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Abstract

Polyalpha olefins (PAOs) represent a family of primarily decene-1 oligomers (mostly trimers) that have found wide use as a fully synthetic lubricant base oil component. PAOs provide superior lubricant properties in viscosity, viscosity index, cold cranking capability, emulsion resistance, lower pour point, lubricity, friction reduction, low volatility in use, higher flash temperature, and thermal and oxidative stability. The downside is lower solvency and biodegradation, poorer seal swell, and higher cost. The American Petroleum Institute (API) designates PAO components as Group-4 fully synthetic basestock. Periodic shortages in decene-1 LAO (linear alpha olefin) feedstock availability have forced PAO producers to occasionally blend C_{10} with both lighter (C_8) and heavier (C_{12}) LAO feedstocks to produce PAO with adequate physical and performance properties. The oligomerization process is not very selective, and produces a reactor product containing LAO dimers, trimers, tetramers, and pentamers, plus unreacted feedstock.

While originally developed to produce fully synthetic basestock for conventional motor oil requiring 4 centistoke (cSt) viscosity, additional product grades with different viscosities have been supplemented with newer PAO components of much higher viscosity (100+ cSt) that have found widespread use as blend stock components in heavy duty gear boxes, transfer cases, and transmissions, such as those found in wind turbine generators.

Given the inherent lack of selectivity in production, newer PAO processes have been commercialized that use metallocene oligomerization catalysts (rather than Lewis acids) to produce reactor products that have a much narrower molecular weight distribution and higher kinematic viscosity (KV), and therefore more precise properties for specific end use applications.

In this design, we present our understanding of the process technology and production economics of metallocene PAO produced by Chevron Phillips, ExxonMobil, and INEOS. We also describe our understanding of the technologies used by Chemtura (acquired by Lanxess in 2016), and Idemitsu. Idemitsu no longer produces PAO for sale as a lubricant base oil, but does sell an A-20 dimer for heat transfer fluid applications in refrigerant service.

KEYWORDS: Polyalphaolefin, PAO, metallocene, mPAO, synthetic lubricant, Group-4

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