Pushing the Boundaries of the Rotomoulding Process

The big step-changes in the growth of rotomoulding will only happen if we develop new and better rotomoulding materials. Put simply, more choice in materials mean that more products can be produced using the rotomoulding process.

In Matrix when we develop new materials rather than spending a lot of time and money creating things that no one wants, we prefer to look at specific problems that our customers have. It could be an existing product that isn't performing well or a totally new application.

Venplast is an Italian company that specialises in manufacturing a wide range of industrial ventilators and extractor fans. Some of these ventilators are used in the petrochemical industry, in chemistry laboratories and in metal treatment processes. They are used to extract dangerous and corrosive fumes and gases.

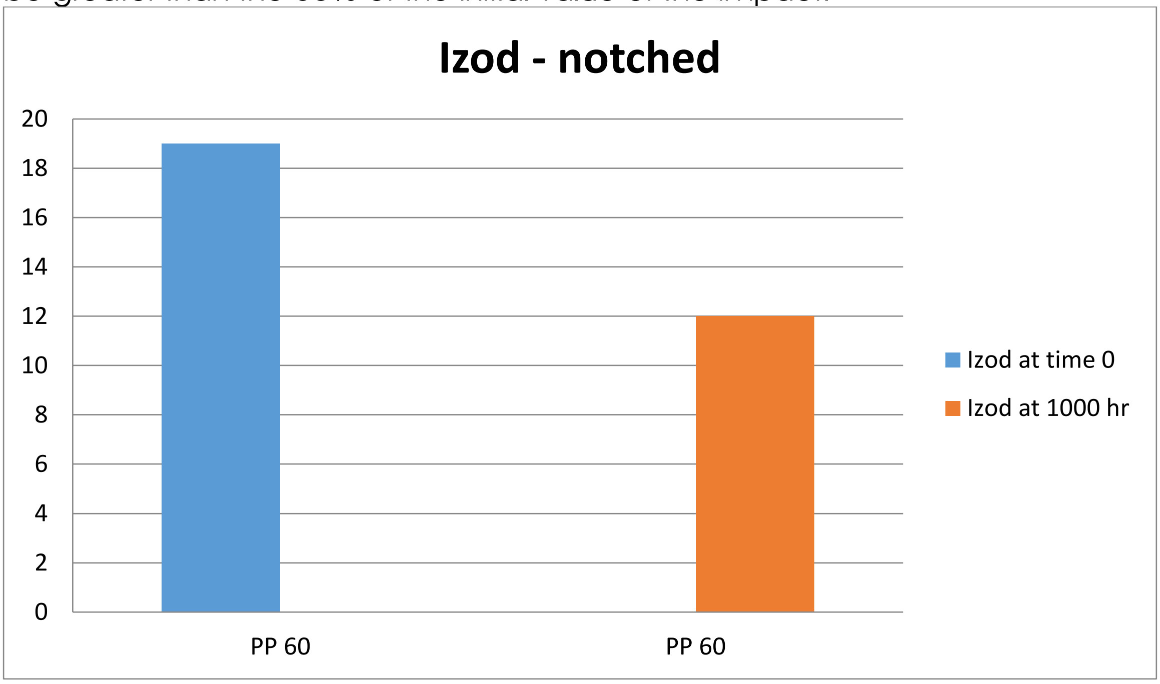
The challenge we had was that Venplast wanted to produce the blower part for their ventilator system by rotomoulding and they were having difficulties. The operating environment for these products can be extremely harsh and they needed a material that was tough and stiff and that could also operate at high temperatures – higher temperatures than polyethylene could cope with. In addition the material had to handle varying pressures and there was the serious problem that some of the gases extracted can be explosive and so the material had to be electrically conductive as well, so no spark could be generated by a build-up of static electricity.

To meet all these demands we developed as part of our "Designed for Roto" programme a new material called "R Tuff PP60".

As I've said, one of the issues we had was that the product needed to withstand high temperatures and this made Polyethylene unsuitable. We therefore decided to look at developing a Polypropylene, but it needed to have tougher and easier to rotomould than most other Polypropylenes.

The customer specified that the material must comply with the Underwriters Laboratory Standard "UL 746 B" for "Relative Thermal Index".

