Chapter 6
New Catalytic Approaches for Producing Alternative to MTBE Additives for Reformulation of Gasoline

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ABSTRACT

Due to the lead phase out that began in 1973, refiners had to replace the octane loss in gasoline. For this purpose, oxygenates and highly branched alkylates will play a major role as gasoline additives because they have relatively high octane ratings. Methyl tertiary-butyl ether (MTBE) is the oxygenate as a gasoline additive the most widely used nowadays in most of the countries in the world. It is used to raise octane levels, enhance engine performance, improve combustion efficiency and to reduce emissions of air pollutants such as carbon monoxide and hydrocarbons.

INTRODUCTION

Alkylates containing C_8 fractions or higher hydrocarbons are usually produced from alkylation of isobutane with olefin process in the presence of concentrated sulphuric acid or hydrogen fluoride that is used as liquid catalyst. The demand for branched C_8 fractions (isomers) increases sharply due to their uses as prime solvents and additives to gasoline. The present alkylation process suffers from inherent drawbacks such as corrosion, toxicity, and environmental problems. Therefore, oligomerization of light

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olefins might be an attractive alternative to produce liquid hydrocarbon alkylates as components of gasoline and high value petrochemical products.

In addition, in view of the growing concern on environmental pollution, fuel reformulation is now carried out on a worldwide basis due to US and European legislations, which are focused on reducing evaporative emissions, lower sulphur content, lower aromatics and on complete fuel combustion. In this context, an interesting route for the production of environmentally friendly fuel is the dimerization, trimerization, tetramerization or oligomerization of light olefins

Oxygenates are hydrocarbons that contain one or more oxygen atoms. The primary oxygenates are alcohols and ethers, including: fuel ethanol, MTBE, ethyl tertiary butyl ether (ETBE), and tertiary amyl methyl ether (TAME).

The blending of (MTBE) into motor gasoline increased dramatically since it was first produced 37 years ago. MTBE has a blending octane in the range of 106-110 and make up approximately 5-15% of the gasoline pool. MTBE usage grew in the early 1980s in response to octane demand resulting initially from the phase out of lead from gasoline and later from rising demand for premium gasoline.

Methyl tertiary butyl ether use was mandated into united state automobile gasoline in the early 1990s. Due to leaking storage and distribution systems, MTBE contamination of water supplies has been discovered, causing state of California to completely banned MTBE in 2005. With other states proposing similar legislation. Refiners will replace MTBE in gasoline with ethanol. Some MTBE plant shut down and some will be converted to isooctane or alkylation in order to consume the excess isobutylene no longer consumed for MTBE.

Upgrading Gasoline in Oil Refining Processes

In view of MTBE phase out schedules adopted, various options for octane enhancement have been explored. The following main oil refining processes play key role in gasoline production:

- Crude oil distillation.
- Catalytic cracking conversion processes.
- Upgrading processes, such as catalytic reforming, isomerization, alkylation, polymerization of light olefins to form polygasoline, etherification processes, and isobutene dimerization.

In a breakthrough development, a research team at the National Center for Petrochemical Technology has developed a technology that has the potential to substantially expand the prospects for clean fuel. The technology involves a new

Membrane Engineering and its Role in Oil Refining and Petrochemical Industry

Adele Brunetti, Miriam Sellaro, Enrico Drioliand Giuseppe Barbieri (2016).
Petrochemical Catalyst Materials, Processes, and Emerging Technologies (pp. 116-149).

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