DESIGN INNOVATION IN ROTATIONAL MOULDING

Wednesday 19th May 2010

www.bpfevents.co.uk
Design Innovation in Rotational Moulding
At PDM10 Exhibition

Wednesday 19th May 2010
Telford International Centre, Telford, Shropshire

SEMINAR PROGRAMME

10.25 Chairman Introduction: Martin Spencer, Rototek

10.30 Overview of Rotational Moulding
Nick Henwood – 493K

- Design Consideration
- Process Control
- Repeatability of Process

11.00 Materials available to the Rotomoulder
John Steele – ICO Polymers

- Most commonly used materials
- Comparative Properties
- Alternative materials used by progressive Rotomoulders

11.30 Design bugs out…..
Ian Thompson – Kinneir Dufort

12.00 Coffee Break

12.15 Adding value by innovative design in rotomoulding
Aldo Quaratino – Matrix Polymers

12.45 New Surface Treatments
Matteo Cortesi – Persico

13.05 Moulding Graphics
Peter Clark – MIG

13.25 Recycling and Rotomoulding
Mark Roberts – Linpac Recycling

- Availability of Raw materials

13.45 Discussion

14.00 Close of Seminar
Delegate List

Design Innovation in Rotational Moulding
At PDM10 Exhibition

Wednesday 19th May 2010
Telford International Centre, Telford, Shropshire

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<tr>
<th>Name</th>
<th>Company</th>
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<td>Mr Darren Beevor</td>
<td>Polypipe Building Products</td>
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<td>Mr Tony Bunting</td>
<td>Amber Plastics Ltd</td>
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<td>Mr Fabricio Castilho</td>
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<td>Mr Peter Clark</td>
<td>Mould in Graphics</td>
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<td>Francis Ward</td>
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<td>Miss Beth Holden</td>
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<td>Mr Rob Johnston</td>
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<td>Mr Henry Jones</td>
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Mr Mark Roberts  Linpac Recycling
Mr Alan Rolf  Angal Ltd
Mr George Ross  Balmoral Tanks Ltd
Mr Luca Sacchi  Polivinil Rotomachinery Group
Mr Paul Shipton  Plastics Consultancy Services
Mr Ray Simpson  Matrix Polymers
Mrs Sandra Smith
Mr Stephen Smith  JFC Manufacturing
Mr Martin Spencer  Rototek
Mr John Steele  ICO Polymers
Mr Richard Taylor  Pyranha Mouldings Ltd
Mr Ian Thompson  Kinneir Dufort
Mr Richard Venables  Rapra Ltd
Mr Mike Woolley  Grolman Ltd
Mr Stuart Wright  Rototek
Mr Jonathan Wurr  Francis Ward

Delegate List as at 17th May 2010
Overview of Rotational Moulding
Nick Henwood, 493K

Presentation slides not available at time of going to print
Design Innovation in Rotational Moulding
Wednesday 19th May, 2010

“Materials available to the Rotomoulder”

Sections

1. Rotomoulding - a zero shear process
2. Most common materials used
3. Alternative materials used by innovative moulders
4. Comparative properties
5. Application examples
Rotomoulding - a zero shear process

- Video inside tool
- Powder sintering process
- Ductile polymeric end products
Most common materials used

- There are many different types of plastic in the world but generally only semi-crystalline types are useful in rotomoulding. Why? Because rotomoulding has a very severe HEAT degradation effect on polymers and rotomoulding needs the plastic to quickly coalesce under ZERO SHEAR (no external applied pressure).
Volume of material used (x1000 MT)

The world of rotomoulding - Tonnes PE sold per year\(^*\) (1268KT)

