Alternate materials for rotational molding

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Background

- At the Fall 2015 meeting, ARM's education committee led a workshop titled "Expanding the Rotational Molding Portfolio"
  - Gather molder input on the attributes required to produce their next generation of products made by rotomolding
  - Session output was compiled and reported back on the last day of the meeting
  - Education committee analyzed the output and sponsored a number of webinars
  - ARM forums & program committee incorporated material topics into subsequent meetings
- Findings were that rotomoldable material solutions were available to address many of the attributes that rotomolders were looking for
  - Need to raise awareness of "What's Now" in terms of rotomoldable materials available and possessing these attributes

Refresh – session output

- Good flow/fill in tight tolerances. Break barriers of existing rotomolding radius/kiss off guidelines and allows molding of sharp corners
- Step change improvement in dimensional stability (fit, temperature versus current PE)
- Step change improvement in flammability with no loss of properties
- Clarity with more robust moldability to Polycarbonate
- Education on material options that are currently rotomoldable
- Properties of ABS, but not ABS based
- Step change improvement in stiffness (200 kpsi??) and hardness (Rockwell 100?)
- High flow (liquid?) option potentially offering paintability and scratch resistance with existing PE properties
- Crosslinkable PE properties with step change improvement in use temperature (PP based?)
- Alternative to PVC with like properties that are non-corrosive, flexible and clear
- Alternative physical forms (liquids)
- Faster curing/step change improvement in cycle time (1/3 of existing cook times?)
- Step change improvement in use temperature resistance
- Ability to incorporate recycle
- Step change improvement in permeation resistance to meet 2017 permeation requirements
- Step change improvement in stiffness/dimensional of parts so as to be structural components (long strand fiberglass reinforced)
- Tight tolerance resins like Dupont Hytrel – Refresher on its applications
- Properties of ABS, but not ABS based
- Multilayer rotomolding options (PU/PE/liquid)
- Fusable/glueable/repairable options for parts with long term performance
- Alternate solutions for fuel tanks

What's now - Polypropylene

Advantages over HDPE

- Higher melt flow ratio, MFR, so better flow
- Higher use temperature
  - Heat distortion temperature
  - Autoclavable
- Higher stiffness
- Higher ESCR performance
- Superior creep resistance
- May be more cost effective than Polyamide for elevated temperature

Shortcomings versus HDPE

- Inferior low temperature impact strength
- Narrower processing window
- Lower inherent UV resistance
  - Requires higher loading of UV additives
- Inferior moldability in thick parts
- Prone to stress whitening
- Some grades require cryogenic grinding
  - Alternative is micropelletizing

What's now – Polyamide (PA6, PA11, PA12)

Advantages over HDPE

- Higher use temperature
  - Heat distortion temperature
- Impact strength at ambient temperature
  - Inferior at low temperature
- Higher stiffness
  - Able to run thinner wall thickness
- Fuel permeation resistance
  - Barrier properties
- Chemical resistance
- Abrasion resistance
- Paintable
- PA11 does not require inert atmosphere during rotomolding
  - PA6 and PA12 require inert atmosphere

Shortcomings versus HDPE

- Inferior low temperature impact strength
- Narrower rotomolding operating window
  - Higher rotomolding processing temperature
- Hygroscopic, sensitive to moisture pick up
  - Moisture pick up affects properties
- Certain versions require inert atmosphere during molding
- Poor performance with strong acids
- Hydration of molded parts to achieve physical properties

What's now – PVC

Strengths

- Typically used as a liquid plastisol
  - Automation of metering
- Fine details can be molded
- Flexible and soft touch
- Transparent grades available
- Good chemical resistance
- Weatherable
- Paintable

Shortcomings

- If over cured HCl can be generated
  - Safety
  - Corrosion

What's now – Polyolefin plastomers

Strengths

- Flexible and soft touch
- PVC free
- Clarity
- May be compatible with LLDPE and HDPE
  - Depends on monomer basis
- Similar processability to LLDPE

Shortcomings

- Require cryogenic grinding
  - Alternative is micropelletizing

What's now – Hytrel (polyester elastomers)

Strengths

- Flexible and soft touch
- Paintable
- High use temperature
- Fuel and chemical resistance
- Creep resistance
- Fatigue resistance

Shortcomings

- Specialty material
- Attack by some chlorinated solvents
- Require cryogenic grinding

What's now – Polycarbonate

Strengths

- Transparent
- High strength and stiffness
- Heat distortion temperature
- Paintable

Shortcomings

- Moisture absorption leads to poor clarity and inside surface discoloration
- Brittleness
  - Though good impact strength
- Limited chemical resistance

What's now – ABS

Strengths

- Excellent stiffness
- Paintable
- Surface finish and hardness
- Creep resistance
- Can be glass filled to further enhance molded part properties

Shortcomings

- Low temperature impact strength
- Requires adequate thermal stabilization for rotomolding
- Requires inert atmosphere during rotomolding
- Sensitive to cooling conditions in order to prevent warpage

What's now – Acetal copolymers

Strengths

- Excellent combination of stiffness and strength
- Chemical resistance
- Creep resistance
- Can be glass filled to enhance stiffness

Shortcomings

- Low temperature impact strength
- Requires adequate thermal stabilization for rotomolding
- Moisture absorption that leads to part surface issues
  - Bubbling, blisters
- Sensitive to cooling conditions in order to prevent warpage

What's now – Fluorocarbon polymers

Strengths

- Highly resistant to chemical attack
- Stress crack resistance
- Low permeability
- There is no known organic solvent for it up to 250°F.

Shortcomings

- Specialty material

What's now – other - PE based compounds

- Higher stiffness, impact and toughness compounds
- Flame retardant compounds
  - V-2, V-1, V-0
- Electrically conductive compounds
- Foamable compounds

Summary

- Many non-polyethylene based rotomoldable material solutions are currently available
- Many of these materials offer the property attributes that rotomolders highlighted as needing to produce their next generation products by rotomolding
- These material solutions allow rotomolders to expand the market for products that can be made by rotomolding

Thank you