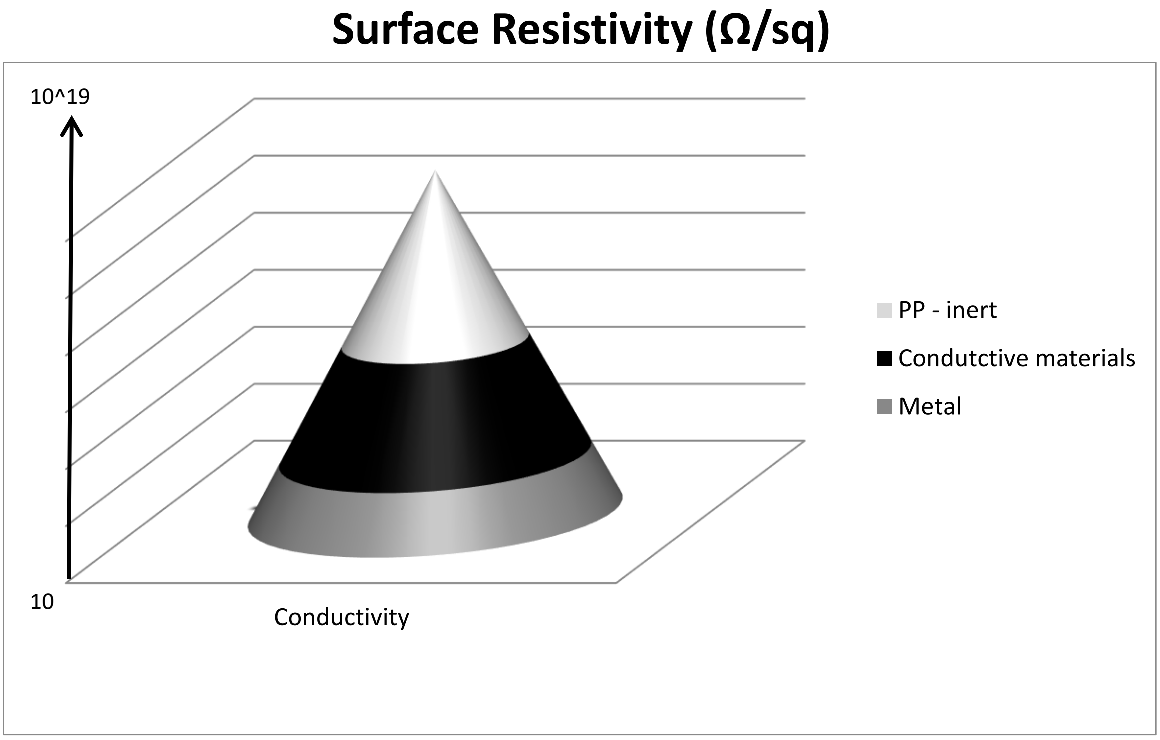
The **Relative thermal index** (RTI) is a relative measure of a polymer's ability to retain its physical properties over a period of time at an elevated temperature. Revolve R-Tuff PP60 was exposed for more than 1000 hours (greater than 40 days) in a climatic chamber at a temperature of 110 °C. After this time an impact test was conducted to assess the performance of the material. An Izod was performed on notched samples in accordance to the ASTM D256. For the material to pass its value had to be greater than the 50% of the initial value of the impact.



You can see that the material after 1,000 hours retained 63% of its original impact strength and easily passed the test.

