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Single-Step MIBK Process

PEP Review 2019-03

April 2019

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Abstract

Methyl isobutyl ketone (MIBK), an organic compound with chemical formula $(CH_3)_2CHCH_2C(O)CH_3$, is a colorless liquid, flammable in nature. MIBK is an excellent solvent for resins used in the production of surface coatings, vinyl, and acrylic resins, in the extraction of metallic salts, and as a reagent in the dewaxing of mineral oil. It is also used in rubber chemicals for the production of tires, as a solvent in the manufacture of pharmaceuticals and adhesives, and for specialized metallurgical extraction. Solvent applications account for nearly half of total MIBK consumption worldwide.

MIBK has been commercially produced on a large scale by the conventional three-stage process, two-step process and the single-step acetone condensation process. Both processes involve aldolization of acetone to form di-acetone alcohol, which is then dehydrated to mesityl oxide (MO) and finally hydrogenated to MIBK product. The first two steps are base and acid catalyzed reactions respectively, while the third step is generally catalyzed by supported noble metals. In the three-step process, three reactions are executed separately, while in the single-step process, three steps are carried out in a single reactor in gas or liquid phase.

The three-step process suffers from low acetone conversion per pass and low MIBK product yield; a considerable amount of less useful MIBC is also formed in the final reaction stage. The single-step MIBK process provides lower operating costs as a result of fewer unit operations involved, as well as higher acetone conversions, and also prevents the reversion of mesityl oxide to acetone.

PEP Report 77, *Acetone Methyl Ethyl Ketone and Methyl Isobutyl Ketone* (May 1972) [RP77] covers MIBK production economics from acetone by the single-step process (via direct condensation of acetone—the Veba-Chemie process) and from isopropanol feed by two-step process (via MO route—the Esso Research & Engineering company process) and the two-step process (via MO route—the Esso Research & Engineering company process). PEP Review 81-1-2, *Methyl Isobutyl Ketone by Direct Condensation of Acetone* (November 1981) [RW81-1-2] covers MIBK production economics from acetone via a single-step process developed in the Soviet Union. This review covers various technology developments for the production of MIBK from acetone via single-step method that have occurred in the last few decades. It provides a technoeconomic evaluation of the various single-step MIBK production processes and the process economics for the Mitsubishi process on the US Gulf Coast.

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