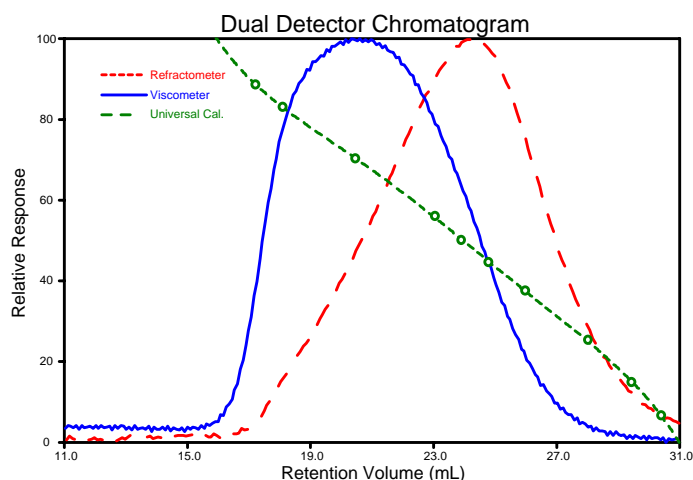


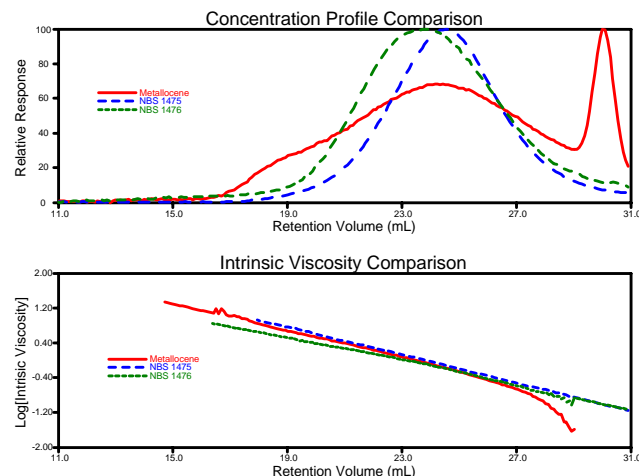
Detectors

Waters 150C Refractometer
 Viscotek Differential Viscometer

Metallocene catalysts are in common use for polyethylene manufacturing. By employing this single site catalyst technique, polyethylenes can be custom tailored for specific performance properties. By using the metallocene catalysts versus multiple site catalysts, an overall linear polyethylene structure can be achieved with a very controlled amount of short-chain branching. The Viscotek Differential Viscometer can be used to detect small differences in branching among these polyethylene processes.



From the Dual Detector response, the intrinsic viscosity polydispersity is clearly evident. By using the Universal Calibration technique, direct molecular weight comparisons can be made among samples regardless of their structure (including regularly spaced grafting sites). Furthermore, differences in small amounts of branching can be determined quickly and effectively. An intrinsic viscosity comparison can be overlaid, directly showing differences in branching level as shown in the plot below.

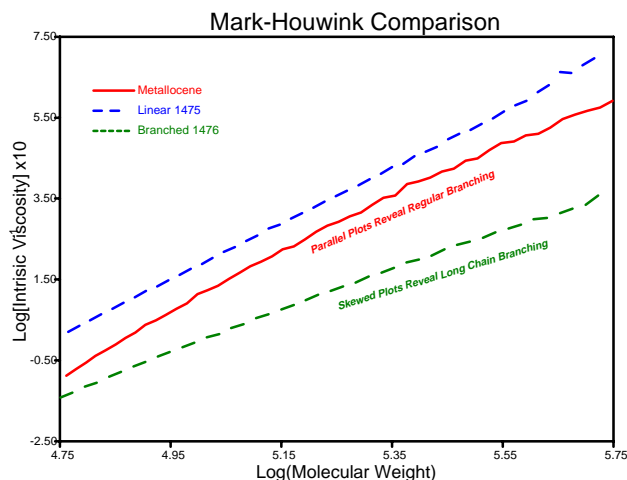


Run Conditions

Solvent: TCB
 Column Set: 3 Linear Columns
 Concentration: Approximately 0.2%
 Injection Volume: 100 μ L
 Flow Rate: 1.00 mL/min

The previous plot shows that the metallocene polymerization produces a small amount of short-chain branching: the polymer has a slightly low intrinsic viscosity at each retention volume.

The Mark-Houwink Plot represents intrinsic viscosity as a function of molecular weight. Since intrinsic viscosity has the units of dL/g, it represents the inverse of density (g/dL). The more branching a polymer possesses, the lower the intrinsic viscosity will be (relative to the molecular weight). Below, a small amount of regularly-spaced branches can be accurately determined in the metallocene-catalyzed resin by the difference in the Mark-Houwink Plot intercepts, whereas a randomly-spaced long-chain branched polyethylene exhibits decreasing slope with increasing molecular weight as shown below.



Differences in copolymer grafting can also be rapidly determined for metallocene-catalyzed resins. Shown below is a comparison of regularly-spaced grafts and randomly-spaced grafts.