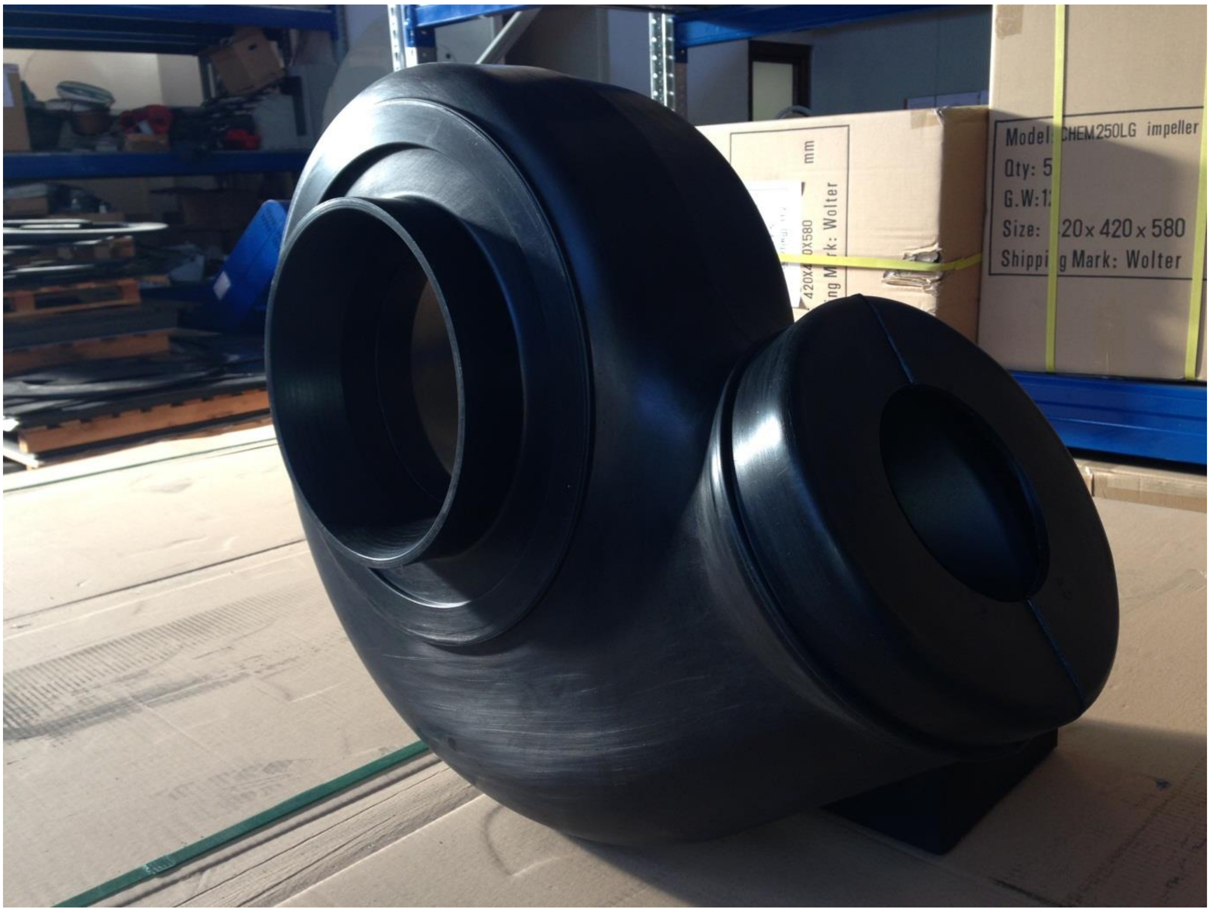
Next was the issue of making the polymer electrically conductive. The surface of any rotational moulded product made from Polypropylene is charged with electrons which creates the potential for a static spark. This can trigger an explosion when certain vapours or gases are present. The way to prevent this happening is to make the material electrically conductive. Making polypropylene conductive presented a few challenges. Although conductivity is well established in rotational moulded polyethylene it is less common in polypropylene resins. After extensive testing and experimentation carried out at the Matrix Technical Centre in the UK, Revolve R-Tuff PP 60 was developed with a surface resistivity of 2.5 * 10^5 Ω/sq, - which is enough to prevent any static sparks.

This illustration shows the level of surface resistivity required for an inert polymer such as polyethylene and polypropylene to be conductive in comparison with a metal (e.g. steel).



One of the general perceptions about polypropylene in rotational moulding is that it has inherently poor mouldability and it has poor impact strength. It is seen as having a very narrow operating window. This is true in many cases, but with our new material we have made a polypropylene which moulds easily, is tough and has a good processing window.

So how well does it mould and what about pin-holes? Well you can see from this picture that the new grade moulds out very easily and there is no pin-holing.

