Introduction to Commodity Plastics

Polymers & Plastics

by

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Polymers & Plastics

- **What is Polymer** ?
- Term “Polymer” is derived from Greek words “Polus” and “Meros” meaning many
  parts
- “Polymer” : high molecular weight compound (molecule) formed by the repetition of
- small, simple chemical units called monomers
- “Polymerization” : Process of generating entire molecular structure through repetition of one or more monomer units using Ziegler-Natta catalyst

What is a “plastics” Material?

- Organic in nature (based on carbon)
- High molecular weight (>25000)
- Plastic (adjective) = ability to change shape, to be deformed sometime during the manufacturing process

Attributes of a plastics/polymeric material

- Molecular weight (MW) and its distribution (MWD)…along with branching contributes to polymer architecture
- Percent crystallinity (% cxn) ranging from 0% (totally amorphous) to upwards to 85%
- Glass transition temperature, Tg

Processing considerations

- In general, it can be stated that the higher the molecular weight, the better the properties…
- BUT…at the expense of processability
- As MW increases, the melting temperature (Tm) and viscosity (n, n*) increase
- With increasing percent of crystallinity, the processing temperature increases (Only crystalline materials have a Tm)
- As MWD broadens and short-chain branching (SCB) increases, the processing temperature and viscosity decrease

Typical Physical Properties of "Generic" Plastics

Soft Polymers	Semi Rigid	Rigid Polymers
Polyethylene	Flexible PVC	PVC
EVA	HDPE	Polystyrene
Ionomers	PP	Acrylics
Silicones … etc.	TPUs …. etc	Nylons …. etc

Typical properties:

Property	Soft	Semi- rigid	Rigid
Specific Gravity	<1.0	1.1	>1.2
Tensile Strength, (Mpa)	210	350	620
Elongation, %	300+	100	2 to 25
Tensile Modulus, (Mpa)	700	3500 t0 10,500	25,000
Impact Resistance	No Break	Varies	Varies

Typical properties:

Property	Soft	Semi- rigid	Rigid
Creep Resistance	Poor	Poor- OK	Good
Hardness	Soft	Semi-soft	Hard
Clarity	Varies	Varies	Varies
Chemical resistance	Varies	Varies	Varies
Burning Behavior	Varies	Varies	Varies
Price	Varies	Varies	Varies

Typical Upper Use Temperatures of Selected Plastics

Low temperature performance:

- LDPE, LLDPE, VLDPE, ULDPE
- Ionomers
- EVA
- CPE
- Flexible vinyls (function of the amount and type of plasticizer(s)
- Elastomers: nitrile, silicones, urethanes

Typical Upper Use Temperatures of Selected Plastics

Medium temperature performance:

- PVC
- Polyesters (PET & PBT)
- Styrenics
- Acrylics
- ABS
- Modified PPE
- SMA and SAN copolymers
- Cellulosics
- Some neat polyamides

Typical Upper Use Temperatures of Selected Plastics

High temperature performance:

Neat resins:

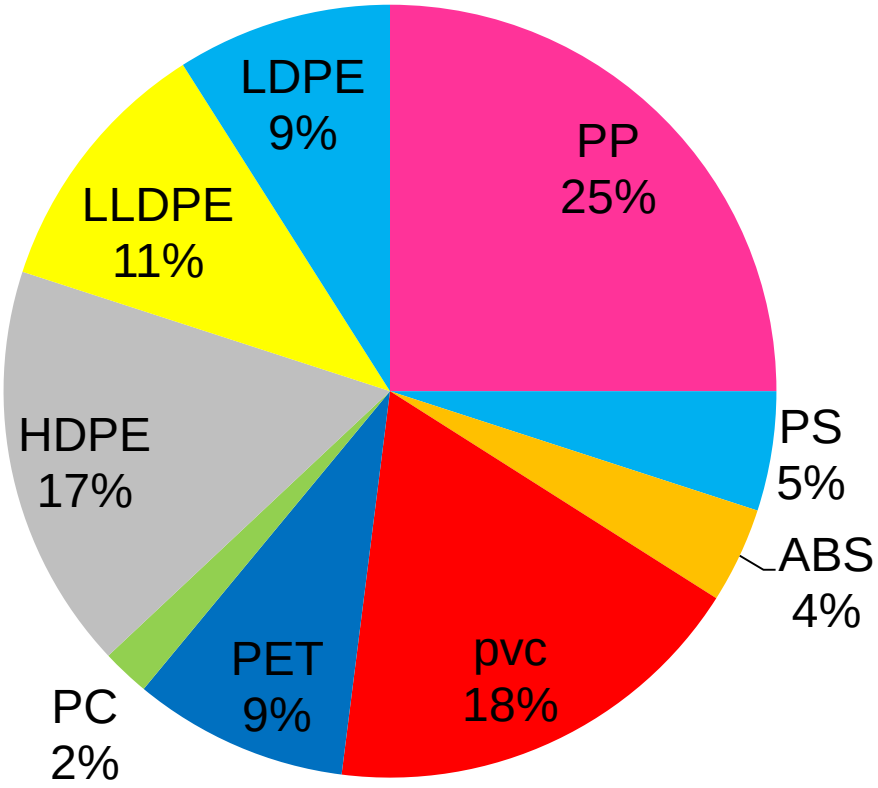
- Engineering types: PC, PSO, PAY, PEI, PES, PAS, LCPs, PPS, PEI, some alloys

Reinforced resins:

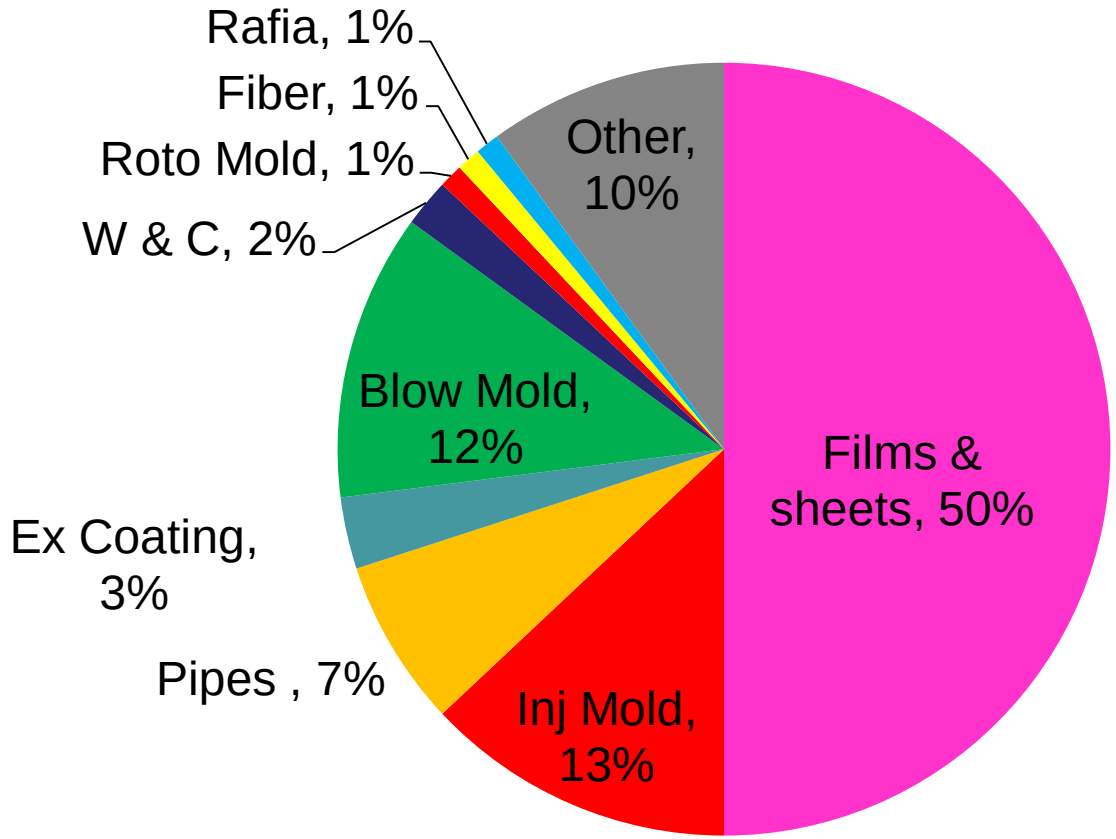
- Commodity: gr-PP, gr-PS, gr-SMA, gr-SAN
- Engineering: PBT, PET, PTT, PC, PSO, polyamides, acetals, etc

