Innovative rotomoulding development to improve cycle times and process efficiency whilst facilitating greater flexibility in product design and integrity for the SME rotomoulding sector.

Rotational moulding is the process of choice for the manufacture of large hollow, seamless products, such as automotive components, tanks, containers, toys and kayaks. Most of these applications use polyethylene.

It is a very competitive alternative to blow moulding, thermoforming, and injection moulding, using simple and relatively inexpensive moulds. Designers have the opportunity to achieve the economic production of low-stress articles, with uniform wall thickness and in complex shapes.

The principle of rotational moulding of plastics comprises introducing a known amount of plastic into a shell-like mould. The mould is then rotated whilst heating and cooling.

Project Consortium

SMEs

493K http://www.493k.com
MAUS http://www.maus-gmbh.de
SORCERER http://www.sorcerermachinery.com
TECNIFORM http://www.tecniform.com

Research Organisations

SMITHERS RAPRA http://www.rapra.net
QUEEN’S UNIVERSITY BELFAST http://www.qub.ac.uk/pprc
UNIVERSITY OF MINHO http://www.uminho.pt

Associations

ARM-CE http://www.rotational-moulding.de
ASSOCOMAPLAST http://www.assocomaplast.org
BPF http://www.bpf.co.uk
VKC http://www.vkc.be

Please visit the RotoFlex website for more information: www.rotoflex-eu.org
About the Project

Objectives
The objectives of ROTOFLEX are to advance the competitiveness of the European SME rotational moulding sector through:

- The development of an automatic feed system that can be retrofitted to standard rotational moulding machines leading to advanced composite and multilayer products.
- Quantification of the rotomoulding process through the use of simulation software, leading to improved, control, and product quality.
- Development of processes using the automatic feed system to deliver controlled internal mould pressurisation.

Work Package 1 – Detailed Specifications and Requirements
The objectives of this Work Package are to update the state-of-the-art knowledge, including a patent search; to define the end-user requirements; detailed planning of the automatic feed system and its integration into existing rotational moulding machines.

Target End Products / Technical Example Requirements
- Multi-layer Fuel Tanks – complex multilayered part with through holes and fins or ridged on the outside.
- High temperature air ducts – multi layer high temperature composites with bends, angles and profile changes to form required shapes.
- Vehicle engine manifolds – multi layer high temperature composites.
- Furniture – composite and multilayer structural applications.

Work Package 2 – Automatic Feed System Development
Work Package 2 involves the development of a ‘universal’ automatic feed system that can be attached to any rotating mould, such that if required materials and fluids may be fed at any stage in the rotational moulding cycle. Rather than design a system solely for new rotational moulding machines, a key aim of this stage is that the system be retrofittable to any type of rotational moulding machine. The development has the potential to significantly increase the automation of the production of multilayer parts for enhanced product performance, fibre-reinforced composites and facilitate automatic and controlled internal mould cooling.

Work Package 3 – Process Optimisation and Validation
Work Package 3 relates to the validation of the new feed system to provide data for industrial trials and will involve substantial testing and rotational moulding trials using a range of conventional and engineering polymer materials and fibres. These exploratory trials will be conducted to determine optimum process parameters to produce a range of complex and innovative multilayer mouldings e.g. skin-foam-skin, multi-layer engineering polymer structures as well as fibre-reinforced composites with multiple alternating layers of polymer and fibre. The effectiveness of the feed system in applying internal mould cooling and pressurisation will also be evaluated at this stage.

Work Package 4 – Empirical Study of Dimensional Stability and Moulding Characterisation
One of the main tasks of Work Package 4 is to investigate issues surrounding dimensional stability in rotational moulding. A literature survey of dimensional stability issues will be used to define the processing parameters to be studied in subsequent tasks. Other objectives include:
- The production of rotationally moulded samples using several processing conditions to provide the baseline data for comparison with the results obtained with the RotoFlex system.
- The characterisation of the as-moulded, in-moulded shrinkage, warpage and microstructure of rotationally moulded products. 3D scanning will be used in order to assess the effects of shrinkage and warpage on these samples.

Work Package 5 – Process Simulation and Analysis
The objective of Work Package 5 is to provide a quantitative analysis of the processes occurring in the rotational moulding operation as the RotoFlex system is deployed. A fundamental understanding of the process will be developed in order to guide the optimisation of the RotoFlex feed system and to determine the optimum processing parameters. Other work to be undertaken includes:
- Simulating powder fusion processes using RotoSim.
- Analysing the effects of mould pressurisation during cooling.
- Simulation of multilayer mouldings and stress analysis of new rotationally moulded products.

Work Package 6 – Industrial Application
Work Package 6 aims to develop the RotoFlex system within the industrial environment. The purpose of the work package is to establish the capability of the technology that has been developed, the ways in which it can be utilised by moulders, and the benefits it can bring to end users. Potential applications include the following:
- Petrol tanks.
- Diesel tanks.
- Hydraulic oil tanks.
- Chemical processing tanks.
- Industrial machine covers.
- Agricultural and earth moving equipment consoles, fenders, roofs, mudguards.
- Interior, conservatory, and garden furniture.
- Low-volume automotive under bonnet components.

Low-volume automotive under bonnet components. Industrial development trials using the new feed system will be undertaken to establish the advantages in producing composite parts to end-user specifications. Studies will be undertaken to quantify the improvements in cycle times and process efficiency, particularly with regard to energy consumption. The results of the trials will be evaluated to validate the feed, machine, and tool design criteria.

Work Package 7 – Environmental, Technical and Economic Evaluation
The aim of Work Package 7 is to evaluate the environmental and technical performance of the new innovative automatic feed system for rotational moulding, especially in regard to the energy consumption during production of the new composite and multilayer mouldings. A ‘guide to best practice for the production and use of the RotoFlex system’ will be produced. Technical, economic and environmental evaluations will be undertaken to estimate economic and environmental viability of the innovations when applied to the major designs of rotational moulding machines.