Abstract
Process Economics Program Report 273
GASOLINE BENZENE REMOVAL
(September 2009)

In most developed countries, the benzene content of gasoline is regulated to 1 vol% or less. The United States Environmental Protection Agency’s Mobil Source Air Toxics Phase 2 rule requires refiners and importers to the U.S. to reduce the benzene content of conventional, as well as reformulated gasoline, to a corporate annual average of 0.62 vol% effective January 1, 2011 for most refiners (2015 for small refiners). This is a reduction from the current 1.0 vol% benzene limit (except in California). The regulation also requires the maximum benzene content to be 1.3 vol% for the gasoline pool and provides for an averaging, banking and credit trading program to help meet the 0.62 vol% specification. In addition, the U.S. revised renewable fuel standard will require the future gasoline pool to contain about 10 vol% ethanol.

Catalytic reforming is the source of about 70-85 vol% of the gasoline pool benzene while fluid catalytic cracking accounts for another 10-25 vol%. To meet the current 1.0 vol% benzene requirement, many refiners have utilized reformer operational and catalyst changes. Additional benzene reduction to meet the new limit will require implementing additional strategies and adding or modifying process units in many refineries. Processes to reduce benzene include fractionation of reformer feedstock or of reformate, saturation either as a separate process or combined with hydroisomerization, benzene alkylation and extraction of benzene.

To meet the 0.62 vol% benzene requirement, more than half of the refineries reporting to the U.S. EPA indicated in their 2008 pre-compliance reports that they plan to install new benzene reduction facilities.

This PEP Report first provides an overview of the United States gasoline benzene regulations, market supply and demand trends plus planned new construction. Reaction chemistry, catalysis and processes to remove benzene from gasoline streams are reviewed. We then develop the process economics for removal of benzene from the refinery gasoline pool by three different technologies:

- Saturation of benzene by catalytic distillation of whole reformate
- Saturation of benzene combined with hydroisomerization of C₅-C₆ naphtha
- Extractive distillation to recover marketable benzene and optionally toluene from a C₅-C₇ reformate cut.
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For detailed marketing data and information, the reader is referred to one of the SRI Consulting programs specializing in marketing research. THE CHEMICAL ECONOMICS HANDBOOK Program covers most major chemicals and chemical products produced in the United States and the WORLD PETROCHEMICALS PROGRAM covers major hydrocarbons and their derivatives on a worldwide basis. In addition the SRIC DIRECTORY OF CHEMICAL PRODUCERS services provide detailed lists of chemical producers by company, product, and plant for the United States, Western Europe, Canada, and East Asia, South America and Mexico.
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