# Corn

## Part of a Global Economy

Corn Refiners Association
Annual Report 2007

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# Corn Industry Statistics

# The Year in Review

Audrae Erickson
*President*
*Corn Refiners Association*

The United States is the largest corn producer in the world. This year, U.S. corn farmers maintained their distinction as the most abundant and reliable global supplier of corn by producing the largest crop on record ever.

Corn grown on American soil benefits consumers throughout the world in a variety of ways—from the golden kernels used to feed animals to the corn starch used in binding pharmaceuticals. Products from the corn refining industry touch human lives all over the globe by making thousands of foods, personal and health care items, home products and industrial goods possible.

### 2007 *Corn Annual*

This year's *Corn Annual* provides a glimpse of the importance of American corn to the global economy. Our featured guest author is well known to the corn refining industry and a respected veteran of agricultural policy and promotion. U.S. Department of Agriculture (USDA) Acting Secretary Charles F. Conner shares his thoughts on the impact of export markets for U.S. corn as they relate to price, availability and policy.

Corn Refiners Association Chairman James P. Zallie of National Starch and Chemical Company analyzes the patterns of exports of refined corn products over the past twenty years to provide insight into potential areas for market developments in the coming years.

Sakharam K. Patil, Ph.D., draws on his 30 years of experience in the industry to discuss the impact of technological advancements in refined corn products to help meet the needs of an expanding global population.

### Issues of Importance to the Industry

#### *Obesity*

The national debate on obesity involves an important health concern facing our nation and raises issues that deserve well-founded, science-based responses. Unfortunately, the media cover the subject of obesity with varying levels of expertise and depth that at times oversimplify the issue by attempting to single out specific food ingredients, including high fructose corn syrup (HFCS), as the sole or predominant cause of this multi-faceted societal problem.

The CRA employs a number of strategies to correct the record by providing science-based facts about HFCS. CRA's rapid response system for communicating with journalists and media outlets that mischaracterize HFCS has been effective in educating both the media and the public. Reports that provide inaccurate HFCS information appear to be declining, and we have begun seeing articles that defend HFCS as a safe and useful ingredient, consistent with the Food and Drug Administration's "Generally Recognized as Safe" or "GRAS" determination that was initially granted to HFCS in 1983.

Several studies published in peer-reviewed journals in 2007 have added further scientific support for our efforts to demonstrate the safety and value of HFCS. The February 2007 issue of *Nutrition*, for example, includes a study by Kathleen J. Melanson, et al. on the effects of HFCS and sucrose on circulating levels of glucose, leptin, insulin and ghrelin. The study found no differences in the metabolic effects of HFCS and sucrose. Similarly, Pablo Monsivais and colleagues at the University of Washington demonstrate that beverages sweetened with sucrose, HFCS and aspartame all have similar effects on satiety (feeling of fullness) in a study published in the July 2007 issue of the *American Journal of Clinical Nutrition*. The August 2007 issue of *Critical Reviews in Food Science and Nutrition* includes an expert review on HFCS and weight gain led by Richard Forshee, Ph.D., of the University of Maryland Center for Food, Nutrition, and Agriculture Policy. These experts found insufficient support for the notion that HFCS could play a unique causal role in obesity. The August 2007 issue of *Food and Chemical Toxicology* includes a study by Sam Sun and Mark Empie concluding that those who frequently consume sweetened soft drinks do not have a higher obesity rate than those who rarely drink them.

Proactive communication with dieticians, other health professionals and the journalists who cover this field is another component of CRA's engagement in the obesity debate. The

CRA had discussions with relevant professional groups at several conferences, including the American Dietetic Association, Institute of Food Technologists, School Nutrition Association and the North American Association for the Study of Obesity as well as numerous groups represented at the Experimental Biology conference.

CRA works closely with its Scientific Advisory Panel to assure that its communications with the public on the subject of obesity have a sound basis in the underlying science. CRA also interacts with a number of important allied organizations to present science-based, factual information concerning refined corn products.

### *Farm Bill*

How the U.S. sugar program is structured under the next Farm Bill is crucial to ensuring that the free trade promised under the North American Free Trade Agreement (NAFTA) is realized by January 1, 2008—not only for the corn refining industry, but for many other food and agricultural commodities as well. If any element of the sugar program restricts or otherwise negates free trade in sugar between the United States and Mexico, then corn sweeteners will pay a very steep price including loss of jobs to our industry. If the United States does not live up to its NAFTA commitments on sugar, we can be certain that Mexico will come under intense political pressure to nullify its NAFTA commitments for numerous high value U.S. exports.

