CEL® CORE›PMI

PMI (polymethacrylimide) is a foam developed specifically for use as a structural core in connection with vacuum infusion processes. It is applied in components for various sectors including aerospace, automotive and sports equipment with resin injection to reduce weight.

The PMI core allows sandwich panels to be produced in a single step (co-polymerisation), resulting in shorter overall production times. It is highly suitable for autoclave technologies and vacuum infusion processes, including RTM (resin transfer moulding) and VARTM (vacuum resin transfer moulding).

The cells of this foam have particularly small diameters in relation to other structural foams. This material achieves an optimal compromise between low resin absorption and satisfactory adhesion of the skins to the core.

CEL COMPONENTS

PCS ProCompositeSolutions Ltd.

Characeristics and Processing

PMI foam, or polymethacrylimide foam, is a lightweight, rigid, and closed-cell structural foam material that finds applications in various industries due to its unique properties.

It has important technical characteristics including very high compressive strength and high temperature resistance.

CEL CORE > PMI Mechanical characteristics

LIGHTNESS AND RESISTANCE

Despite achieving the same mechanical properties for an equal density, PMI is 20-50% lighter than PVC and 40-80% lighter than PU.

TEMPERATURE RESISTANCE

PMI has unique compressive creep behaviour at a high temperature. It can withstand harsh processing **up to 180°C**. Not only can it be applied to autoclave processes, but can also be co-cured with most high temperature resins such as epoxy and bismaleimide (BMI), greatly improving the foam's performance and reducing fabrication costs.

100% CLOSED CELL FOAM

PMI structural foam is comprised of 100% closed-cells, resulting in very low surface resin consumption during curing/forming processes like RTM (Resin Transfer Moulding).

LOW PERMITTIVITY

PMI is considered one of the best solutions for antennas and medical beds, as it **does not alter the electrical field's strength**, having an extremely low permittivity.

PROCESSING

PMI can be **easily machined** by drilling machines, cutting machines, milling machines and CNCs**.**

Furthermore, it can be **thermoformed** to obtain complex geometries.

RE-DRY PROCESS

Re-drying is **recommended prior to use**.

The foam must be brought up to a temperature of 130°C. There is no requirement for pressure.

Up to a thickness of **30 mm**, the required cycle is **3 hours long**, it then increases by **one hour for every additional 10 mm of thickness**.

Re-drying **can be repeated** as frequently as necessary.

Dry sheets in an air-circulating oven between heating plates, or use infrared heaters if sheet thickness is less than 10 mm.

- *Separate each foam sheet by no less than 25mm. This will enable consistent air flow around the material.*
- *All precautions regarding foam panel placement and accurate temperature control must be strictly followed.*

Main application fields and added value

AEROSPACE, AVIATION AND DEFENCE:

PMI foam is commonly used in aerospace applications, including aircraft interiors, due to its lightweight nature and high strength-to-weight ratio. Its low density helps reduce the overall weight of the aircraft, improving fuel efficiency and performance.

AUTOMOTIVE:

PMI foam finds applications in automotive components where weight reduction is essential, such as in interior panels, headliners, and structural components. Its high stiffness and strength contribute to improving fuel efficiency and vehicle performance.

WIND ENERGY:

PMI foam is used in wind turbine blades to provide structural support while minimizing weight. Its excellent fatigue resistance and dimensional stability make it suitable for withstanding the harsh conditions experienced in wind energy applications.

SPORTS:

PMI foam is used as a core in sports equipment, such as surfboards, snowboards, and kayaks, where lightweight materials with high strength are required to enhance performance.

MEDICAL:

PMI foam can be used in medical beds to achieve clearer images with lower doses of radiation, due to its low aluminium equivalency.

RAILWAY TRANSIT:

PMI composite parts can reduce weight, resulting in faster acceleration and lower fuel consumption in railway transit.

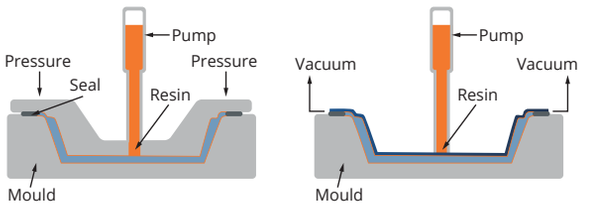
RADOME & ANTENNA:

With a permittivity similar to air, PMI's low density and high strength can significantly enhance ray transmission. Additionally, using metallised PMI composite foams to replace traditional pure copper antennas can reduce the weight of an individual antenna up to 30 times.

