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Chromium oxide/metallocene binary catalysts for bimodal polyethylene: Hydrogen effects

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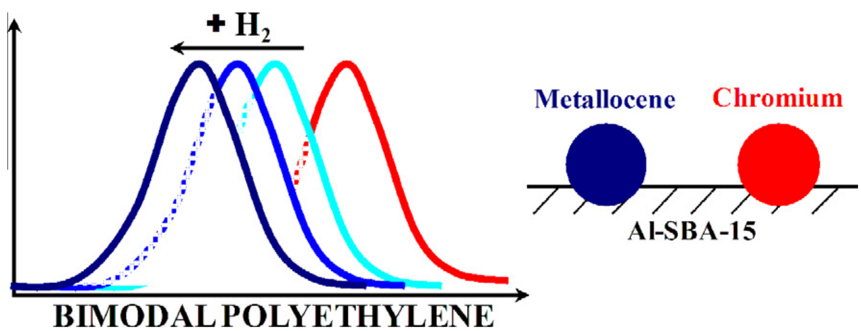
HIGHLIGHTS

- Bimodal polyethylene can be obtained by chromium–metallocene catalysts.
- These binary catalysts are able to run in one-step polymerization process.
- Chromium and metallocene catalytic centres present different behaviour with hydrogen.
- Properties of bimodal polymers can be adjusted by changing hydrogen concentration.
- Obtained bimodal polyethylenes combine high molecular weight with processability.

GRAPHICAL ABSTRACT



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ABSTRACT

Bimodal resins came up to meet application requirements: low molecular weight for good processability and high molecular weight for mechanical properties. For obtaining this bimodality there are several strategies: physical melt mixing of the two components produced separately, a single catalyst in two different serial reactors and a single reactor technology employing a tailor made catalyst and/or switching conditions. This last method has many advantages such as lower investment costs, less process complexity and intimate mixing of high and low molecular weight components (improved product quality). By means of this single reactor technology, bimodal polyethylene was synthesized using a mesostructured catalyst based on Al-SBA-15 where two active centres, chromium and metallocene, were incorporated. Ethylene polymerizations were carried out over binary catalysts (hybrid and mixed Cr–metallocene) and the polyethylenes obtained were compared with those obtained with individual catalysts in order to determine the contribution of each active centre. As well, the effect on polymer properties of the partial pressure of hydrogen in the reactor was evaluated. Results indicate that the hybrid catalyst (metallocene supported over Cr–Al-SBA-15) and physical mixture (Cr–Al-SBA-15 mixed with met-Al-SBA-15) lead to bimodal polyethylenes which combine high molecular weight, crystallinity and melting point with good processability (high melt index).

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1. Introduction

The possibility of widening polymer properties profile remains a fruitful field of research aimed at producing more versatile materials. In this sense, bimodality has become an additional degree of freedom in tailoring polyethylene (PE) properties. A bimodal polyethylene consists of a mixture of low and high molecular weight polyethylene fractions [1], where the term "bimodal" comes from the shape of the gel permeation chromatography curve, that is, a bimodal molecular weight distribution (MWD). As known, MWD is clearly related with the rheological properties having a great influence on polymer processing behaviour. Since

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