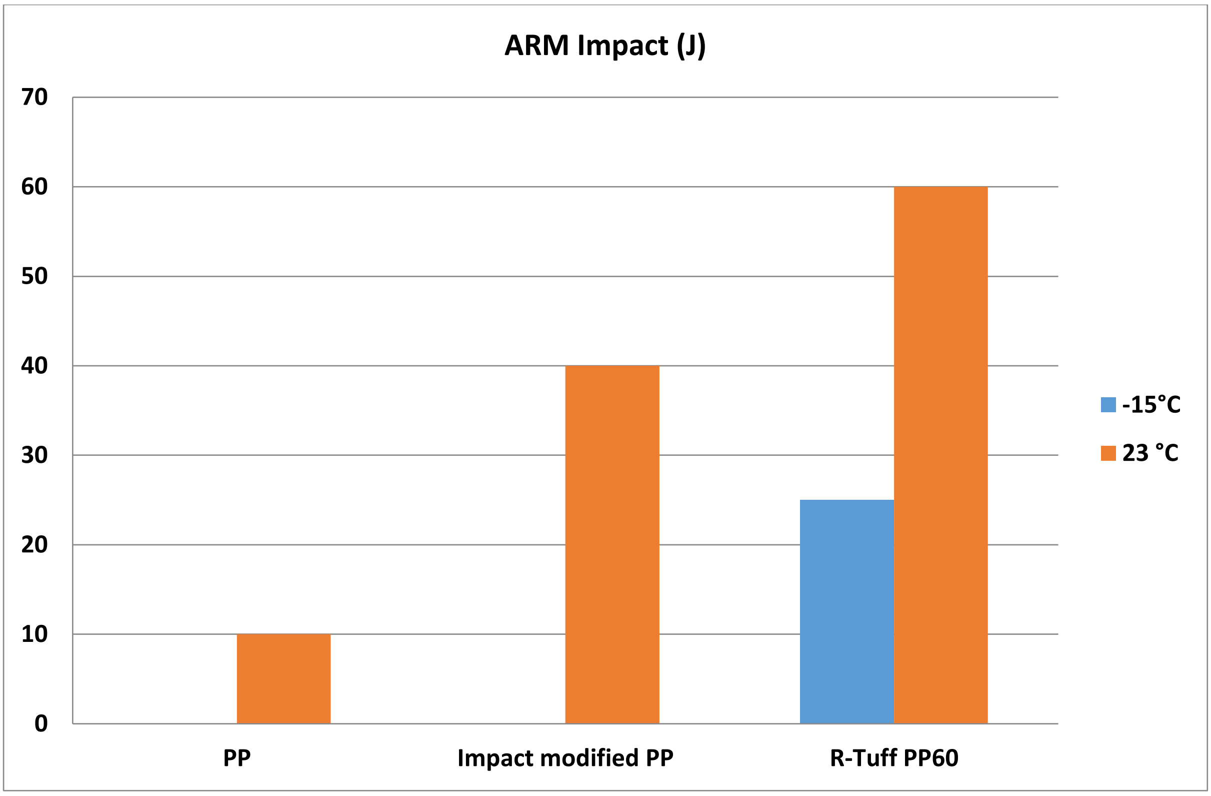


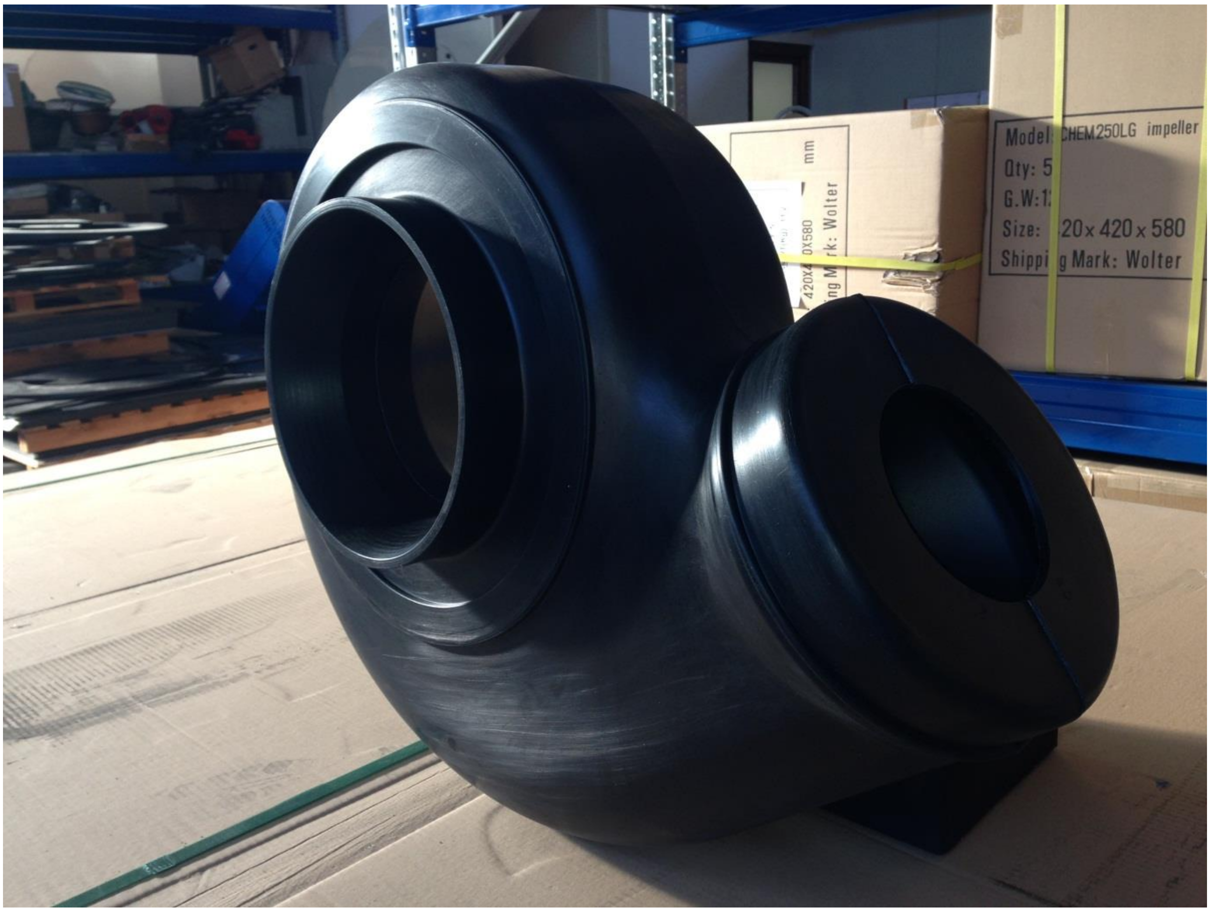
What about toughness?

The most popular scientific test carried out on rotational moulded products is the impact test based on a falling dart method, which was developed by ARM in America. We used this to compare this with other materials.

Standard rotational moulded test mouldings were made with a 5 mm wall thickness and were produced at the optimum moulding condition on our Ferry carousel RS1.90 rotomoulding machine. The oven temperature was fixed at 250 °C. The rotational moulded products were then cut and standard plaques were prepared. The plaques (125 x 125 mm) were then conditioned at -15 °C and plus 23°C for 24 hour before being impact tested.

The graph you can see shows the results. The impact performance of R-Tuff PP60 compared with a conventional rotational moulding polypropylene is very significant and the material has 50% better performance than an impact modified polypropylene. What is also unusual is that the material has some impact strength at minus 15 degrees, whereas traditionally rotomoulded polypropylene grades have been glass-brittle at temperatures below freezing.


ARM Impact (J)
70
60
50
40
30
20
10
0
PP
Impact modified PP
R-Tuff PP60
-15°C
23 °C


