Basic Polyethylene Parameters Related to Resin Properties and Performance

Rob Donaldson

June 3, 2008

Session Overview

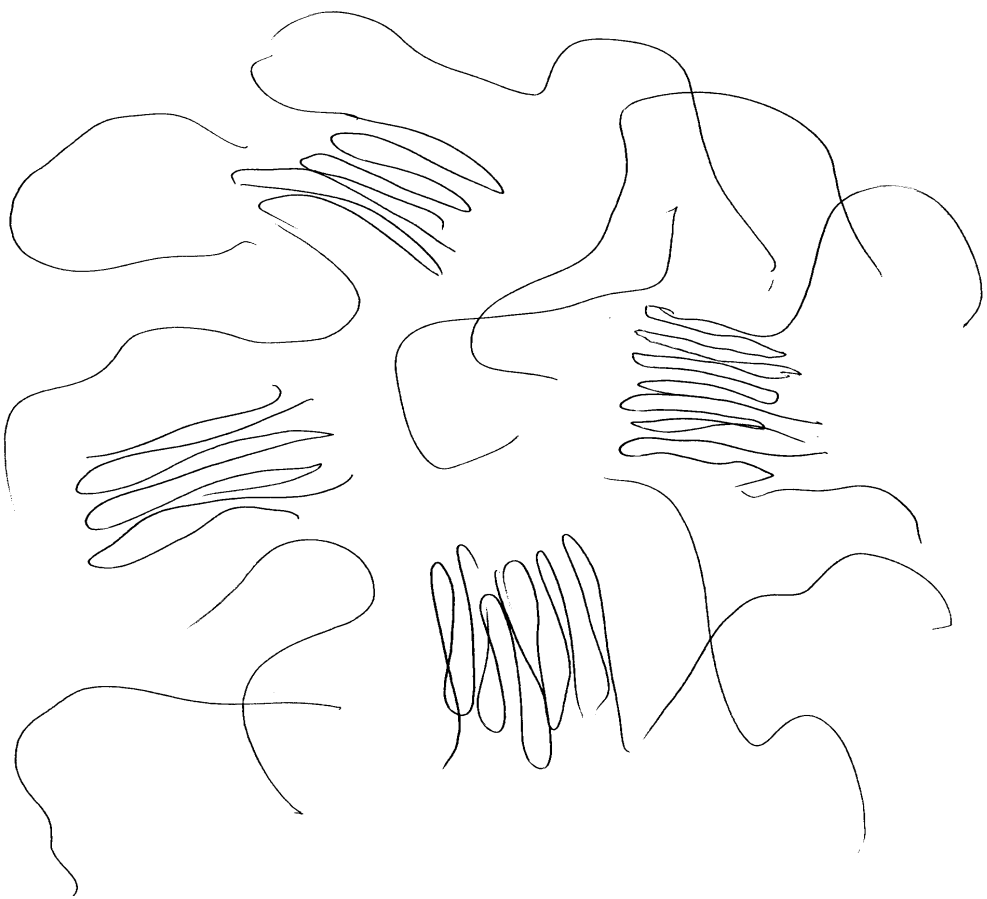
- Platform / Catalyst / Comonomer
- Density
- Melt Index
- Molecular Weight Distribution
- Polymer Property Effects
- Rotational Molding Performance

Polyethylene

- **Platforms**
  - Gas-phase, Solution, and Slurry
- **Catalysts**
  - Ziegler/Natta and Single site
- **Comonomer types**
  - Butene, Hexene, Octene

