Midas Technical Support

Understanding RIM – Reaction Injection Moulding

What exactly is RIM?

Reaction injection moulding or RIM is a cold casting process that begins life as a two-component material. Although a number of different materials, including polyurethanes, polyesters, and epoxies can be processed; the most commonly used material is polyurethane. When components A and B, polyol and isocyante in the case of polyurethane, are mixed together, a chemical exothermic reaction occurs creating a **thermosetting** polyurethane resin (PUR); once fully cured the plastic part **cannot** be returned to its liquid phase.

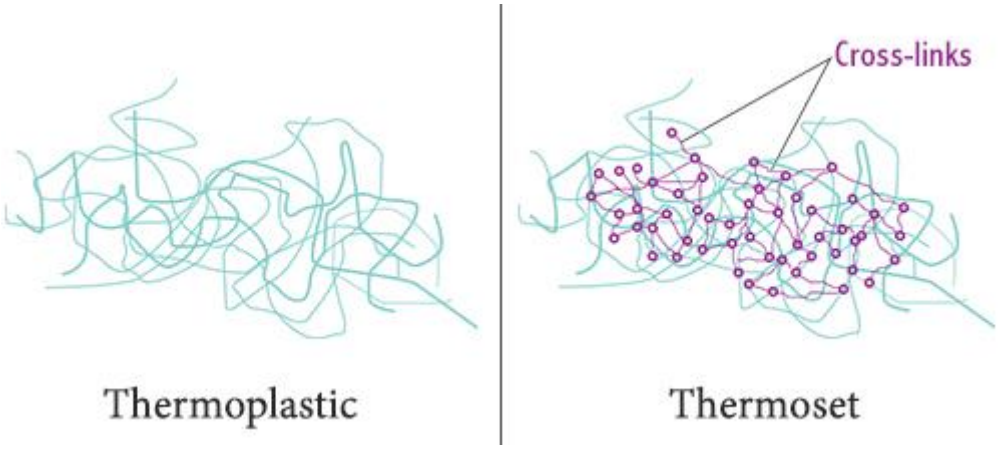
What are Thermosetting Materials?

'Denoting substances (especially synthetic resins) which set permanently when heated'

Thermosetting resins are generally in a liquid form at room temperature and harden ***irreversibly*** with heat or chemical addition - hence the term Reaction injection moulding

During solidification, typically referred to as the cure phase, certain molecules along the polymer chain become chemically activated and bond with their neighbouring molecules. This phenomenon is called cross linking and is the cornerstone as to why thermosets cannot be heated and turned back into a liquid phase. If the material is heated excessively, it will just degrade.

When you compare this to thermoplastics, both amorphous and semi-crystalline can return to their liquid state to be re-formed



This cure phase and cross linking is one of the reasons why sink is not such an issue in RIM. Whilst is would be incorrect to state sink never happens with reaction injection moulding, with sensible design and good DfM input combined with good mould tool design and operation, you can benefit from a greater wall section ***variation*** and significantly lower risks of im perfections. In addition, most RIM mouldings are painted so any surface imperfections can be removed during this stage of finishing.

In order to process the material constituents, low pressure meter mix equipment is used to separately pump the two liquids into the mixing head; Thompson (2011) provides a simple overview of the process as shown below. Once in the mixing head the chemical reaction begins and the operator has a short period of time to complete filling the mould tool; typically referred to as the "pot life" of the material.

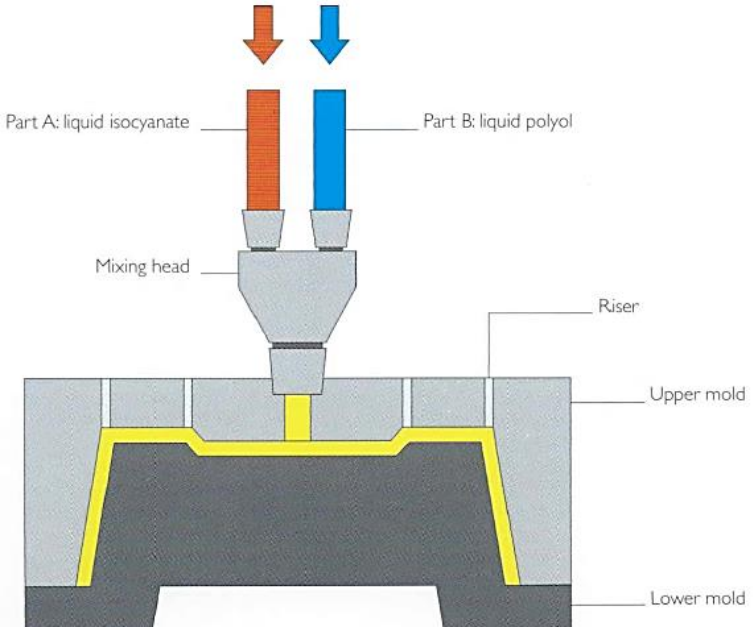


Illustration of RIM the Process (Thompson, 2011, pg. 15).

With all product development it is important to work with your chosen manufacturing company to ensure that the design is suitable and 'robust' for manufacture and with regards RIM, ensure that the weight and pot life requirements for your product is manageable. It is important to engage support from your manufacturing specialists early on to gain DfM support (Design for Manufacture) which can save thousands throughout the life cycle of the product.

How Thermosets Compare?

Although not an exhaustive list, below you will find how thermoplastics compare to thermosets to help a little with your decision making.

Thermoplastics	Thermosets
Easy to recycle and reuse although there will be polymer degradation with each cycle	More challenging to recycle – tends to be repaired and reused and then ground down for bulk filler
High impact resistance (10 X thermosets)	High structural rigidity (more strength)
Heat and chemical resistant dependant on material choice	Excellent heat and chemical resistance
Expansive choice of materials and colours	Limited raw materials
Excellent surface finish direct from tool BUT at higher risk from imperfections due to both design and tooling manufacture.	Attractive finishes but created with lengthy post processing
Very rigid rules to adhere to, time consuming and high risk due to cost of tooling	Highly adaptable design process including thick and thin wall section formation and greater range of part size and complexity
High set up costs, more suited to the smaller, technical part (<A4) and where large volumes of parts are required	Low cost set up, ideal for low volume projects and for parts larger than A3, up to 3M
Adhesion dependant on material selection, changes in material can affect size control and processing	Better wetting and adhesive properties

If you are interested in understanding how rigid polyurethane can assist you with your product development then click **here** for more information or **contact Rachel Sparkhall at:**

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