The CRA worked diligently to ensure that the interests of the corn wet milling industry were taken into account in the House and Senate 2007 Farm Bills. Both the House and Senate legislation included unfettered access for Mexican sugar imported into the United States, ensured that managed bilateral trade of HFCS with Mexico was not permitted and guaranteed that any sugar for ethanol program would operate under a competitive bid arrangement by the USDA.

### *Trade*

As we have seen with the NAFTA and the Central American-Dominican Republic Free Trade Agreement (CAFTA-DR), unrestricted trade is an important tool in expanding export markets. While regional trade agreements are positive developments and strongly supported by the CRA, the best path for free trade is through global negotiations under the World Trade Organization (WTO). Talks are ongoing to finalize a framework agreement for the WTO Doha Development Agenda. Significant behind-the-scenes efforts continue to forge a breakthrough. The CRA supports a final WTO agreement that significantly opens new markets for refined corn products.

The House of Representatives recently approved a free trade deal with Peru and

## Shipments of Products of the Corn Refining Industry – 2006

| | |
|---|---|
| Starch Products *(includes corn starch, modified starch and dextrins)* | 6,541,956,000 |
| Refinery Products *(includes glucose syrup, high fructose syrup, dextrose, corn syrup solids, maltodextrins)* | 33,061,474,000 |
| High fructose corn syrup—42% | 10,290,837,000 |
| High fructose corn syrup—55%+ | 13,135,413,000 |
| Total HFCS | 23,426,250,000 |
| Total - Domestic Basic Products | 39,603,430,000 |
| Total - Export Basic Products | 2,540,965,000 |
| Corn oil *(crude and refined)* | 1,233,337,000 |
| Corn gluten feed and corn oil meal | 10,620,928,000 |
| Corn gluten meal | 2,645,418,000 |
| Steepwater | 1,413,841,000 |
| **TOTAL SHIPMENTS** | **58,057,919,000** |

*Compiled for the Corn Refiners Association by VERIS Consulting, LLC. Statistics represent shipments by members of the association. Shipments are in pounds, commercial weights, and do not include co-products derived from ethanol production.*

Senate ratification of the agreement is expected by the end of the year. The CRA urges Congress to secure quick passage of additional free trade agreements with Panama, Colombia and South Korea.

### *Biotechnology*

Corn refiners recognize the importance of biotechnology and embrace its use to ensure an abundant, affordable and safe global food supply for generations to come. Our industry, in coalition efforts with other food and agricultural organizations, is working hard to secure international acceptance of this important technology. Much work remains to be done, especially in key export markets such as the European Union.

Since the 2006 corn harvest, the U.S.-EU trade in corn gluten feed has fallen to a fraction of prior years' levels due to the presence of Herculex RootWorm (HRW) in the corn supply—a biotech corn variety that only recently gained approval for import into the European Union. Worldwide CGF exports are 40% of the previous years' volume.

The industry faces a nearly identical situation for feed produced from the 2007 corn crop because of the presence of two additional EU-unapproved corn varieties. CRA continues to cooperate with European feed compounders and importers' efforts to seek short and long-term solutions for science-based, timely approval of biotech events in Europe.

### *Regulatory Matters*

The CRA is working cooperatively with the Environmental Protection Agency to address concerns with a new air quality modeling tool, known as AERMOD, which is used to determine whether a proposed project will comply with air permitting requirements under the Clean Air Act. On this and another matter, an industry-wide protocol to measure volatile organic compounds (VOCs) emissions, the CRA has provided sound scientific information to not only meet existing regulatory requirements, but to improve upon them as well.

### Summary

The corn wet milling industry is a dynamic, innovative industry that is dedicated to providing high quality ingredients to facilitate a rapidly-growing, ever-changing global economy.