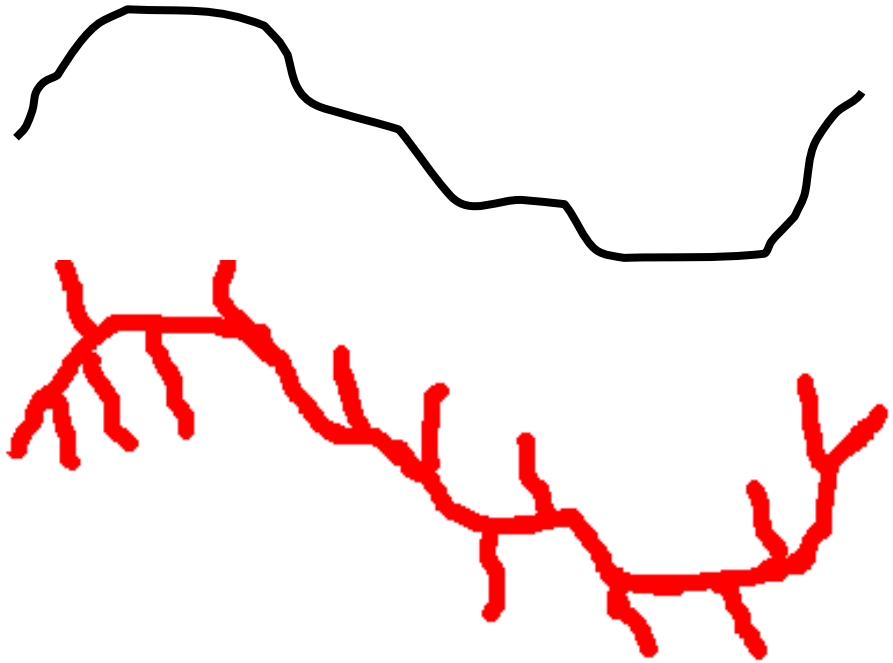
Density

- Polymers chains can assume an ordered structure



Density

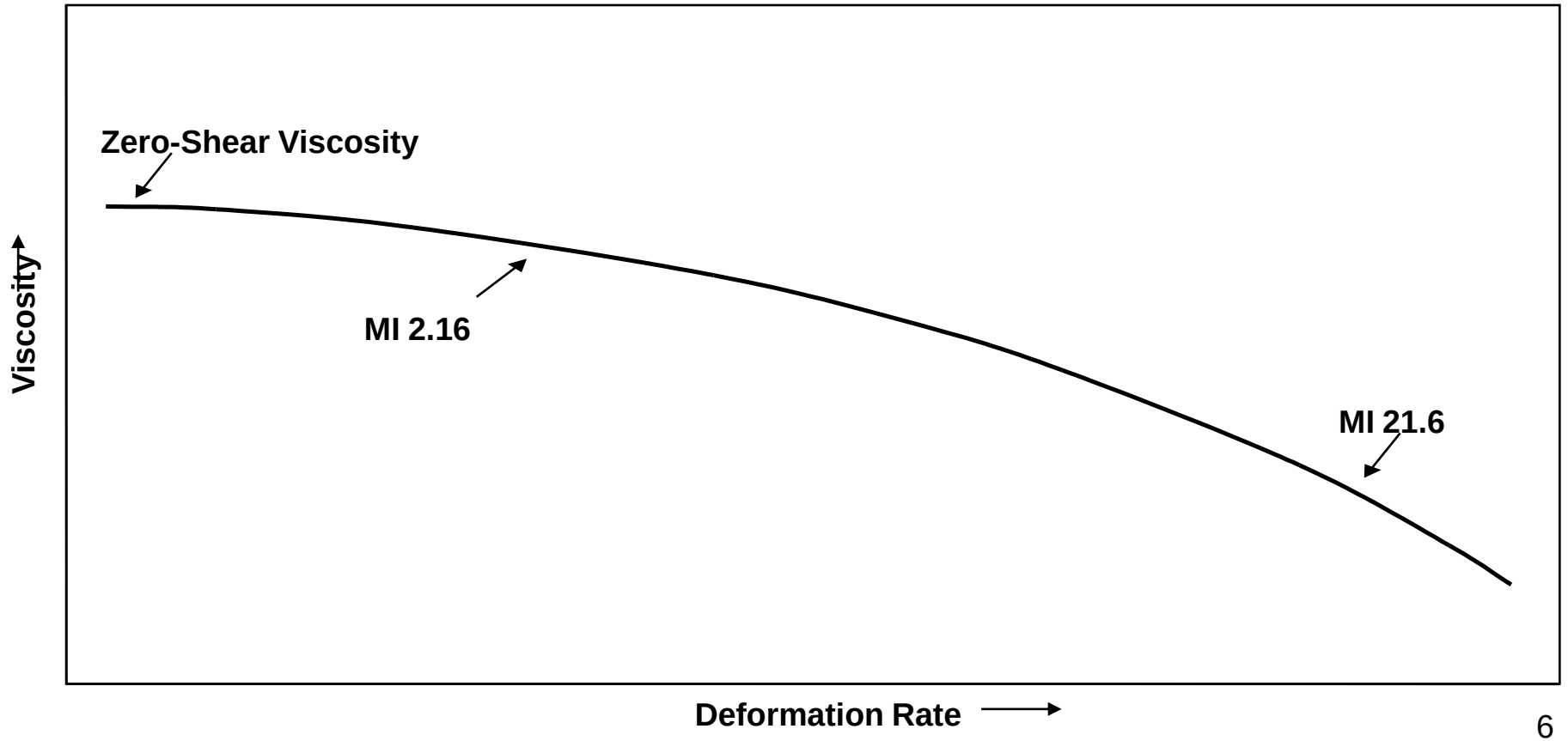
- To change a resin density comonomer is added
- Weight per volume



