Insights on SMC / BMC / DMC Start-ups

Sridhar NB
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What are the names indicate

- SMC: Sheet moulding compound
- BMC: Bulk moulding compound
- DMC: Dough moulding compound
What can be produced?

For Trucks... Trunk Lid, Hood, Fenders, Noise shield, Technical Frontend, Filter Housing, Oil Sump
What can be produced?
SMC/ BMC Technology - design for success

- A fiber-reinforced composite material consisting of a thermosetting resin, glass fibre reinforcement and filler.

- Additional ingredients such as low-profile/ low-shrink additives, cure initiators (peroxides), thickening additives, process additions mold release agents are used.
The complete Value chain

- The machine
- Formulation & compounding
- Testing
- The press
- Moulding
- Tooling
- Component testing
- Painting
The Machine

- SMC/ BMC

(What we need to look....)

- Primary
  - Glass content %
  - Filler loading
  - Sheet weight (gsm)
  - Production speed
  - CTQs of the compound (requirements)
  - Industry you like to cater
  - Future needs
  - Quality control

- Secondary
  - SMC cutting & slitting system
  - Dosage, mixing & pumping units
  - Measurements & control system
  - Raw material storage

- Capital Investment
- Cost varies with need
- Project viability
Formulation & Compounding

• The Raw materials
  - Resin
  - Low shrink/ low profile additive
  - Glass fiber
  - Fillers
    - Calcium carbonate, ATH, Talc, Barium Sulfate, Glass
      Hollow Spheres
  - Additives
    - Wetting & dispersing
    - Processing
    - Anti-separation, Anti-settling
    - Air release
    - Release agents
Shrinkage

Shrinkage:

- Polyester Resins have a certain shrinkage during and after the polymerization - Influence on linear shrinkage on final molded parts.
- Thermoplastic solutions and Saturated Polyester are added to SMC/BMC formulations to compensate the shrinkage.
- With LS- an LP-Additives it is possible to adjust the desired shrinkage. Expansion is also possible.

Examples for Linear Shrinkage

- Standard SMC ~ 0.5%
- (LS) Low Shrink SMC 0.05 - 0.25%
- (LP) Low Profile SMC 0 or Expansion
- Class-A SMC Expansion ~ 0.1%
Types of LS - and LP - Additive

• Low Profile - Additive
  - Polyvinylacetate (PVAc)
  - Polymethylmetacrylate (PMMA)
  - Saturated Polyester (PEs)

• Low Shrink - Additive
  - Polystyrene
Low profile: Impact on the product

SMC / with out LPA

SMC / with LPA

[Images of SMC samples with and without LPA]
Types of additives

- Wetting and dispersing
- Anti-settling
- Anti-separation
- Release agent
- Processing
- Air release
Wetting and dispersing

Dispersion of fillers and pigments

- Viscosity of the paste
- Improved distribution of particles

- Mechanical properties
- Chemical resistance
- Weathering
- Etc.
Dispersion

Flocculation

Agglomerate
Flocculate

Primary Particle
(Ideal Dispersion)

Flocculated

Dispersion

Flocculation

Deflocculated
Flocculation

Dispersion

Agglomerate
Flocculate

Primary Particle
(Ideal Dispersion)

Flocculated

Deflocculated
Processing additives

• surface smoothness
• color homogeneity
• homogeneous surface
• etc.

improved stable distribution of all components in the compound

effect on all formulation components

Processing additives
The usage of materials at high temperature cause migration of some of the components….. even after metalization and coating.

This becomes visible as a haze on the cold part (polycarbonate pane) inside a headlamp.

Called: F O G G I N G
Processing additives for headlamps

FOGGING

BMC with stearates
BMC with additive
Processing additives
With Additive – anti-separation effect

Control

1 phr additive

2 phr additive
Processing additives
Impact on surface

Control formulation
40% mold coverage

With additive formulation
40% mold coverage
Processing additives
Impact on surface

Control formulation
80% mold coverage

With additive formulation
80% mold coverage
Processing additives

• Many types of processing problems and/or difficulties can be solved through the use of processing additives.

• Changing the processing characteristics can open-up windows of opportunity in many applications.

• Improved processing always leads to cost reduction.
Filler for SMC/BMC

- **CaCO$_3$**
  - Mining product
  - Density 2.70 g/cm$^3$

- **ATH**
  - The flame retardant effect
  - Density 2.40 g/cm$^3$
Filler for SMC/BMC

- Barium sulphate $\text{BaSO}_4$
  - Filler for heavy weight applications / noise reduction
  - Density $4.50 \text{ g/cm}^3$

- Glass hollow spheres
  - Filler for light weight applications
  - Density $0.37 \text{ g/cm}^3$
Equipment and Manufacturing

Resin and Color paste

Resin and Color paste + Filler

Final Mixture
The mixer....

Dimensions:

- Filling level
- Periheral speed > tbd m/s
- Dimensions:
  - $D - 2,0 \times D$
  - $D - 0,5 \times D$
  - $2 \times D - 3,0 \times D$
Storing, dosing, mixing: attention needed…

Raw materials storage:
  • Temperature, moisture, age

Dosing the paste:
  • Constant quantity of Filler, MgO, Peroxide, Additives

Mixing the components:
  • Constant parameters (Homogeneity, temperature)
Thickening is essential for entire SMC process!

Thickening can influence:

- Impregnation of glass
- Separation of components (e.g. resin / LP-Additive)
- Flow in the mould / transport of fibers
- Handling of SMC (e.g. cutting, sticking)

Thickening of the SMC will be influenced by:
Resin / Additive, Acid number, MgO concentration (type, quantity), Temperature / storage / time, Moisture content in the paste / filler
Equipment and Manufacturing

- Carrier Film
- Glass Fibers
- Cutter
- Resin
- Resin Film
- Carrier Film
- Impregnation Area
- Resin Film
- SMC
- Equipment and Manufacturing
Manufacturing and Molding
Thank you for your attention...