Source: ICO research
STANDARD ICO PE RANGE

MFI

0.925 0.935 0.940

STANDARD ICO PE RANGE

Gen
Purpose

TOYS

CHEMICAL
FLEXIBLE

Industrial

TANKS

BIG TANKS

FLEXURAL MODULUS – wider RANGE of roto grade materials

Polycarbonate

PP copol

Nylon 12

Kayak & HDPE

Tank grades, X link, mPE

General purpose grades & mPE

LLDPE grade

PE Density g/cc

STIFFNESS

2500

2400

1200

1100

950

700

500

300

100

1200

1100

950

700

500

300

100

1200

1100

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**Materials not used**

Amorphous materials:
- ABS
- PS
- HIPS
- hPP
- PET
- TPE, EPDM
- PMMA

**Speciality Materials also used:**

Small quantities of low viscosity grades:
- EVA
- PC (low viscosity)
- POM
- PBT
- CAB
- Flexible TPEE
- ECTFE

**Speciality Materials also used:**

Liquid systems used
- Plasticised PVC
- Two part PU
- Silicone
Comparative properties

Everything compares to PE

• PE is inexpensive
• PE is very stable to degradation & is tough
• PE melts fast but forms a gel not liquid

Comparative properties

Other materials are used for:

• Higher stiffness & temperature resistance
• Better scratch resistance and gloss
• Clarity
• Chemical resistance eg gasoline
• Paint ability
• Flex fatigue resistance
• Long term creep
Comparative properties

Moulders find that they are more difficult than PE:

- More expensive to buy and grind
- More difficult to get perfect powders
- Less stable, prone to degradation/lower toughness
- Melts and trap more air during sintering
- Different shrinkage rates

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Application examples

- From all around the world

CAT Multipurpose tractor example

Features: multiple Fuel Tanks

Slab Fuel Tank
Material: XLPE
Size: 130 Liters (35 Gallons)

Primary Fuel Tank
Material: XLPE
Size: 605 Liters (160 Gallons)
References/thanks

ICO North America
ICO Asia
ICO Brasil
Persico Italy
Mark Kearns Queens University Belfast
Prof R Crawford Waikato University
RotoWorld Magazine
Rototek UK, Solar Plastics USA
ICO customers
Design Innovation in Rotational Moulding

Wednesday 19th May, 2010

design bugs out….

The story of ‘design bugs out’…
Patient Bedside Cabinet design.

Ian Thompson
Innovation and Design Consultant

Who are we?
Our innovation and design facility in Bristol

1,200 square meters of studios providing dedicated research, innovation, design and prototyping facilities

Research

Design
Prototyping

Packaging Design

Product design
Who do we work with?

GE Healthcare

Innovators in the human experience

What’s our focus?

we are innovators in the human experience...

So what’s the story?

early 2009
design bugs out..
Challenging top designers to help control the risk of Healthcare Associated Infections by making hospital furniture and equipment easier and quicker to clean.

The starting point...

What’s happening on the hospital ward?
Patients can't store their belongings.

Impossible to clean effectively?

Research insights...

"Patients can't store their belongings..."

"It's too old fashioned."

"My bag can't even fit onto the shelves."

"It's brown and dirty looking!"

"It's too old fashioned."

"It's easy to clean the bed frames and panels!"

"Corners and hinges are impossible to clean!"

"No dust or dirt should be left in corners.

Cleaning routines will be clear and agreed.

"I expected it to all be clean and white."
Creative thinking based on insight...

Turning design thinking into product...

Product design and experience sketching...
Assessing ideas and building concepts...

Concept direction...

Manufacturing considerations?
Manufacturing collaboration...

Working at 1:1 scale...

Presenting, testing and developing concepts...
Full scale test rigs...

Look and feel prototype..
Final design.

Top shelf
- Full, easy clean continuous moulded form with a smooth surface
- Rotational moulded from high density polyethylene
- Chemically resistant and no joints / junctions
- Open access middle shelf with raised edges
- Shelf faces the patient bedside
- Easy to clean castors 100mm
- Open access handles
- Soft, easy-clean continuous moulded form with a smooth surface
- Open access laser key

Design detail…

The rear of drawers are flush to each other vertically and fit within the body of the cabinet
- Hooks for coats etc.

