

# Analysis of Propylene-Butene Copolymer Composition by GPC with Online Infrared Detector.

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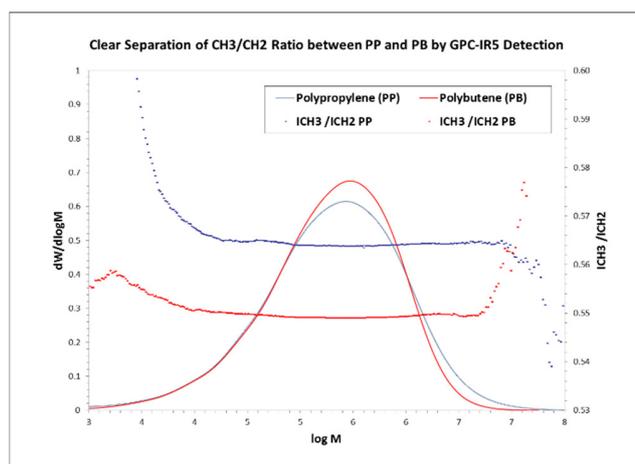
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The use of GPC with online infrared detector to analyze copolymer composition of polypropylene-butene (PP-PB) copolymer is investigated in this study. This technique is based on the measurement of the methyl to methylene ( $\text{CH}_3/\text{CH}_2$ ) ratio by online infrared detector. This study is made possible by the highly discriminating power of IR5 detector to detect the difference between PP and PB, as shown in the attached Figure. A new calibration approach is used to improve the precision of the methodology.

The application of GPC-IR5 for compositional analyses of ethylene-based copolymers with  $\alpha$ -olefin co-monomers (LLDPE) has been widely reported in the literature, and recognized as one of the most significant advances in polyolefin characterization in recent years (see Reference 1). In this case with LLDPE, the presence of one co-monomer adds one extra  $\text{CH}_3$  group to the molecule and creates a direct increase in the  $\text{CH}_3/\text{CH}_2$  ratio that makes it an easier measurement by GPC-IR5. The increase in  $\text{CH}_3/1000\text{C}$  so determined provides the important short chain branching (SCB) measurement for the LLDPE polymer.

However, the detection of copolymer composition of propylene-based copolymer with higher  $\alpha$ -olefins is a much more challenging test for GPC-IR5. In this case, the replacement of one propylene unit by a higher  $\alpha$ -olefin co-monomer (like butene, hexene, or octene) can cause no change of the  $\text{CH}_3$  content in the molecule. What such a propylene substitution does do is to add a few extra  $\text{CH}_2$  groups to the molecule and causes a slight decrease of the  $\text{CH}_3/\text{CH}_2$  ratio. This decrease of  $\text{CH}_3/\text{CH}_2$  ratio must necessarily be very slight because there is already an abundance of large amount of  $\text{CH}_2$  groups existed in the molecule.

This makes the compositional test of PP-PB copolymer the most challenging one of all cases, where each replacement of propylene unit by a butene co-monomer adds only one extra  $\text{CH}_2$  group to a large total number of them in the molecule, while it makes no change to the total  $\text{CH}_3$  content. To overcome this challenge, a new calibration approach is conceived and implemented in this PP-PB study to greatly improve the precision of the  $\text{CH}_3/\text{CH}_2$  methodology using the GPC-IR5 dual wavelength detection.



## References:

1. Benjamín Monrabal, Advances in Polymer Science Volume 257, 2013, pp 203-251.