CHEM250LG impeller
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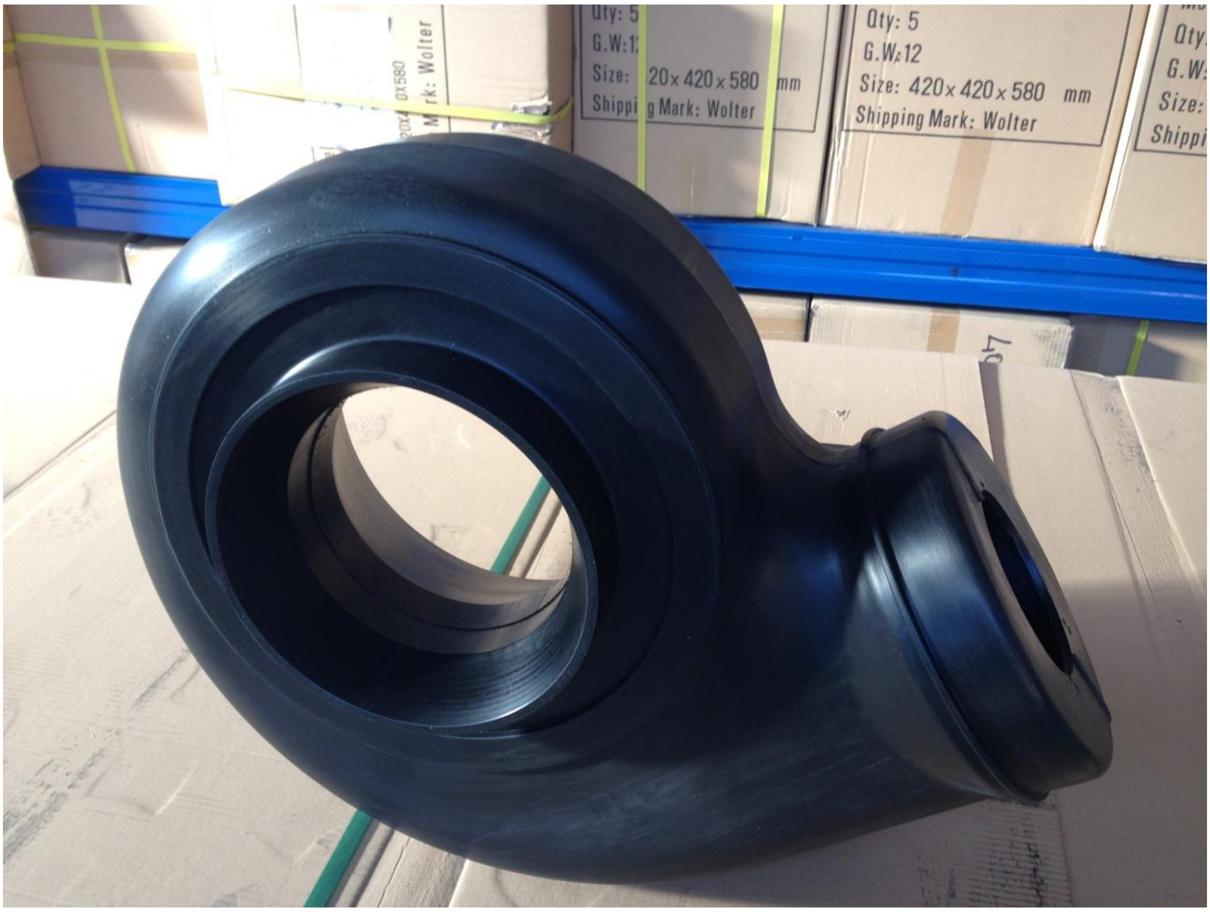
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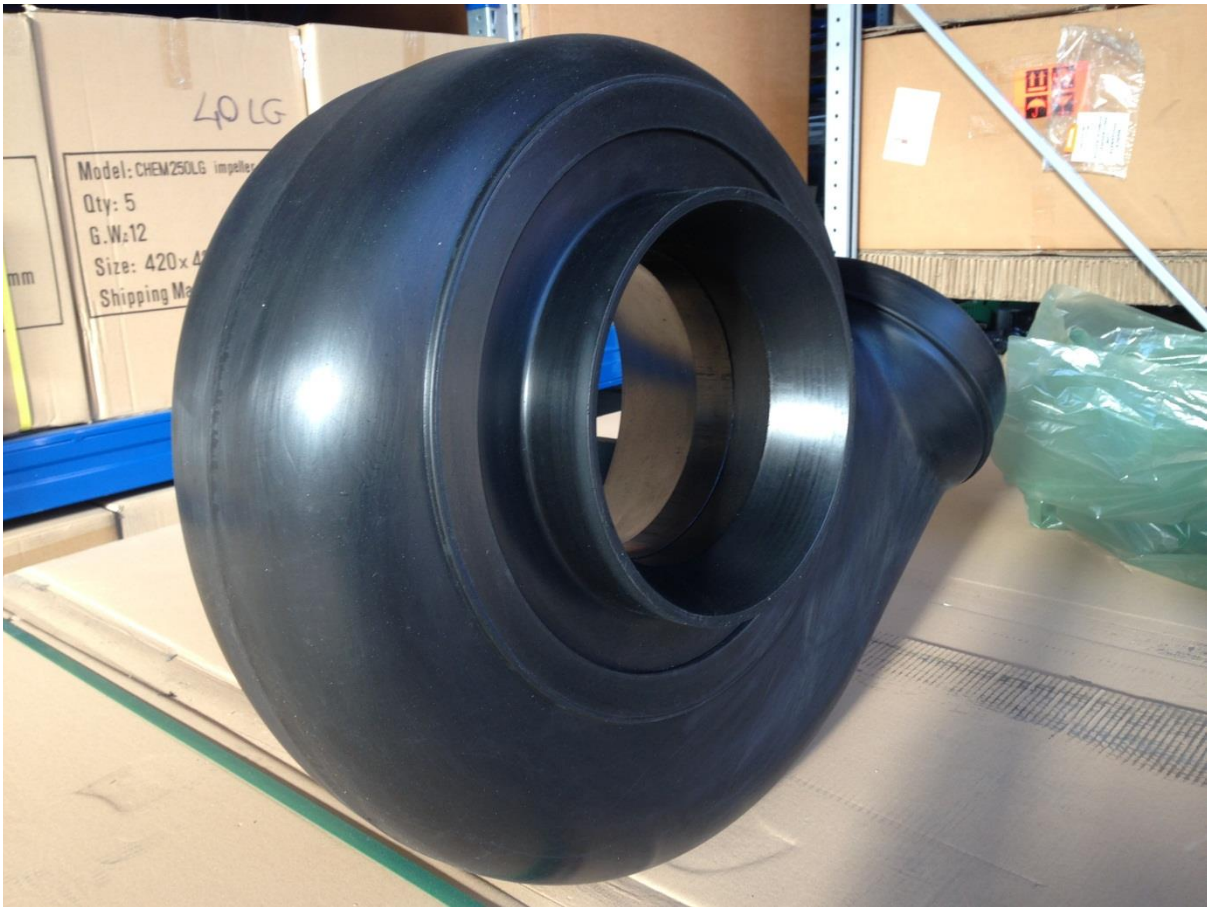
