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Catalysts for Polyolefins

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Abstract

Polyethylene (PE) and polypropylene (PP) are the two largest polymer families, in terms of of both product volume and catalyst usage. Linear polyethylenes (HDPE, LLDPE, MDPE, VLDPE, plastomers, and elastomers) are produced catalytically at low pressures using suspension (slurry), gas phase, or solution processes. Other polyethylene production (LDPE) uses non-catalytic, free radical initiated processes with bulk ethylene and high pressures. All processes for propylene polymerization are catalyzed. Catalyzed processes account for 87% of polyolefin production.

Among the three broad classes of commercial olefin polymerization catalysts; Ziegler-Natta (ZN) catalysts, chromium-based catalysts, and single site catalysts (SSC); about 75% are of the ZN type. The discovery of ZN catalysis in the 1950s enabled the PE industry and launched the PP industry.

This report provides process design and economics for three Ziegler-Natta olefin polymerization catalysts:

- A batch process producing 0.11 million lb per year (50 tpa) of Ziegler precatalyst for use in slurry phase production of PE.

  The precatalyst may be similar to those employed in the JCES series developed by Sichuan Jincheng Chemical Catalyst Company. This type of catalyst has been used in production of bimodal or unimodal HDPE by the Innovene S (INEOS), CX (Mitsui), and Hostalen (LyondellBasell) processes.

- A batch process producing 2.1 million lb per year (961 tpa) of Ziegler precatalyst, slurried in oil, for use in gas phase production of PE. The design capacity is 0.717 million lb per year (325 tpa) of solid precatalyst (oil-free basis).

  The precatalyst may be similar to Univations's UCAT™-J catalyst, used in the UNIPOL™ PE process to produce a broad range of LLDPE and HDPE products.

- A batch process producing 0.11 million lb per year (50 tpa) of Ziegler-Natta precatalyst for use in gas phase production of PP.

  The precatalyst may be similar to those employed in the DJD series manufactured by Liaoning Dingjide Petrochemical Company. This type of catalyst is used in gas phase PP production such as the UNIPOL PP process.

Catalysts, process designs, and process economics are presented for the aforementioned ZN catalysts. The report also includes industry and technology overviews for the field of polyolefin process catalysts. The ZN Catalysts interactive iPEP module is included, enabling the user to compare economics for the different processes in several geographic regions.

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While the processes presented herein represent the IHS Markit Process Economic Program's (PEP's) independent interpretation of the literature, and may not reflect in whole or in part the actual catalyst formulations and plant configurations, PEP believes the conceptual designs sufficiently representative of materials used and plant configurations to enable Class III economic evaluations.

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