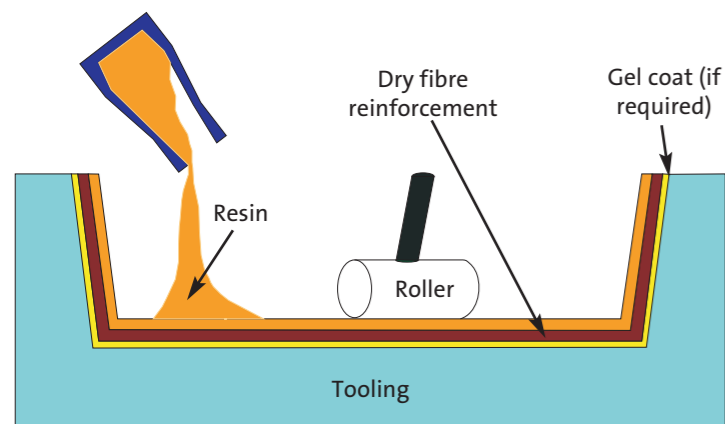




# Composite Processing Techniques . . . options used across various market sectors

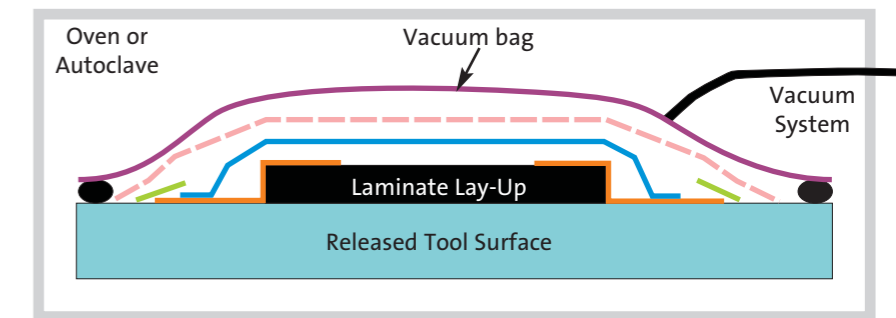
## Wet Lay-Up

- Advantages:**
- Low cost, simple technique
  - Complex shapes can be easily moulded
- Disadvantages:**
- Laminate quality operator dependent
  - Poor part repeatability, quality control and health and safety issues



## Prepregs - Oven or Autoclave Cure

- Advantages:**
- Very high mechanical performance
  - Labour saving and significant potential for automation
- Disadvantages:**
- Increased raw material costs
  - Increased processing costs