World Polymer Demand-2012

211 MMT



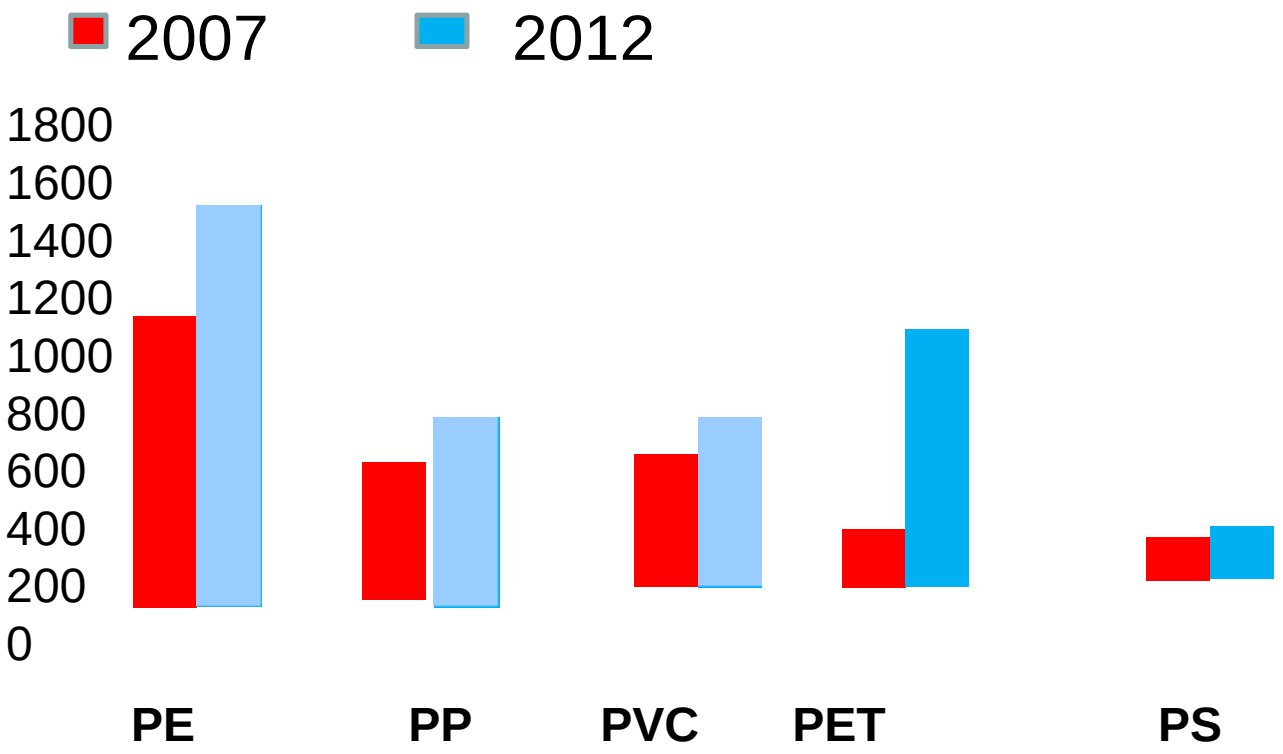
Consumption by end use sector



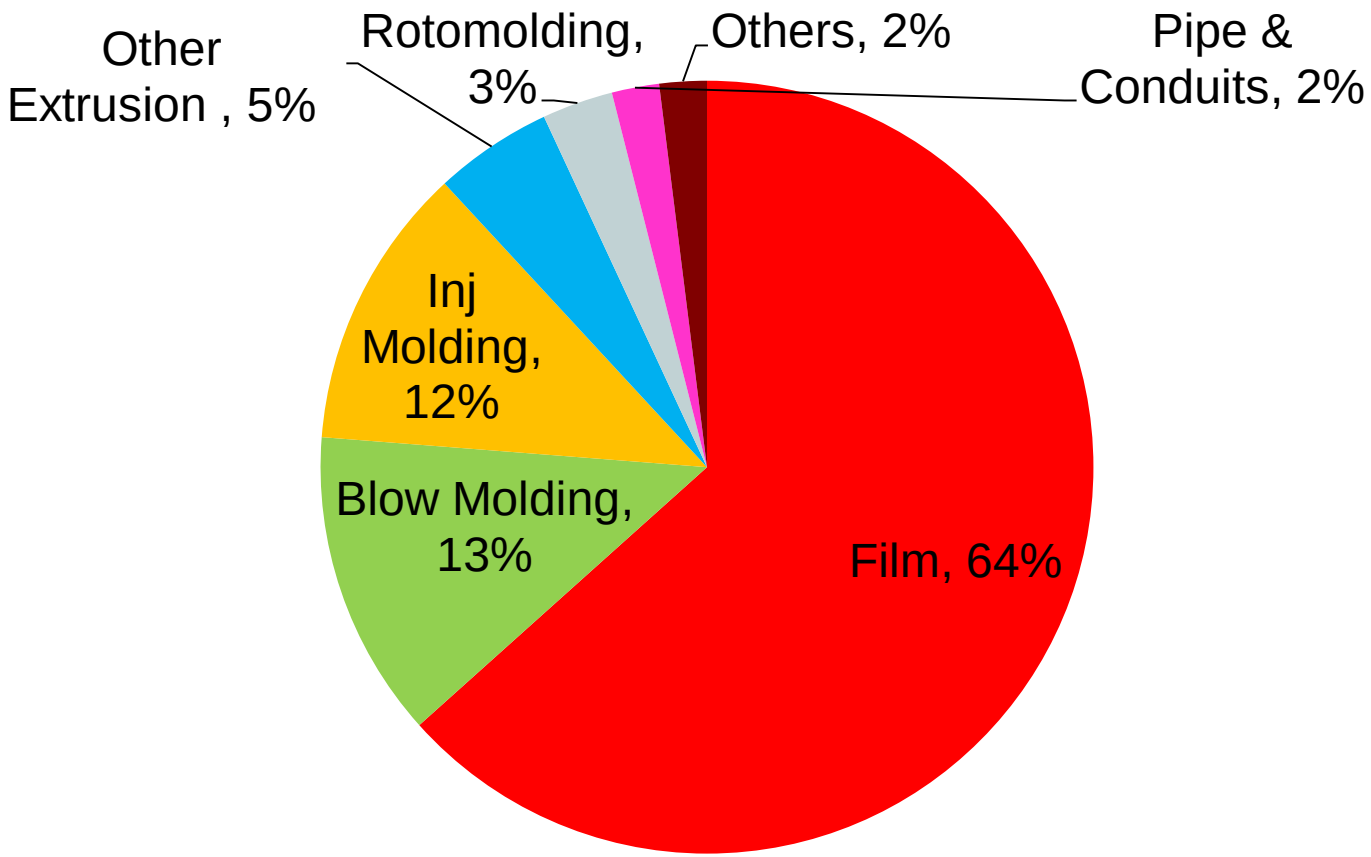
GCC Plastics Processing Industry

- The GCC has experienced a period of rapid growth in recent years, propelling itself from its original status as an oil and gas producer, to become a leading olefins and polymers producer.
- Polymer production capacity has soared during the past five years increasing from 8.8 million tons in 2007 to 19.9 million tons in 2012, along with consumption which has risen on average by ten percent per year from 2.8 million tons in 2007 to 4.5 million tons in 2012.
- This level of growth is forecast to continue over the next five years at annual rate of around eight percent.

GCC Plastics Consumption



GCC Sectorial Consumption



Thank You

….. To Polyethylene