REFRIGERATED VEHICLES:

As PMI has exceptional thermal insulation properties, it is often used to manufacture insulation panels for refrigerated vehicles to ensure that goods remain at a stable low temperature during transportation

Liquid Moulding Process

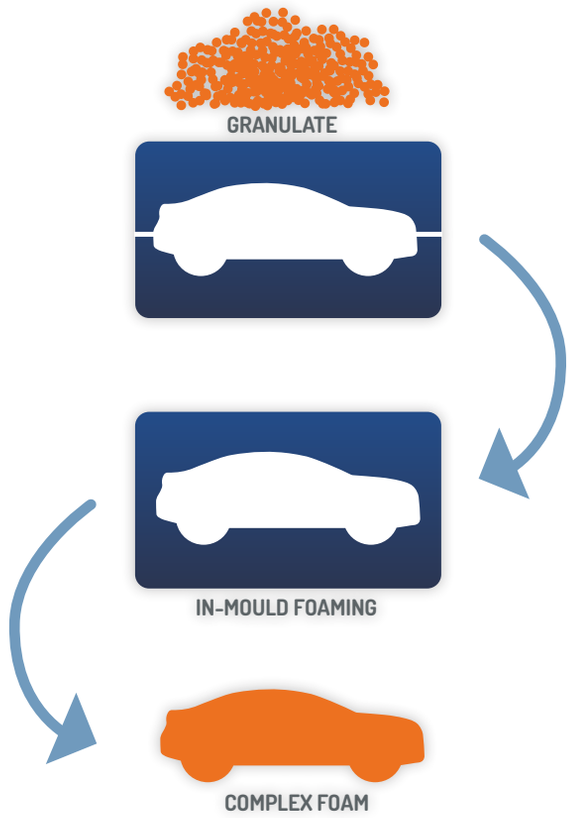


RTM (Resin Transfer Moulding) VARI (Vacuum Assist Resin Injection)

The exceptional specific strength and modulus of PMI foam result in significant reductions in core weight, while its 100% closed-cell structure minimizes resin absorption, a key factor for RTM and VARTM (Vacuum Activated Resin Transfer Moulding) processing. Additionally, its impressive creep resistance complements high-performance resins, allowing for curing temperatures of up to 180°C. This not only enhances performance but also streamlines production efficiency.

IN-MOULD FOAMING

Using granulated PMI foam in a mould allows you to form parts directly using an in-mould foaming process, which significantly reduces the lead time required to create parts when compared to machining three-dimensional parts from foam blocks. This process also minimizes material wastage and lowers the manufacturing costs associated with sandwich structural composites.



Main application fields and added value

CEL CORE > PMI IH specially developed for general industry field, used as structural foam in the field of automotive, shipbuilding and sports equipment etc.

CEL CORE > PMI RS specially developed for use as a structural core in connection with vacuum infusion processes. It is applied in components of aviation, aerospace, sports equipment using resin injection processes to reduce the weight of the finished components.

CEL CORE > PMI WH specifically designed for aerospace applications, such as fairing and middle sections of launch vehicles. It can also be used in the back pressure frame of large civil planes due to its excellent mechanical properties.

In helicopters, PMI WH has been mainly used in main & tail rotor blades and fuselage panels etc.

CEL CORE > PMI HF specifically designed for antenna application, due to its extremely low dielectric constants and particularly favourable transmission properties. It can also be used as structural core for radomes and mammography plates.

CEL CORE > PMI WX mainly used in the aerospace field. This foam material that can be co-cured with BMI resin, cyanate resin and other materials.

CEL CORE > PMI MF specifically designed for complex geometrical parts, it can dramatically increase the yield of the material and reduce the manufacturing time. Complex 3D-foam core parts can be obtained directly from the in-mould foaming process.

CEL CORE > PMI FR suitable for parts of ships and aircrafts, which can effectively reduce the weight of parts, and plays the role of a flame retardant.

Product Type per Application:

CEL CORE > PMI

PRODUCT TYPE	DENSITY	MCT	APPLICATIONS	CELL	PROPERTIES
CEL CORE > PMI IH	50 / 75 / 110 / 150	130°C	Industrial, medical, sport, automotive, electronics	Medium	Base grade
CEL CORE > PMI HF	50 / 75	150°C	Aircraft, Radome, Medical, Electronics	Fine	Best dielectric performance, smallest cell
CEL CORE > PMI WH	50 / 75 / 110	180°C	Aircraft, Space, Industrial	Coarse	High temperature and compressive resistance, coarse cell
CEL CORE > PMI RS	30 / 50 / 75 / 110 / 200	180°C	Aircraft, Space, Sport, Industrial	Medium	High temperature and compressive resistance, medium cell
CEL CORE > PMI WX & WX-HT	50 / 75 / 110	180°C 220°C	Aircraft, Space, Automotive, Industrial	Coarse	Higher temperature and higher compressive resistance, compared to WH
CEL CORE > PMI RX & RX-HT	50 / 75 / 110	180°C 225°C	Aircraft, Space, Automotive, Industrial	Medium	Higher temperature and higher compressive resistance, compared to RS
CEL CORE > PMI FR & FS	50 / 75 / 110	150°C	Aircraft, Automotive, Watercraft, Rail vehicles	Medium	Fire and flame retardant