Design detail…

The top of drawers are flush to each other vertically and fit into the body of the cabinet
- Hooks for Meals etc.
Dimensions:
- Top shelf height: 1250mm
- Working height: 850mm
- Depth: 600mm
- Width: 500mm

Electronic lock module contained within drawer.
RF transponder on patient wristband unlocks drawer.
Non-contact, no keyhole.

UK registration of design - 4013824
EU registration of design - 001185466-0001
Patent pending application - GB0906666.3

Drawers can fit on both sides of the locker to suit left or right handed bedside.
UK tour...

UK registration of design - 4013824
EU registration of design - 001185466-0001
Patent pending application - GB0906666.3

Product launched - April 2010

thanks for listening
Adding value by innovative design in rotomoulding

Design Innovation in Rotational Moulding
PDM - Wednesday 19th May, 2010
Aldo Quarantino

Consistently delivering value

Rotomoulding

Consistently delivering value

Adding value – why?

- Penetrate new market
- Consolidate and protect the existing one
- Resolve a technical problem
- Improve margin
- Survive

Consistently delivering value
How?

- Using design to drive innovation
  - To enhance product quality
  - To extend life expectancy
  - To reduce cost
  - To differentiate your offer
  - To launch a new product
  - To re-brand
  - ...

Consistently delivering value

Thermal insulation system

- Protects water pipes and meter from freezing
- Needs extra stiffness without increasing the overall weight
- Durability
- Remove after moulding operations - PU foaming

Consistently delivering value

Solutions in practice

- Revolve M-532
- PE foam technology
- Provide extra stiffness without compromising the overall weight of the product
- Thermal insulation
- Cheaper than PU foam and no delamination problems
- No post moulding process needed

Consistently delivering value
Motorbike Fuel Tank

Polyamide 12 (PA12)
- Excellent hydrocarbons barrier
  - Ideal for petrol tanks
- Excellent chemical compatibility
- Good impact resistance
- Paintable
- High stiffness
- High operating temperature resistance
  - Ideal for hydraulic tanks

Explore Technology
- Explore CT PA12
  - Dual layer system based on PA12 (outer) and PE (inner)
  - Combine benefits of two materials PA12 and a PE modified
  - Generate a chemical bond between layers during rotomoulding
  - Enhance the impact performance at low temperature
  - Paintable
  - How does it work?
How does it work?

- Two-shot system
  - Easy to process
- Rilsan PA12 outer layer
  - Paintable
- PE modified inner layer
  - Ductile layer where propagation starts
  - Provides a chemical bond during rotomoulding

Consistently delivering value

ARM Impact (J) at -40 °C

Consistently delivering value

Demon Lamp

- www.demonlamp.com
- High surface definition
- High flow resin
- Bright colour
- Heavy metal pigments free

Consistently delivering value
• High flow resin
• Heavy metal free
• Food contact
• Heat stability
• Durability
• High surface definition
Vase

- Designed by Philippe Starck for Kartell
- Polycarbonate
- Weather-resistant
- Durable
- Transparent
- Height 164 mm
- Diameter 57 mm
- 13 kg

Kimere

- Designed by Omar Ronda
- PE painted
- Durable
- Weather resistant

Final comments

- R-M is a flexible process with endless potential
- The boundaries are set only by your creativity
- Wide choice of materials is today available

FOR YOUR NEXT PROJECT THINK ROTO!!!
Adding value by innovative design in rotomoulding

Thanks!!!

aldo.quaratino@matrixpolymers.com
www.matrixpolymers.com
Design Innovation in Rotational Moulding
Wednesday 19th May, 2010

Persico S.p.A. “New surface treatments”

Our Company Structure
- Manpower: 288
- Turnover: 55 Mln€

Research & Development
Know-how influential, among one of the most qualified in the world in its field, at customer’s disposal to
- assess the feasibility of the project;
- to define the ideal moulding capability.
Persico can help its customers making small preproductions directly.