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Model: CHEM250LG impeller
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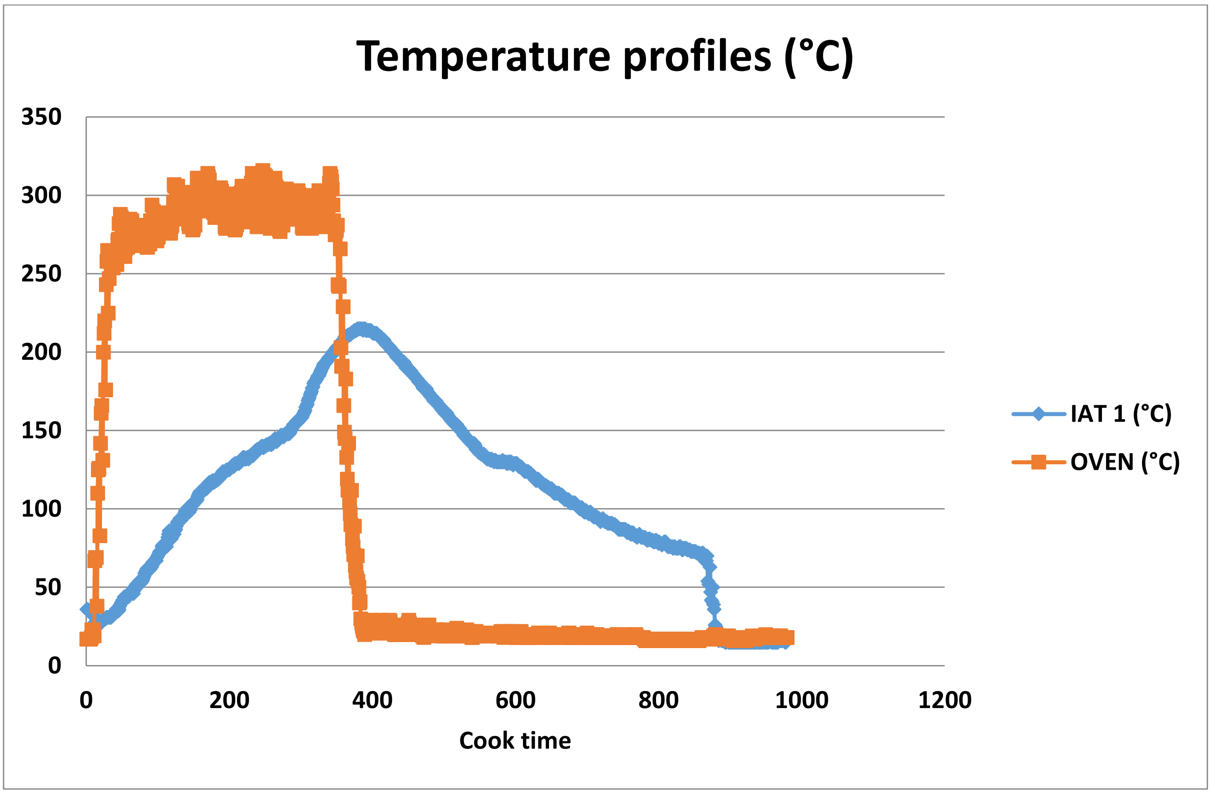
And what about processing window?

