

Ethanol, Starch, and Sorbitol Increase the Demand for Corn

Despite the Court stay on the U.S. Environmental Protection Agency's renewable oxygenate requirement, high methanol prices and a recent Treasury Department announcement that ETBE is eligible for excise tax exemption could push ethanol production close to 1.5 billion gallons in 1995. Industrial uses of corn are forecast to reach 748 million bushels in 1994/95, up 12 percent from 1993/94. Cornstarch is used to make sorbitol, a polyol widely used in personal-care products.

Ethanol Had a Busy Year in 1994

The year began with ethanol supporters, oil companies, agricultural interests, and the U.S. Environmental Protection Agency (EPA) continuing their debate over what role ethanol will play in the Clean Air Act's reformulated gasoline (RFG) program. EPA had announced their decision in December 1993 to require 30 percent of the oxygen in RFG be derived from renewable sources. This "renewable oxygenate requirement" (ROR) would guarantee ethanol a role in the RFG program.

On January 14, 1994, EPA held a public hearing on the ROR and testimony was given by witnesses representing oil companies, agricultural interests, environmental groups, state regulatory agencies, and public interest groups. This hearing was followed by a 30-day comment period during which written comments and other documents were placed in the official record.

USDA submitted comments indicating strong support for the Administration's decision and pointing out the many benefits this rule would have on U.S. agriculture. USDA estimated full implementation of the ROR would increase net ethanol demand by 500 million gallons annually. This increase would account for an additional 200 million bushels of corn use. Added to the 1.25 billion gallons of production expected in 1994, ethanol production would increase to more than 1.7 billion gallons by crop year 1997/98.

EPA issued a final ROR regulation on June 30, 1994, which would require 15 percent renewable oxygen in RFG during 1995 and 30 percent thereafter. However, on July 13, 1994, the American Petroleum Institute and the National Petroleum Refiners Association filed suit in the U.S. Court of Appeals for the District of Columbia asking the Court to overrule EPA and find the ROR illegal. While many expected this challenge by the oil industry, ROR supporters are pleased with the aggressive response EPA has made toward this suit.

On September 13, 1994, the Appeals Court ordered EPA to stay its implementation of ROR. The Court also ordered a quick review of the case so that it can be

resolved before the RFG program has been in effect a long time. The Court order lays out a schedule for EPA, the oil industry, and the Renewable Fuels Association to file legal briefs with the Court. The last set of briefs is due January 12, 1995, and oral arguments likely will begin shortly thereafter. A final decision is expected in the spring.

The RFG program will begin on January 1, 1995, in all areas that are mandated or have opted into the program. Annual demand for RFG is expected to be about 36 billion gallons, all of which must contain at least 2.0-percent oxygen by weight. Oxygen can be added to gasoline in the form of alcohols or ethers made from alcohols. Currently, there are three oxygenates that are expected to be widely used in RFG: ethanol, ethyl tertiary butyl ether (ETBE) made from ethanol, and methyl tertiary butyl ether (MTBE) made from methanol.

All three can be used to produce RFG, but ethers like ETBE and MTBE have some advantages over ethanol. First, RFG made with ethers can be shipped in pipelines; ethanol blends cannot because they attract water. Second, ethanol increases the evaporation rate of gasoline. For this reason, ethanol cannot be mixed with other RFG fuels because the evaporative emissions contribute to smog formation. ETBE, however, does not increase evaporation; in fact, it reduces evaporation significantly. A common misunderstanding about ETBE is that it uses less ethanol to make a gallon of RFG. This is not true. The oxygen in ETBE comes from ethanol. Therefore, to make a gallon of RFG using ETBE, just as much ethanol is needed for ETBE as would be needed for blending ethanol directly into the fuel.

With the Court stay in place, many have wondered what the future holds for the ethanol industry. Difficulties associated with using ethanol in RFG, because of mixing and blending restrictions, were thought to put ethanol at a disadvantage in RFG markets. ETBE has been more expensive than MTBE because methanol has been cheaper than ethanol and it contains less oxygen than methanol. A recent market development that could promote the use of ethanol, regardless of the Court's ruling, has been the rapid increase in methanol prices over the past year.

