Economics

SMC molding

ver 1

Important factors

- Material
- Labor
- Capital
- Energy

Cost model

- Formulation specification
- Sheet line calculations
- Sheet molding inputs
- Molding cost estimate

Formulation specification

- General purpose
  - non-structural
  - non- Class A
- Low profile 1
  - Class A
  - no ribs
  - no thick sections
- Low profile 2
  - Class A
  - ribs
- High strength
  - structural

Generic SMC

Component	Weight Percent	Function
Styrene	13.4	Reactive monomers that provide a cross-linking structure
Polyester	10.5	Reactive monomers that provide a cross-linking structure
Glass fiber	30.0	Reinforcement
Calcium carbonate	40.0	Filler--increases bulk volume and reduces part cost
Low profile agent (LPA)	3.45	Controls part shrinkage--a thermoplastic additive
Initiator	1.00	Provides free radicals to initiate polymerization
Magnesium hydroxide	0.70	Increases viscosity
Zinc stearate	1.00	Lubricant / mold release agent

High Strength SMC

Formulation Number: SMC-13
Source: Rapp, R. S., "High Strength Molding Compounds" (Oct. 1976), SPI RP/CI Thermostat Press Molding Committee meeting.
Type Compound: High Strength SMC

A. Formulation

	PHR	Percent
1. SG-30 Resin @ 60% solids	100	27.32
2. Zinc Stearate	3	0.82
3. t-Butyl Perbenzoate	1	0.27
4. MgO Dispersion	6	1.64
5. Glass, 1" PPG-518	256	69.95
6. Total Compound	366	100.00

B. Compound Properties

1. Masterbatch Viscosity	600–800 cps
2. 1-hour Thickened Viscosity	800–1400 cps
3. Time to 20 × 10⁶ Viscosity	48–72 hrs.
4. Sheet Weight	7 oz./sq. ft.

C. Typical Physical Properties

1. Flexural Strength, psi	61,000
2. Flexural Modulus, 10⁶ psi	2.50
3. Tensile Strength, psi	30,000
4. Tensile Modulus, 10⁶ psi	2.40
5. Izod Impact, notched ft. lb./in.	21.5
6. Izod Impact, Unnotched, ft. lb./in.	28.6
7. Shrinkage, mils/in.	1

Sheet line calculations

- Sheet cost
  - materials
  - labor
  - capital
  - energy

Material cost (MC)

MC = weight * price / (1-scrap)

Labor cost

LC = cycle time * wage * laborers / (prd * cav)

- wage = direct labor wages including direct benefits
- laborers = number of direct laborers per molding press
- prd = productivity (productive time / available time)
- cav = number of cavities / mold

Capital cost

- Fixed recovery period (5 years)
- Fixed interest rate (12%)
- Annual capital recovery payment distributed over annual production, yields capital cost per pound of SMC

Cost breakdown for producing low profile SMC

	$/lb	percent
Materials	$0.481	90.24%
Energy	$0.001	0.13%
Labor	$0.010	2.84%
Capital	$0.036	6.80%
TOTAL	$0.528	100%

Molding cost estimates

- Material cost
  - seen above
- Labor cost
  - seen above
- Main machine cost (MMC)
  - see next slide

Main machine cost (approx.)

- Compression Press:$ = 9,000 (tons)$^{0.57}$
- Injection Press: $ = 10,000 (tons)$^{0.57}$
- Compression Mold: $ = 19,000 (part weight, lbs)$^{0.76}$
- Injection Mold: $ = 20,000 (part weight, lbs)$^{0.76}$
- Low Pressure Mold (<100 psi): $ = 10,000 (part weight, lbs)$^{0.27}$
- "tons" = US tons (2,000 lbs) of force required to keep mold closed

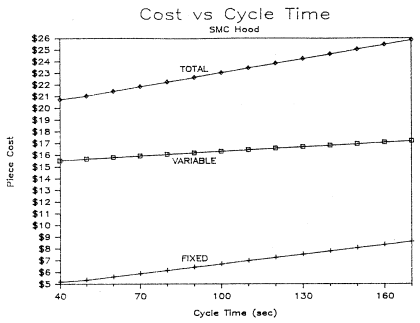

Figure 1. - Sensitivity Analysis
Cost as a Function of Cycle Time

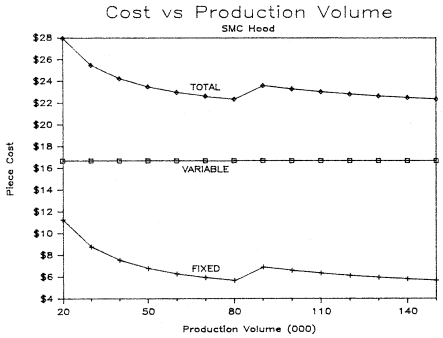

Figure 2. - Sensitivity Analysis
Cost as a Function of Annual Production Volume