- Higher Density
- Lower Density

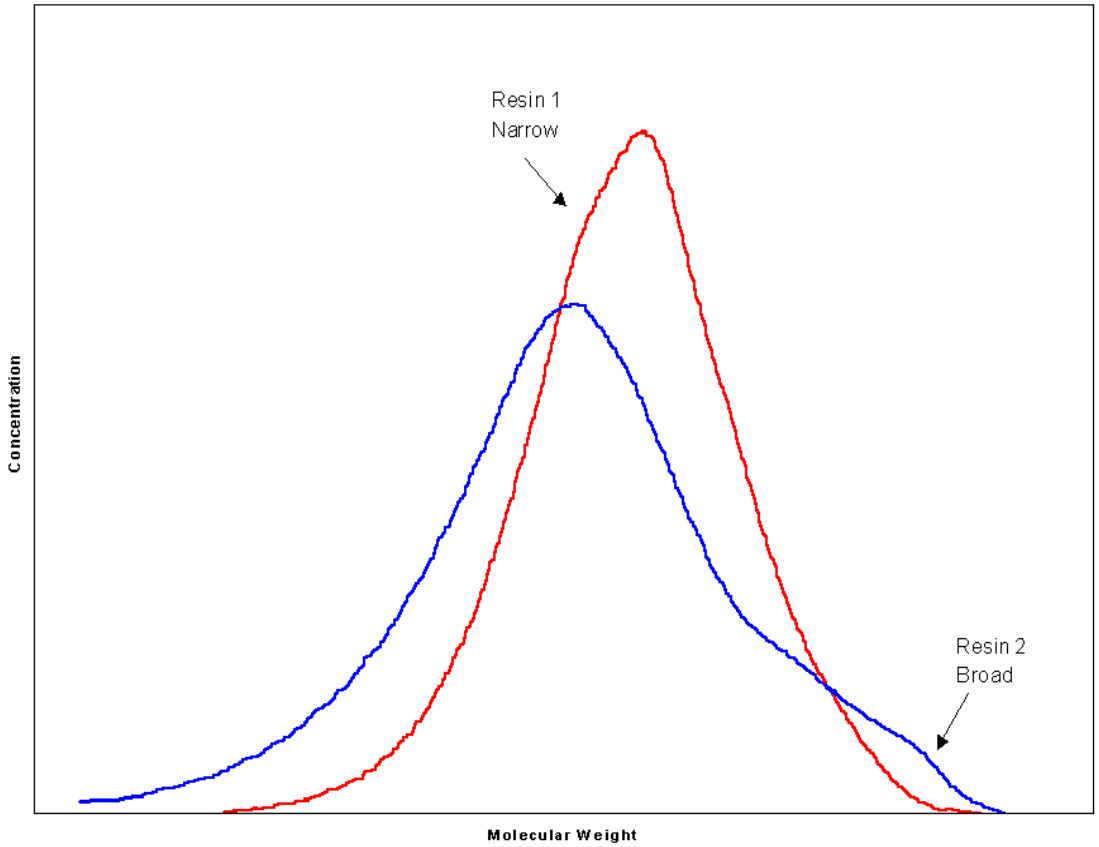
Melt Index

- MI is an indicator of melt flow (or viscosity) and a resin's processability
- Differing resins can have the same MI
- Lower MI (long molecules), Higher MI (short molecules)

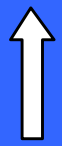


Molecular Weight Distribution

- Polymers are composed of chains of differing lengths, or molecular weights
- A distribution of chain lengths defines the polymer $\rightarrow$ molecular weight distribution (MWD)



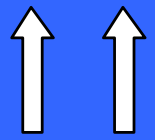
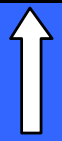
Polymer Property Effects

Note: These relationships show trends only, not the magnitude of the relationships.		As Comonomer Chain Length Increases (C4 < C6 < C8)
Flexural Stiffness		
Impact Strength		
Low Temperature Ductility		
Bent Strip Environmental Stress Crack Resistance		
Constant Tensile Load Environmental Stress Crack Resistance		

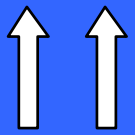
Polymer Property Effects

Note: These relationships show trends only, not the magnitude of the relationships.		As Density (crystallinity) is Increased	As Melt Index is Increased (Molecular Weight Decreased)	As Molecular Weight Distribution is Broadened
Impact Strength				
Low Temperature Ductility				
Bent Strip Environmental Stress Crack Resistance				
Constant Tensile Load Environmental Stress Crack Resistance				
Chemical Resistance				
Permeability				

Polymer Property Effects

Note: These relationships show trends only, not the magnitude of the relationships.		As Density (crystallinity) is Increased	As Melt Index is Increased (Molecular Weight Decreased)	As Molecular Weight Distribution is Broadened
Flexural Stiffness				
Tensile Strength @ Yield				
Elongation				
Resistance to creep				
Hardness/ Abrasion Resistance				

Rotational Molding Performance

Note: These relationships show trends only, not the magnitude of the relationships.		As Density (crystallinity) is Increased	As Melt Index is Increased (Molecular Weight Decreased)	As Molecular Weight Distribution is Broadened
Melt Viscostiy				
Softening Point				
Melt Strength				
Shrinkage				
Warpage				

Summary

- The polymer properties of interest to a rotomolder are interdependent.
- Product data sheets offer an indication of polymer performance, but the true test is in the processing.
- It is the combination of resin parameters, additive package and processing environment that ultimately determines resin performance.