Methanol is made mostly from natural gas. Methanol is not only used as fuel and a feedstock for MTBE, but also in chemical applications. For example, methanol is a feedstock for the resins and adhesives used in making plywood and other building materials. Greater economic activity and the upcoming RFG program have caused an increase in methanol demand that has pushed prices up to \$1.40 per gallon from 35 cents just a year ago. The recent temporary closing of a large U.S. methanol plant due to an explosion has increased the tightness in methanol markets, and prices in mid-October reached \$1.80 per gallon. Industry experts are now predicting these tight market conditions may persist until additional plant capacity comes on line in 1996.

In addition, the Treasury Department announced on October 17, 1994, that the ethanol portion of ETBE will be eligible for the same excise tax exemption now available to ethanol and other qualifying alcohols. This ruling will remove significant economic barriers to ETBE commercialization in the RFG market.

While the ROR Court stay could have negative effects on ethanol use, rising methanol and MTBE prices and the recent Treasury tax ruling have created positive economic opportunities for ethanol and ETBE in the RFG market. Many refiners are talking about using ethanol, ETBE, or both in their RFG around the country. If the market situation continues with high methanol prices, this could be enough to maintain ethanol-industry growth at levels USDA predicted earlier this year (see June 1994 issue of this report). Ethanol production is expected to be about 1.25 billion gallons in 1994 and could approach 1.5 billion gallons next year.

More Corn Needed for Ethanol and Starch in 1994/95

Industrial uses of corn are forecast to reach 748 million bushels in 1994/95, up 12 percent from 1993/94 (table 1). Most of the increase is expected to be used to produce ethanol. In 1994/95, industrial demand is expected to account for 8 percent of total corn use, down from 9 percent in 1993/94.

Starch production in 1993/94 used 2 percent more corn than the year before. Growth in the economy helped increase starch use, which was essentially unchanged during marketing years 1991/92-1992/93. The U.S. economy will likely expand 2.9 percent in 1995, thus starch production is expected to continue to rise. In 1994/95, starch production for industrial purposes is anticipated to require 3 percent more corn than the 207 million bushels needed in 1993/94. A lot of starch is used in paper products, and as the economy grows, more shipping boxes and other types of paper are needed. Also, greater use of recycled paper has helped boost starch use because the shorter wood fibers need extra bonding.

With the decrease in corn prices in July 1994, starch wholesale prices declined in August but still stayed slightly above year earlier levels. Prices for starch are generally negotiated between buyer and seller and depend upon size of purchase, amount of modification done to the starch, and competition among sellers. Many starch users have shifted from buying unmodified starch to buying modified starch that has the particular properties they need in their manufacturing process. Producers are now researching user needs and supplying different types of modified starch to their customers. With the large corn crop harvested in 1994, processing supplies will be lower priced than in 1993/94, but the stronger demand for starch will likely keep starch prices from reflecting the full decline in corn prices.

Sorbitol Production Uses Cornstarch as a Feedstock

Sorbitol is a six-carbon polyol made by catalytic hydrogenation of sugars, using either batch or continuous-flow processes. Most sorbitol produced today is from dextrose sugars derived from cornstarch. It is available commercially in food and industrial grades, and is sold in powdered, granular, or liquid form.

There are seven producers of sorbitol in the United States: Archer Daniels Midland Company; ICI Americas; Pfizer, Inc.; Lonze, Inc.; Hoffmann-LaRoche; Ethichem Corporation; and Roquette Corporation. They have a

Table 1--Industrial uses of corn, 1990/91-1994/95

Marketing year 1/	HFCS 2/	Glucose and dextrose 2/	Starch			Fuel alcohol	Total industrial use 4/
			Food uses	Industrial uses	Total 3/		
			Million bushels				
1990/91	379	200	35	197	232	349	546
1991/92	392	210	36	202	237	398	600
1992/93	414	215	36	202	238	426	628
1993/94	442	223	37	207	244	458	665
1994/95 5/	455	225	38	213	250	535	748

1/ Marketing year begins September 1. 2/ High fructose corn syrup (HFCS), glucose, and dextrose are primarily used in edible applications, such as food and health-care products. 3/ Industry estimates allocate 85 percent of total starch use to industrial applications and 15 percent to food applications.

4/ Industrial uses of starch and fuel alcohol. 5/ Forecast.

combined capacity of 527 million pounds. In 1992, 408 million pounds of sorbitol was produced and consumed in this country, utilizing roughly 25 million bushels of corn.

