

Abstract
Process Economics Program Report 281
ON-PURPOSE TECHNOLOGIES FOR POLYETHYLENE COMONOMERS
(July 2011)

This Process Economics Program report presents technical and economic appraisals of ethylene-based commercial technologies for production of polyethylene comonomers, namely, 1-butene, 1-hexene, and 1-octene. Although linear alpha-olefin and Fischer-Tropsch processes are currently the major sources for production of these comonomers, their demand is expanding at a faster rate with respect to higher alpha-olefins. This has created opportunities for alternative methods for their production through on-purpose technologies which offer producers a better way to balance productivity according to market demand.

The following three technologies are evaluated:

- Ethylene tetramerization (for 1-octene production)
- Ethylene dimerization (for 1-butene production)
- Ethylene trimerization (for 1-hexene production)

Ethylene tetramerization technology has been analyzed on the basis of information and concepts extracted from the technical articles and patents of Sasol. The catalyst systems are based upon a chromium source, a bidentate phosphine ligand and an aluminoxane activator, which are capable of providing 1-octene selectivities of up to 70%. Normal temperature and pressure ranges for the ethylene tetramerization process are 122–140°F (50–60°C) and 40–50 bar, respectively. The catalyst system can be varied to produce a mixed product of 1-octene and 1-hexene if desired.

Ethylene dimerization technology has been analyzed on the basis of information and concepts extracted from the technical articles and patents of IFP and SABIC. The catalyst system is basically an organo-metallic complex comprised of titanium alkoxide and a modifier (possibly an ether, e.g., tetrahydrofuran). Triethylaluminum is used as an activator. Normal temperature and pressure ranges for the ethylene dimerization process are 122–140°F (50–60°C) and 20–30 atm, respectively.

Ethylene trimerization technology has been analyzed on the basis of information and concepts extracted from the technical articles and patents of Chevron Phillips. The catalyst system is basically an organo-metallic complex formed from chromium(III) 2-ethylhexanoate (catalyst) and 2,5-dimethylpyrrole (ligand). Triethylaluminum is used as an activator. A chloride source, e.g., diethylaluminum chloride, is also added as a modifier. Normal temperature and pressure ranges for the ethylene trimerization process are 230–266°F (110–130°C) and 700–800 psia, respectively.



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**ON-PURPOSE TECHNOLOGIES FOR
POLYETHYLENE COMONOMERS**

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