Chapter 7

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Background

The exact composition of the mixed alcohol product produced by a facility is dependent upon the catalysts and reactor conditions employed. Since the catalyst and reactor conditions are only imprecisely known at the present stage of the research, the actual composition of the mixed alcohol product can only be hypothesized. Therefore, the actual demand and value of this product cannot be determined until decisions are made regarding the product composition. However, some insight may be gained into the potential demand and market value for the proposed mixed alcohol fuel by examining the market for individual alcohols.

The near-term potential of methanol as a fuel oxygenate or neat fuel in the United States is questionable. Its use in this capacity is marred by numerous problems ranging from consumer and industry acceptance to its lack of economic competitiveness. Despite its relative abundance, consumption of methanol in gasoline has declined steadily from its high point of 400 million liters (106 MM gallons) in 1985 to less than 15 million liters (4 MM gallons) in 1987 [1]. By 1988, the demand for methanol as an octane enhancer had virtually disappeared.

Historically, this trend has been attributed to methanol's acceptance problems and its recent lost cost advantage over other octane enhancers. Many of the acceptance problems are a result of adverse publicity as well as mechanical problems. In the 1980's, several automobile manufacturers stated warranties would not be honored if owners used methanol enhanced gasoline blends in their cars. While these manufactures discouraged the use of gasoline containing methanol as an octane enhancer, they warranted the use of gasoline blends containing up to 10% ethanol. Methanol's acceptance was further eroded by technical problems such as fuel foaming, aldehydes emissions, vapor locking in hot weather, and starting problems in cold weather, along with numerous corrosion problems in the engine and fuel system. Reports of these problems prompted the EPA to limit the amount of neat methanol in unleaded gasoline to 0.3% by volume despite the fact that

neat methanol concentrations of up to 3% (vol) have been used in Germany for several years without any reported problems [1].

The use of ethanol was met with less resistance due in part to the efforts of the corn lobby from the Midwest. Initially instituted as a means of conserving crude oil in the late 1970's, a mixture of 10% ethanol and 90% gasoline was used in place of straight gasoline. The manufacture of ethanol soon became profitable as a result of government subsidies, and demand for ethanol continued to grow through the 1980's at the subsidized prices. However, these subsidies only apply to fermentation ethanol and are dependent on legislative support. Without these subsidies, its use as a fuel additive would be no longer economically viable, since, from a pure manufacturing cost perspective, it is the most expensive of all currently used blending agents. Synthetic ethanol is also relatively expensive in comparison to other blending agents, which accounts for its lack of use in this market.

The most promising alcohol fuel additive, from cost and technical viewpoints, appears to be tertiary-butyl alcohol (TBA) which is currently approved by an EPA interpretative rule that permits blends approaching 16% by volume for straight TBA. However, ARCO Chemical Company appears to have a monopoly on the production of TBA since 1986. TBA may also be used as a cosolvent with methanol, although its use in this capacity has declined since methanol blending was stopped because of problems stated previously. The features that make this product so attractive are that it can be used in its original form or it can be further refined to produce high purity isobutylene, which can be reacted with methanol to produce methyl tertiary butyl ether (MTBE).

Isobutanol was once considered to be an unwanted by-product generated in the production of oxo-chemicals derived from propylene. This may, in part, explain its growth as a fuel additive in the early 1980's. A number of companies under the United States Environmental Protection Agency's (EPA) Petrocoal waiver [2] began to use alcohols as octane enhancers during this time period. Under this waiver, the addition of up to 15 volume percent alcohol could be used as a blending agent in gasoline. However, the composition of the alcohol was limited to a maximum of 12 percent methanol and a maximum methyl to butyl alcohol ratio of 6.5 to 1. Consumption of isobutanol and n-butanol peaked under this waiver at approximately 9100 metric tons and 4500 metric tons, respectively, in 1983, after which the market essentially collapsed due in part to the EPA's efforts to rescind the Petrocoal waiver.

Continued growth in the propylene-based oxo-chemicals industry has forced producers of oxo-chemicals to rely on virtually any source of C_4 oxo-molecules, causing the conventional price spread between n-butanol and isobutanol to decrease significantly. As a result of this significant price inducement, isobutanol was adopted as a substitute for n-butanol in many markets. However, the overall tightening of C_4 feedstocks also decreased the economic viability of adding butanols to gasoline. Currently, butanols are more valuable as chemical feedstocks than fuels. Estimates suggest that butanol may be economical if it can be produced for less than $0.37 per liter ($1.40/gal) provided that the

pre-tax gate cost of gasoline is in the range of $ 0.19 to $0.21 per liter ($0.72-0.79/gal) [2].

Although the Petrocoal waiver permitting the use of butyl alcohols was revoked in 1984, legislation as of September 1990 permits the use of butanol as an octane enhancer. Currently aliphatic alcohols (other than methanol) may be added to gasoline so long as there is no more than 2.7 percent oxygen by mass. There are specific EPA waivers for various blends of alcohols with gasoline, but all strictly limit methanol. Since the fuel product is likely to be a blend of various alcohols, it should be emphasized that methanol appears to be an undesirable product from the standpoint of EPA regulations. Therefore, to avoid complications of obtaining waivers for the use of this alcohol product, it may be advisable to eliminate methanol from the mixed alcohol fuel.

The potential local annual market (West Virginia and a surrounding seven-state area) is approximately 6.4 billion liters (1700 million gallons) used as a 10% blend. The potential problems from the marketing aspect may be regulatory if the alcohol fuel product does not fall into one of the approved categories.