Four major market segments account for most of sorbitol use: personal-care products, food applications, surfactants, and vitamin C (figure 3). Plastics, specialty plasticizers, and pharmaceuticals make up the remaining 10 percent. The U.S. Food and Drug Administration has approved sorbitol for use in foods, cosmetics, and pharmaceuticals.

Within the personal-care segment, sorbitol is used in toothpastes, cosmetics, and toiletries. The toothpaste industry is a significant consumer, where sorbitol is used as a humidity control agent and delivery vehicle. Sorbitol's use in toothpaste grew rapidly in the 1970's when gel toothpastes became popular. Gel toothpastes contain up to 50-percent liquid sorbitol, which is twice the amount in paste toothpastes.

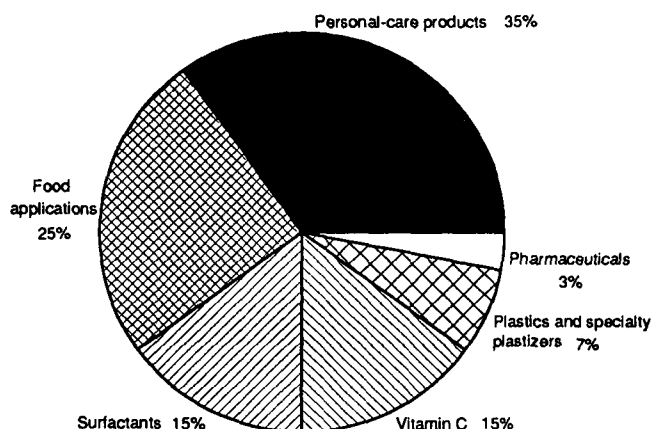
Sorbitol's main competitor at the time for the toothpaste market was glycerol (a 3-carbon alcohol commercially known as glycerine), which had been used in toothpastes for some time. Although about 10 percent higher in price, sorbitol was viewed with favor because it was a natural product. In the 1970's, about 70 percent of glycerol was petrochemically derived. By the middle of the 1980's, two-thirds of glycerol was derived from natural sources and there was no difference between the nature and quality of sorbitol and glycerol. By then, however, the markets for sorbitol were established and production costs were below those for glycerol. In the 1990's, sorbitol has made further inroads into glycerol's markets in the personal-care industry. Colgate regular toothpaste is now the only toothpaste on the market that contains only glycerol. Currently, sorbitol is priced at 33 cents per pound, while glycerol is \$1.07 per pound.

Sorbitol also is used in mouthwashes, imparting a cooling sweet taste. The cosmetic industry uses sorbitol as a humidity control agent and as a gel base. Because sorbitol is hygroscopic (it absorbs moisture from the air), it also serves as an emollient in creams and lotions.

Sorbitol is used in foods as a sweetener; it is 60 percent as sweet as sucrose. Since sorbitol is resistant to tooth-decay bacteria, it is increasingly used in many "sugarless"

Figure 3

U.S. Uses of Sorbitol in 1992^{1/}



^{1/} Production and use in 1992 was 408 million pounds.

Source: Irshad Ahmed; Booz, Allen & Hamilton, Inc.; Bethesda, MD; October 1994.

products, such as sugarless gums and candies. Sorbitol also is used as bulking and flavoring agents. A more recent application is as a cryoprotectant (to maintain the structural integrity of frozen foods).

Vitamin C (ascorbic acid) production consumes about 15 percent of sorbitol supply. Before sorbitol was used to make Vitamin C, most of it was produced from petrochemical sources, with a small percentage extracted from natural citrus sources.

Sorbitol is esterified to produce a wide range of surfactants and related surface-active products. The major uses of sorbitol derivatives are as lubricant additives, softeners in textile manufacturing, plasticizers, antifog agents, antistatic agents, and components in dry cleaning fluids. Sorbitol-based surfactants are also used in food processing, cosmetics, and pharmaceuticals.

Sorbitol is being used to manufacture plastics and specialty plasticizers. For example, various polyethers are made from sorbitol. It is also used in the manufacture of polyol components of polyurethane resins and foams. Sorbitol has additional uses in the pharmaceutical industry as a stabilizer or sweetening agent for a number of drugs, like cough syrup. [John McClelland, (202) 501-6631; Irshad Ahmed, (301) 951-2060; and Allen Baker, (202) 219-0839]