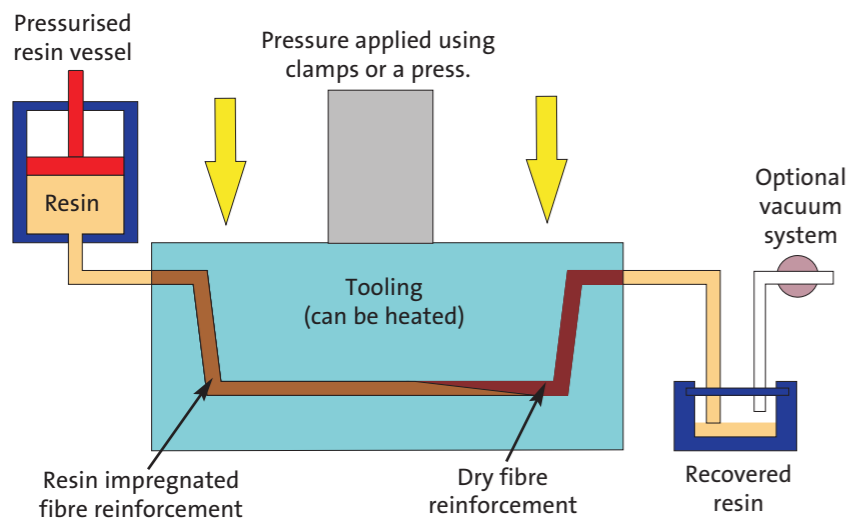


	Wet Lay-Up	Resin Infusion	RTM 'Lite'	Resin Transfer Moulding	Moulding Compounds (Sheet/Dough)	Prepreg
	HLU, WLU	SCRIMP, VARI, VI, RIFT, etc.	n/a	RTM	SMC, DMC	n/a
<b>Material Cost</b>	4	2	4	4	5	2 to 3
<b>Labour Cost</b>	3	2	4	5	5	3 to 4
<b>Tooling Cost</b>	4	4	3	1	1	3
<b>Performance</b>	2 to 3	2 to 3	2	2	1	5
<b>Part Weight</b>	2 to 3	3 to 4	2 to 3	2	1	5
<b>Surface Quality</b>	3	3	4	5	5	3

Key: 1 = Worst / 5 = Best

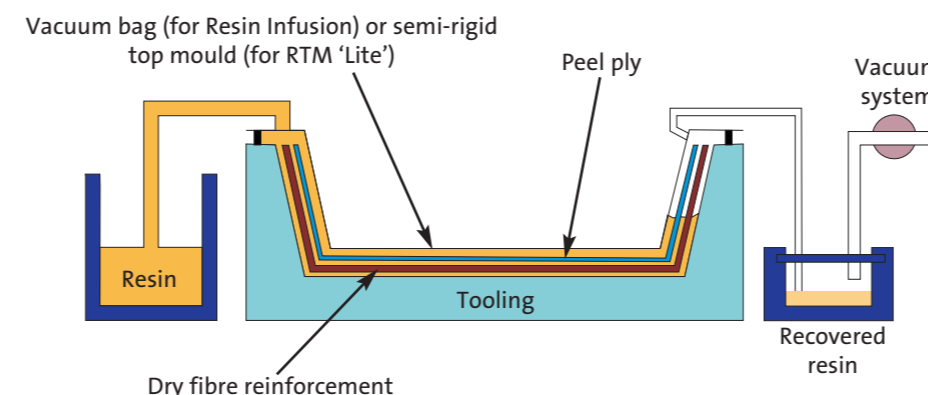
## Resin Transfer Moulding (RTM)

- Advantages:**
- Rapid manufacturing route and reduced labour content
  - Good repeatability with two moulded faces
- Disadvantages:**
- Large production quantities required to amortise high tooling costs
  - Low to medium mechanical performance



## Resin Infusion (SCRIMP, VARI, VI, etc.)

- Advantages:**
- Low tooling and material costs, wet lay-up moulds may be modified
  - Large components can be fabricated
- Disadvantages:**
- Complex, high risk process
  - Process constraints can compromise mechanical properties

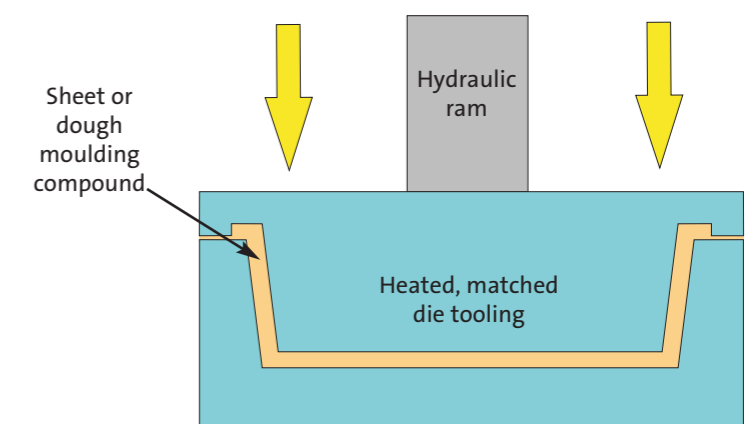


## RTM 'Lite'

- Advantages:**
- Low tooling and material costs
  - Good repeatability with two moulded surfaces
- Disadvantages:**
- Process constraints can compromise mechanical properties

