Student's Name

Professor's Name

Subject

Date

Producing a High Octane Number in Fuel

Introduction

Oil refineries have gradually reduced in number over time, and the remaining refineries have increased their operating capacities and improved efficiency. Many American oil refiners in the 1990s were characterized by having low profitability and low product margins. The operating cash margins were low, and the return on equity was also low. This was partly caused by the cost of regulation. American refineries in the 1990s era spent approximately $30 billion to comply with governmental mandates concerning the environment. Additionally, refineries also dealt with the economic effects of the varying prices of crude oil, the oil's quality, and low transport and marketing profit margins. Consequently, there was a need to increase throughput and flexibility, achieve better conversions and process efficiency, minimize operating costs, and improve reliability. Generally, the lower prices that were prevalent over a protracted period in the 1990s resulted in domestic refiners finding better value from fixed assets while improving efficiency and reducing operating costs. Improvements in the technologies used as well as in the refinement processes and techniques like blending agents to obtain desirable properties and prices of the final products has helped refiners improve their margins, avoid major capital investments, and minimize their environmental impact.

Refining petroleum is critical in everyday life. The majority of transportation vehicles are fuelled using refined crude oil products like diesel, gasoline, fuels oil, and aviation turbine kerosene. Fluctuations in prices over the years have affected the refining industry in several ways, expanding the search for fossil fuel alternatives like alcohols and biodiesels from vegetables. They have also helped improve the synthesis of fuels using the Fischer-Tropsch method, tar sand, and coal gasification processing techniques. Finally, they have initiated the search for long-term solutions like renewable energies. Despite all this, crude oil is still comparably cheap for petrochemicals and transportation. On the other hand, governments have tightened their environmental regulations by increasing the cost of producing clean fuel. Tighter regulations have motivated the search for producing clean fuel using unconventional techniques like ambient desulfurization through liquid oxidants. New technologies and the improved design of the refinery equipment have been developed to help produce clean fuels and reduce costs. In a modern refinery, the processes are classified as either chemical conversion or physical separation.

The separation of crude oil into principal products, distillate fuels, gasoline, and residual fuel is achieved through simple distillation. However, neither the quality nor the quantity of these products reaches the desired demand. The potential yield of gasoline extracted directly from crude oil is lower than 20%, while the demand is approximately 50%. Heavier materials should be converted into lighter material; similarly, the octane number of refinery streams should be improved. Gasoline is made using the naphtha fraction, where the boiling temperature is between 0 ºC and 210 ºC. Gasoline can be directly substituted with virgin naphtha; however, the latter has a research octane number of 78 and a motor octane number of 75. Prior to the banning of lead, tetraethyl lead had been added to increase the octane levels of fuels to acceptable values.

Currently, octane requirements should be reached by altering the chemical composition of the straight-operated gasoline fraction. The main process used to increase the octane value of gasoline components is catalytic reforming. The feed to the reforming process is often virgin naphtha that boils between 0 ºC and 210 ºC. The RON and MON values of the reformers are greater than 100 and 90, respectively, indicating high octane values in the product streams. The reformers are also highly aromatic. Other chemical reaction processes that are used to increase the octane number are isomerization and alkylation.

Alternatives to chemical rearrangements are used to increase the octane number of fuels by using octane-enhancing blending agents. Blending agents are additives for gasoline, and they are not natural elements found in crude oil. Most current blending agents are oxygenated compounds that are made up of ethers like methyl tertiary butyl ether and alcohols like ethanol. Despite their widespread use at present, both ethanol and methyl tertiary butyl ether (MTBE) have disadvantages, and both may not satisfy all future needs for octane increases. This leaves a gap in the market for the creation of blending agents that result in increased octane numbers.