[Diagram of the company structure]

[Diagram of research and development]
Occupied space

The machine looks like a compact production cell where all operations heating, cooling, loading and unloading take place in the same place.

Automatic opening and closing of the mould

Eliminating direct interaction with the operator, the quality of manufactured goods is therefore constant over time.

Production

The raw material is automatically introduced into the mould: accurate distribution inside the mould, as well as a reduction in the powder dispersion around the mould.

Automatic demoulding of the piece

Manpower reduced to machine set up.

Rotational Division - Services

DE

CODEIGN

MOLDS

PROTO MOLDS

STEEL MOLDS

ALUMINIUM MOLDS

ALUMINIUM CNC MACHINED MOLDS

DESIGN & CODESIGN

PERSICO can create and modify 3D files, thanks to last generation Software (Omnicaid 6.11, Catia V5, Alias 12 e Solidworks 2006)
Design & Codesign

Element supplied by the customer

Cabin with all components produced with Rotational Molding

Cast Aluminium Molds

Cast Aluminium mold for engine boat 204x98x40 inches (5200x2500x 1250mm)

Cast Aluminium Molds

Waiting for the Milan Expo 2015 - Regeneration: 12 coloured snails walking around the world.
Cast Aluminium Molds

- "Bouchon d'amour" of Qui est Paul?

It's a chair created with recycled plastic bottle stoppers reduced in little pieces before. Bottle stoppers are the 70% of the end product. Everything is blended with polyethylene (30%) (polyethylene is completely recyclable and very resistant material) and then moulded thanks to the rotational moulding technology.

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<th>Year</th>
<th>CNC Machined molds</th>
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Molds development

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Molds development

![Molds development chart](chart.png)

CNC Molds advantages

- Delivery time
- Flange Assembly | Internal profile
- Aluminium quality
- Tolerances
- Easier modifications
- Texture finishing
- Reduced maintenance
- Time to order > prototypes

CNC Molds examples

- CNC Machined Mold in 6 Pieces
  (a total of 35 aluminum parts, Laser Inspection)
- CNC Machined Mold in 4 Pieces
  (a total of 40 aluminum parts, Laser Inspection)
- CNC Machined Mold in 1 Piece
  (a total of 50 aluminum parts, Laser Inspection)

Courtesy of Remcon Plastics Inc.
CNC Molds examples

- CNC Machined Mold for a Sailing Boat 102x39x23 inches (2600x1000x600mm)

CNC Molds examples

HER - FABIO NOVEMBRE - CASAMANIA

CNC Molds examples

CNC Molds examples

- CNC Machined Mold for a Sailing Boat 102x39x23 inches (2600x1000x600mm)
Surface Finish / Mould Texture

Standard finishing mould

1) Smooth (gr. 120-200-400-800 mirror)
2) Shot Peened
3) Sand Blasted or Grit Blasted

POLISHING SURFACE
- Aesthetics requirements
- Allows better release
- More expensive
Standard finishing mould

- SHOT PEENED
  - High scratch resistance
  - Aesthetical (furniture products)

- SAND BLASTED
  - Matt effect
  - Low scratch resistance

Shining treatment

- SHINING TREATMENT
  - Mechanical treatment
  - Increased hardness
  - No release agent
### Strongest Treatment

- **STRONGEST**
  High technological coating, which provides an exceptional mould hardness (350 HB), in addition to the release effect. The treatment is carried out on the entire mould surface, and it is followed by internal and external cleaning, which guarantees an optimal thermal conductivity.

<table>
<thead>
<tr>
<th>Standard Alu Hardness</th>
<th>Alu + Strongest</th>
</tr>
</thead>
<tbody>
<tr>
<td>90 HB</td>
<td>350 HB</td>
</tr>
</tbody>
</table>

### Flange Hardening & Coating

- **FLANGE HARDENING**
  Persico offers the possibility of an electrochemical hardening, which can remarkably increase the flange hardness (600 HB). Moreover, this treatment makes the flange anti-scratch and prevents the polyethylene powder or other material adhesion on the flange.