One of the popular misconceptions regarding polypropylene we repeatedly see is its alleged poor mouldability and poor impact strength. Rotomoulding PP has inherited an image of a difficult material to be processed with a very narrow operating window. This can be true in some cases but it is also true that there are several PP chemistries which could surprise even experienced moulders. Injected moulded products for automotive applications are dominated by PP as much as rotational moulded products are dominated by PE. So there are many PP grades which could be developed to suit our rotational moulded process.

Below we have reported temperature profiles recorded at our carousel Ferry machine in Matrix.



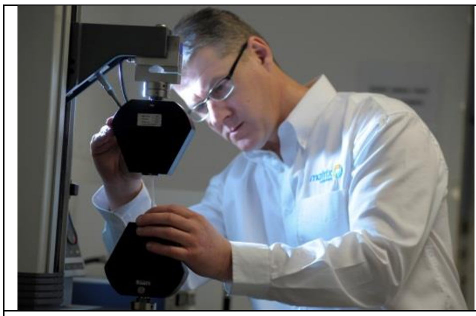
So by listening to our customer and by working with them in close co-operation on their specific product we have developed a new material that is now in commercial use and we have a happy customer!

We see that there are many opportunities for this new powder and polypropylene is very widely used in many other plastics processes and we see an immense number of applications for it in rotomoulding.

Polypropylene is typically used in automotive components (under bonnet applications), containers for hot water, lighting systems and furniture. Applications where high temperature resistance, stiffness, scratch resistance and good flow characteristics are required.

We all know how dominant polyethylene is in our industry because of a number of characteristics like low viscosity (which makes this polymer ideal for a process with no pressure), impact resistance, chemical resistance and durability. It is well known that polyethylene cannot be the solution to every technical problem due to inherent limitations such as a lack of high temperature resistance and lack of stiffness. Expanding the horizon of rotomoulding by learning how to use materials such as polypropylene (PP), polyamide (PA), fluoropolymer (PVDF) and polycarbonate (PC) can add value to rotomoulded products and expand the product range rotomoulders can offer which can help you to penetrate new and potentially lucrative markets.

We believe this industry needs more advanced and higher performance polymers so that it can continue to compete with other processes and can continue to grow. In Matrix we are doing everything we can to help rotomoulders who would like to embrace the future and we welcome you to contact us about any new difficult projects you have. The best way forward is to work with you, your customer and Matrix Polymers

		The rotomoulder
Matrix Polymers		End user