

Producing environmentally acceptable gasoline and diesel

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In Europe, the maximum amount of sulfur allowed in gasoline and diesel fuel was reduced to 50 ppm in 2005 and to 10 ppm in 2010. Deep hydrotreating technology for the removal of sulfur- and nitrogen-containing compounds is needed to attain this low level of sulfur. Hydrodesulfurization (HDS) is used in refineries to lower the sulfur of fuels. In this process, sulfur atoms are removed from oil feed stocks by breaking of the C-S bonds of sulfur-containing molecules and hydrogenation of the sulfur to hydrogen sulfide. Nitrogen-containing compounds compete with the sulfur-containing molecules for the adsorption sites and hinder their reactions. Therefore, it is important to know how nitrogen-containing molecules influence HDS and how they can be removed from fuels.

State-of-the-art deep hydrotreating technology and catalysts as well as reactions that take place in HDS will be presented. Sulfur removal occurs by direct C-S bond breaking as well as by a sequence of reactions of which hydrogenation is the first and rate-determining step. Alkyl groups attached to sulfur-containing aromatic molecules strongly hinder the C-S bond breaking. Amines and aromatic molecules inhibit the hydrogenation reactions, while H₂S strongly inhibits the C-S bond breaking.

The removal of nitrogen from nitrogen-containing aromatic molecules occurs by hydrogenation of the aromatic heterocycles followed by C-N bond breaking. The nitrogen atom is removed as ammonia by substitution of the alkylamine by H₂S followed by the loss of H₂S by elimination or hydrogenolysis. Possibilities for the further reduction of the sulfur and nitrogen contents of fuel will be indicated.