<table>
<thead>
<tr>
<th>Standard Alu Hardness</th>
<th>Hardened Alu</th>
</tr>
</thead>
<tbody>
<tr>
<td>90 HB</td>
<td>600 HB</td>
</tr>
</tbody>
</table>

### Permanent Coating

Persico offers different types of coated flanges with special finishing, in order to improve the mould's performance in various moulding machines and various mould materials.
Bringing your design to reality!
Thank you for your attention !!!
Our Objective

To provide permanent decoration and enhancement solutions for manufacturers and marketers of polyolefin plastic products.

Fact:

Nearly 95% of all rotomoulded products are cast from virtually impossible-to-decorate polyolefin materials that are often utilized in harsh environments and extreme conditions.

Typical Results of Vinyl Stickers on PE
Photos courtesy of Alber Engineering and INCA Molded Products, Inc.

Colourful Mold In Graphics® add value and visibility

Spray MIGS® Adhesive onto the mould

De-mould part

Burnish the graphic onto mould and add resin

Permanent graphics every time
Football “tailgating” cooler boxes can be customized with any bright and colourful Mold In Graphic®

Photos courtesy of L.B. International, Inc.
Tupelo, Mississippi

K&N Performance Filters

Routed by Primetime Products, Inc.

Photos courtesy of Rototek Limited
Technical rotational mouldings in the UK
Photos courtesy of Rototek Limited
Technical rotational mouldings in the UK

Mold In Graphic® Video

Clean part surface with Mold Release Remover
Spray Mold On Graphics® Adhesive onto the graphic
Burnish graphic onto the part

Remove backing
Heat the graphic
Permanent graphics every time
Many rotomoulded products are subjected to year-round environmental attacks.
Rotomoulded Ice-Sailing Sled at South Pole

Photos courtesy of Nylex Rotomould

Rotomoulded Playground Toys

Photos courtesy of GameTime
Rotomoulded water tanks

Photo courtesy of Fylost

Photos courtesy of Ozpoly

Graphics that are moulded in will expand, flex and contract at the same rate as the polyethylene
Permanent Mold
In Graphics®
will survive
destructive
deforces and
environmental
attacks

Photos courtesy of
Oceanwalker
Rotomoulded products using Mold In Graphics®

Golf Kiosk
Product courtesy of Gregstrom, MA, USA

Floor Care Blower
Photo courtesy of Clarke Blowers, Alto, div. of Nilfisk MN, USA

Spineboard
Photo courtesy of Rapid Deployment Products, PA, USA

News Rack
Photo courtesy of gotajob.com, USA

Rotomoulded products using Mold In Graphics®

Sequential Bar Codes for Rotomoulding

- **Rotomoulding**: alphanumeric codes 128 and 39 with rotating sequential number
- **Code 128**: encode large quantity of data in small space
- **Code 39 (3 of 9)**: common (mfg, military, health apps)
Sequential Numbers
Without Bar Codes

Sequential Numbers
and Custom Fields
MI GS® Color In Systems® & Color On Systems®

• Available in standard or custom colours.
• Embed directly into plastic resin surface, making new custom design permanent, resistant to attack by chemicals, solvents or extreme weather conditions.

Kayak featuring permanent airbrushed MI GS® Colors
Spray the mould
Use multiple colours
Pour the resin
Permanent, customized decoration
Spray the part with colour
Spray coating over coloured areas
Permanently fuse colour by heating. Part is done
Faux Rotomoulded Chandeliers with MIGS® Color On Systems® Highlights

Photo courtesy of Schafer Systems, Iowa
RMC3®
Rotational Molding Compound

Three-Dimensional RMC3® Rotational Molding Compound is a tool for creating:

- Perfect, Solid Threads
- Solid Protrusions
- Mounting Tabs
- Flanges
- Solid Moulded-in Feet
- Internal Bosses
- Reinforced Inserts and Hinge Pins
- Solid Moulded-in Handles
- RMC3® immediately corrects flow issues.
Comes in easy to use, easy-to-form, pliable material.

