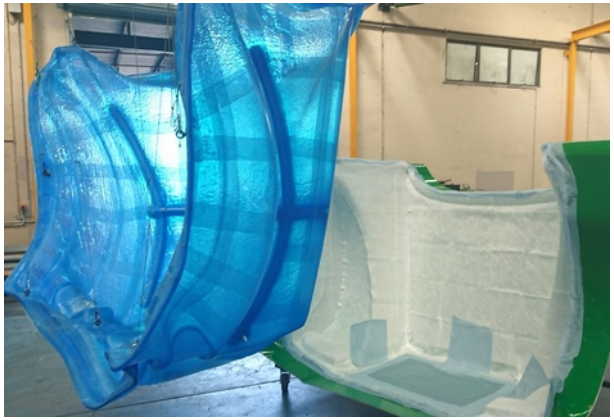
RTM PROCESS VARIANTS



Traditional RTM – Matched Male / Female Soft Mould with Steel Structure backup

LRTM – Male Mould is Lighter and uses Vacuum for Injection

RTM MIT – Similar to Traditional RTM but with removable Skin in Female Mould



Flex RTM – Male Mould is made of Silicon Bag and uses Vacuum for Injection

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KEY ELEMENTS OF THE PROCESS

Man

- Lower Skill Requirement
- High adherence to process needed

Machine

- Dedicated Meter Mix Machines
- High Degree of Automation possible
- Specialised add-on modules available

Material

- Variety of Resin systems can be used from Polyesters, Vinyl Esters to Epoxy
- Variety of Fibre Reinforcements from CFM, SM, WR, Fabric
- Cores and Inserts also feasible

Mould

- Medium Investment
- Can be made of Composite, Steel, Ni Shell, Silicon among many options
- Can be automated for lifting and clamping

Method

- Variety of methods available for specialised needs
- Using Pressure based injection to Vacuum assisted injection

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RTM OFFERS

- Increased Productivity
- Wide range of Production quantity
- Smooth Finish on both sides of the Product
- Elimination of Operator Skill Dependency
- Lower Void content
- Better Quality Control and Process Control
- Better Part Reproducibility
- Lower Styrene Emissions
- Reduced Energy Consumption
- Is repairable like any other GRP part

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RTM APPLICATIONS

- Preferred Process where Part Consistency and both side finish is critical. Typically in Automotive, Aerospace and Defense

- Process variants like Flex RTM can help achieve undercuts and higher glass content requirements

- Process variants like RTM MIT can help achieve high productivity requirements with easy and quick scale up of production volumes

RESIN TRANSFER MOULDING

COMPARISON OF PROCESSES

PROCESS	EQUIPMENT COST	PRODUCTION RATE	PART STRENGTH	OPERATOR SKILL	PART COMPLEXITY	PART REPRODUCIBILITY
HAND LAYUP	1	2	10	10	10	5
SPRAY UP	2	3	10	10	7	3
RTM	3	7	10	7	7	8
SMC	10	10	10	4	9	10

1 - Lowest

10 - Highest

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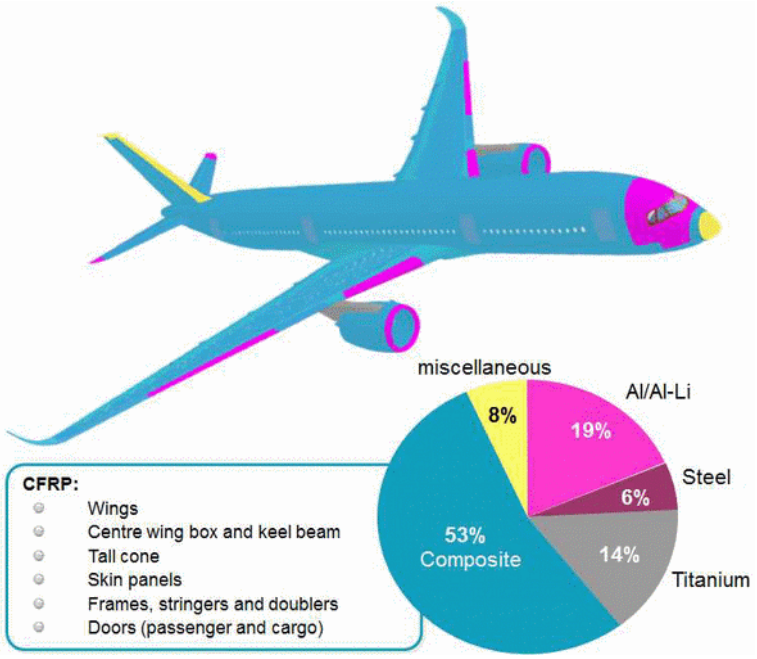
RTM IN AEROSPACE AND DEFENSE

- Access Covers and Doors
- Control Surfaces
- De-Icing Duct Components
- Engine Cowl Beams
- Fan Blades
- Fins and Wings
- Fuel Tanks
- Launch Tubes
- Equipment Boxes
- Propellers
- Radomes
- Armour Panels



* Representative Images shown for understanding purpose only. May not be actual applications

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RTM IN AUTOMOTIVE

- Body Panels
- Bumpers
- Roofs
- Housings
- Dashboards
- Engine Covers
- Inner Panels
- Boxes
- Leaf Springs
- Integral Floor Pans
- Space Frames

* Representative Images shown for understanding purpose only. May not be actual applications

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RTM IN CONSTRUCTION

- Columns and Posts
- Doors and Frames
- Kiosks
- Manhole Covers
- Signages
- Facades
- Wall Panelling
- Roofs
- Tiles
- Prefabricated Units
- Toilet Modules

* Representative Images shown for understanding purpose only. May not be actual applications

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RTM IN ELECTRICAL

- Housings and Covers
- Work Stations
- Parabolic Dishes
- Radomes

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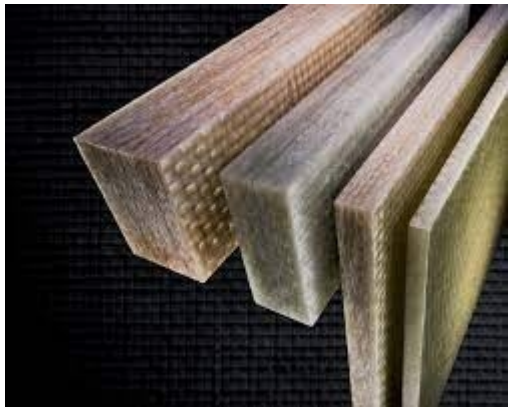
RTM IN MARINE

- Hull
- Deck
- Armour Protection Panels
- Housings and Covers
- Boxes



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QUESTION AND ANSWER SESSION

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THANK YOU !!