## Press Moulding - SMC, DMC

- Advantages:**
- Rapid manufacturing route and low labour content
  - Good repeatability with two moulded faces
- Disadvantages:**
- Large production quantities required to amortise high tooling costs
  - Poor mechanical performance and heavy parts



# A Technological Advantage

## The Prepreg Advantage

A prepreg consists of a reinforcement material (carbon, glass, etc.) in unidirectional or fabric form impregnated at a pre-determined and controlled level with a resin matrix. Prepreg is a fully compounded, reactive system (no handling or mixing of potentially dangerous chemicals). Simply take it from the roll and laminate.

Prepregs have a clearly defined working/out life at room temperature and are stored frozen to maximise their life. The reactivity of any prepreg system is predetermined and this, in turn, dictates the minimum temperature at which a particular resin system will cure.

The out life and the minimum cure temperature are key considerations when optimising material selection, balancing lay-up time and selection of the mould material.

Prepregs are supplied with a controlled level of tack. Plies can be easily and accurately positioned on the mould to give a high level of fibre orientation control without the risk of movement, fibre wash out or the development of resin rich areas during subsequent processing, all of which will lead to loss of performance.

Cored structures (foam/honeycomb) are also easily produced using film adhesive systems that offer high strength bonding and controlled and consistent bond line thickness, rather than just depending on the parent resin matrix.

## Prepregs Offer

- Simplified storage and reduced health and safety issues.
- Low cost tooling options.
- Reduced part labour content.
- Rapid and accurately controlled lay-up, optimising and maximizing final component properties.
- Weight saving.
- Reduced processing risks compared to infusion processes.

## ACG Advantage

ACG is a leader in the development and supply of prepreg materials into high performance markets such as aerospace, motorsport, marine and sports equipment, and in the provision of innovative new material formats and low cost processing options.

ACG's Low Temperature Moulding (LTM<sup>®</sup>) prepregs revolutionised moulding and contributed to the development of the Group's Variable Temperature Moulding (VTM<sup>®</sup>) flexible moulding system. These prepregs offer optimised low temperature, low pressure processing, and flexible cure temperatures between a modest 65 and 120°C, eliminating the necessity for autoclave curing. Also, the 30 day out life presents a wider process window in which to complete the laminating process.

Complemented by an extensive portfolio of Medium Temperature Moulding (MTM<sup>®</sup>) (120°C) and High Temperature Moulding (HTM<sup>®</sup>) systems (180°C), ACG offers an unsurpassed range of processing and performance options to the composite industry.

ACG also specialises in the development of process specific material formats, including next generation of prepreg and film infusion technologies, including ZPREG<sup>®</sup>, DForm<sup>®</sup> and Out-of-Autoclave (OoA), which are being effectively applied across the composites industry.

	Description	Applications
Prepreg	Full, partial or one sided impregnation. Woven or non-crimp fabrics.	All moulding applications.
Unidirectional	Full impregnation. 100% aligned fibres.	High stiffness applications.
Surfacing Films	Partially impregnated format for the production of high class surface finishes.	Optimised surfacing products for the production of high quality finishes for low pressure vacuum bag processing.
ZPREG <sup>®</sup>	Multi-layer and partially impregnated rapid lay up formats.	Rapid lay up of large parts. Format allows efficient air release for the production of high quality surfaces and thick laminates via low pressure vacuum bag processing.
DForm <sup>®</sup>	Prepreg system combining short fibre conformability with handling and laminate characteristics of long fibre composite.	Suitable for tooling and high volume semi-structural applications, offering up to 30% reduction in lay-up time and readily achievable, superior surface finish.
Syntactic/Core Plies	Filled, lightweight resin film products.	Rapid thickness builds up with low weight.
Adhesive Films	Toughened resin film.	Core bonding and part assembly.
Tooling	Resin systems formatted for stability at high temperatures.	High accuracy mould tools capable of operating at high temperatures.

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