Position the RMC® into designated areas of mould or you can “cookie-cut” RMC® to fit your needs.

Remove excess RMC®, then load polyethylene resin charge into hollow mould and begin rotomoulding.

Hollow part now features solid, moulded-in flanges for drilling and wall mounting.

RMC®® adds value to your rotomoulded products.
Empty mould

Add the RMC 3®

De-moulding of tank

Finished product

Photos courtesy of IMS Products, Inc. – Riverside, CA

Hollow tank now features solid external mounting flanges!
New Graphic Technologies for Specialized Applications and Materials

Nylon Graphic System

Nylon compatible Mold In Graphics® transfer onto moulds from 32 - 54°C to your nylon resin products.

Used in automotive, marine, airline, heavy duty trucking equipment and more.
Nylon Graphic System

Mold In Graphic Systems®
Nylon Graphics have been successfully moulded into Nylon 11 and Nylon 12.
Vivid, permanent graphics every time.

MIGS® Vinyl Graphic System

Applications:
automotive, marine, toys, athletic, medical and many more.
Compatible with several temperature ranges.

MIGS® G3 Adhesive is used with our Vinyl Graphics. It is ozone friendly and is compatible with rotational moulding.

Permanent graphics every time.

iMIG Graphic System for Injection Moulding
Thank you.

Mold In Graphic Systems®

www.moldingraphics.com
Overview

- Why consider Recycled Materials?
- The Recycling Process
- Rotomoulding Challenges
- Design for Recycling
- Closed-Loop Opportunities
- Alternative Options to use Recycled Materials in Rotomoulding
Why consider Recycled Materials?

- Conservation of non-renewable fuels sources
- Recycling of plastics as compared with the production of virgin polymer will reduce emissions of CO2, sulphur dioxide and nitrogen oxide
- Recycled polymer consumes only a third of the energy that would be used to produce virgin polymer
- Reduce the amount of waste going into landfill
- Cost?

The Recycling Process

Waste plastic materials are brought to our Allerton Bywater site by road transport and stored until ready to use.

Washing & Granulation

The waste plastic is then chopped or granulated into small pieces prior to passing through the washing and drying process. The resultant clean regrinds are then stored in intermediate bulk prior to further processing.
A passion for profitable growth … .

The different grades of plastic can then be passed through a blending process. This ensures that both uniformity of product and the precise specification required by our customers can be met.

Blending of Materials

Material from the fountain blender is then run through an extruder. Masterbatch can also be added at this stage. Material is gradually heated and passed through de-gassing and melt filtering stages before finally being chopped into pellets at the die.

The Extrusion Process

The pellets are then packaged to customer requirements and dispatched by road transport.

Finished Product
Rotomoulding Challenges

• Small Market Share
• Consumer Waste not an option

Composition of household plastics


Rotomoulding Challenges

• Small Market Share
• Consumer Waste not an option
• Specialist Materials
• Lack of Separation
• Raw Material in short supply!
Design for Recycling

- Single Polymer Construction
- Avoid mixing polymers within a unit
- Clips / Rivets / Labels all increase recovery costs
- Keep life-cycle in mind
- Collection Schemes?

Closed Loop Systems

- Win – Win opportunity
- Case Study
  - Wheelie Bins
  - Collected Domestically
  - Recovered by LINPAC
  - Replacements made from same polymer
  - Cost Savings > £30k
  - 20MT CO₂ saved

Other Options

- Work with customers to secure scrap
- Partnership agreements with Suppliers, like LINPAC Recycling
- Use regular streams mixed with prime
  - 25% Prime Grade still offers cost savings
  - Ask your representative for samples!
LINPAC Packaging
Plastics Recycling Division

Thank You
MAUS MOULD SERVICES THE ONE STOP SHOP FOR THE ROTATIONAL MOULDING INDUSTRY.

BMC™ Coatings: