REFINERY FUEL OXYGENATES IN VIEW OF THE COMPLEX MODEL FOR REFORMULATED GASOLINE

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The final version of the Complex Model for reformulated gasoline (RFG) has now been issued with some surprising features that will significantly affect refinery fuel oxygenates planning. These include the following:

- The only oxygenates included in the model are MTBE, ETBE, TAME, and Ethanol.
- The Complex Model calculates that MTBE and TAME are significantly more effective for reduction of air toxics emissions than Ethanol and ETBE.
- The Complex Model calculates that MTBE and TAME typically produce about equal reduction in air toxics emissions at the same RFG oxygen content.

Although gasoline certification by the Complex Model is optional prior to 1998, after 1998 it will be mandatory for both reformulated and conventional gasolines. This paper considers refinery oxygenates production in view of these features of the Complex Model for RFG, basing the discussion on 2.0 weight percent oxygen content for RFG.

The Complex Model calculates that MTBE and TAME will be more effective in reducing calculated air toxics emissions than ETBE and Ethanol. Although MTBE can be purchased on the open market, MTBE production from the isobutylene contained in the FCC/Coker C4's cut is well-established practice, and can provide as much as 15 to 20 percent of the 2.0 weight percent reformulated gasoline oxygen content requirement for ozone non-attainment areas. Emerging high-olefin FCC catalyst technology can increase this contribution to approximately 25 percent or more.

TAME production from the isoamylenes contained in the FCC/Coker C5's cut is now commercial technology, with a number of plants onstream. Recently announced low-cost upstream C5 selective hydrogenation technology can reduce TAME production costs, making TAME a more economically attractive oxygenate than previously. Applying catalytic distillation for TAME production provides yield advantages, and can provide as much as 15 to 20 percent of the reformulated gasoline oxygen content requirement. Unreacted amylenes can flow to alkylation, or other uses. Developmental skeletal isomerization technology has been announced for C5 olefins, which could increase TAME yields to provide as much as 30 percent or more of the reformulated gasoline oxygen content requirement.

Overall, use of commercially proven technology for MTBE and TAME captive production currently can economically provide about 35 to 40 percent of refinery oxygenates blending requirements, based on FCC/Coker olefins sources. Since both MTBE and TAME are low-pressure processes conducted in mild steel equipment; existing equipment can be advantageously retrofitted to minimize plant investment.

Although the Complex Model shows less air toxics emissions reduction at a given RFG oxygen content, ETBE and Ethanol can play a role in certain RFG blends. It is possible with certain refinery configurations to meet mandated reductions in air toxics reduction using ETBE or Ethanol to furnish the 2.0 weight percent oxygen content requirement. For these refinery configurations, the primary driving force for oxygenates selection will be economics, since emissions targets can be met whichever oxygenate is used, provided the proper configuration is chosen.

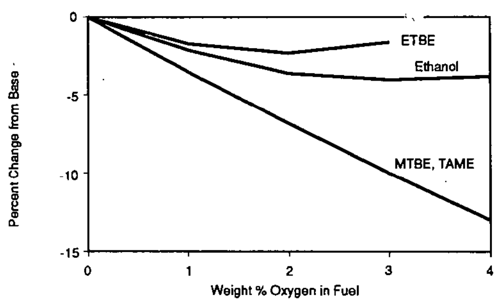
High molecular weight developmental oxygenates such as DIPE, IPTBE, and TAEE offer potential advantages of high octane and low vapor pressure, plus extended captive production from propylene in the case of DIPE. However, these oxygenates are not included in the current version of the Complex Model and special permits to blend them into fuels may be required where advantages for their use are anticipated.

Details of this paper, including Complex Model parametric studies and refinery configurations, will be presented at the national meeting. The attached figures are typical of those which will be included.

Figure 1
LOCATION OF NINE MAJOR COVERED OZONE NONATTAINMENT AREAS*
WHERE EPA RFG STANDARDS WILL BE MANDANTORY STARTING 1998*

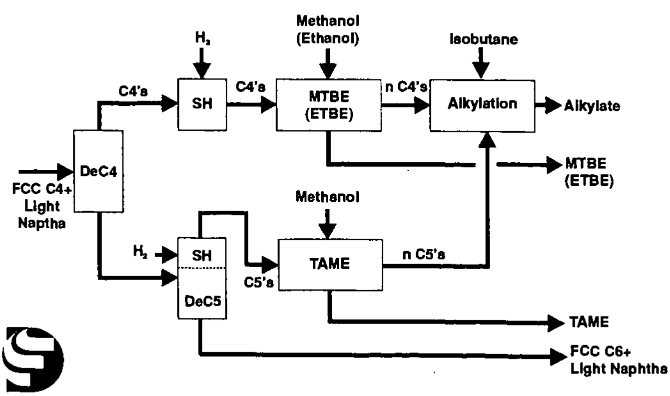
* "Opt-in" provisions for other areas
** 1998 RFG requires 15% reduction in air toxics and VOC from 1990 Baseline Gasoline.

Figure 2
IMPACT OF OXYGENATES SELECTION ON CALCULATED AIR TOXICS EMISSIONS
Final Complex Model



S = 339 RVP = 8.7 E200 = 41 E300 = 83 A = 32 OL = 9.2 BZ = 1.32

Figure 3
MTBE/TAME PRODUCTION FROM FCC C4+ LIGHT NAPHTHA



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