## U.S. Per Capita Sweetener Deliveries* for Food and Beverage Use

| Year | Refined Sugar | HFCS | Glucose | Dextrose | Honey & Edible Syrups | Total Caloric Sweeteners |
|---|---|---|---|---|---|---|
| | | *Corn Sweeteners (dry basis)* | | | | |
| 1970 | 101.8 | 0.5 | 10.7 | 4.6 | 1.5 | 119.1 |
| 1980 | 83.6 | 19.0 | 12.9 | 3.5 | 1.3 | 120.2 |
| 1990 | 64.4 | 49.6 | 13.6 | 3.6 | 1.2 | 132.4 |
| 2000 | 65.5 | 62.7 | 15.8 | 3.4 | 1.5 | 148.9 |
| 2001 | 64.5 | 62.6 | 15.5 | 3.3 | 1.4 | 147.3 |
| 2002 | 63.3 | 62.9 | 15.5 | 3.3 | 1.5 | 146.5 |
| 2003 | 61.0 | 61.0 | 15.2 | 3.1 | 1.4 | 141.7 |
| 2004 | 61.7 | 59.9 | 15.6 | 3.3 | 1.3 | 141.9 |
| 2005 | 63.2 | 59.2 | 15.3 | 3.3 | 1.5 | 142.5 |
| 2006 | 62.5 | 58.3 | 13.8 | 3.1 | 1.5 | 139.3 |

*Units Measured in Pounds*
*Source: USDA—Economic Research Service*
** Per capita deliveries of sweeteners by U.S. processors and refiners and direct-consumption imports to food manufacturers, retailers, and other end users represent the per capita supply of caloric sweeteners. Actual human intake of caloric sweeteners is lower because of uneaten food, spoilage, and other losses. Figures do not include deliveries to alcohol manufacturers.*

# U.S. Corn Exports Are Important to the Economy

As we look back on 2007, we will remember it as a banner year for corn. We broke new records this year in terms of production, price and use.

When I left the Corn Refiners Association in 2001, total U.S. agricultural exports were a respectable $53 billion. The corn crop that year was about 9.5 billion bushels and food, seed and industrial (FSI) uses for corn reached about 2 billion bushels, pushed by demand for corn sweeteners. Corn used for ethanol was at a "then" record of 680 million bushels and the price was about $2.00 per bushel.

Six years later, we are in an entirely new arena. In 2007, our exports are expected to reach a record $79 billion rising to $83.5 billion in 2008. The corn harvest is expected to total 13.3 billion bushels, a higher level than many economists thought possible for this country. Food, seed and industrial uses are estimated at 4.7 billion bushels, now pushed by domestic demand for ethanol. Of the FSI total, 3.2 billion bushels will go to produce ethanol. And the price is averaging a record $3.20 per bushel.

Another remarkable aspect of today's market is that corn exports have held their own. They are still quite strong at 2.3 billion bushels, despite the demand for ethanol. Corn exports alone account for $9.5 billion of this year's export total.

All of this has meant a higher cost of doing business for the corn refining industry. We know that 2008 is going to be an interesting year, and I want you to know that we are watching this market situation very, very closely in order to ensure that there are adequate supplies of the feed grains, food grains as well as energy stocks available for this rapidly growing marketplace. Producers have done their part by planting 19.5% more corn this year than last. But we recognize that we need to expand our horizons in terms of the development of home-grown renewable energy sources.

We want to help make cellulosic ethanol a practical and cost-effective alternative to both grain-based ethanol as well as an alternative to gasoline. That is going to require not only scientific breakthroughs, but innovative approaches to the logistical planning and infrastructure challenges that cellulosic ethanol brings. Ultimately, the development of cellulosic ethanol will ease the pressure on some of our corn supply, and a thriving renewable fuels industry will help us lighten the burden of $90-a-barrel oil. We must move away from our dependence on foreign oil,

*Charles F. Conner*
*Acting Secretary, U.S. Department of Agriculture*

## U.S. Corn Refining Industry at a Glance – 2006

| | |
|---|---|
| Corn Refining Plants: | 27 |
| Location: | 12 states |
| Corn Grind: | 1.6 billion bushels |
| Value of Corn Purchased: | $3.8 billion |
| Number of Corn Suppliers | 41,000 |
| Direct Employment by CRA Member Companies: | 65,300* |
| Capital Investment (Replacement Value): | $12 billion |
| **MAJOR PRODUCTS (estimated)** | |
| Sweeteners (dry weight): | 24.7 billion pounds |
| Starches: | 7.1 billion pounds |
| Ethanol: | 1.4 billion gallons |
| Co-products: | 27.9 billion pounds |
| Value Added by Manufacture: | $9.4 billion |

**Includes employees that provide services in non-corn refining areas.*
*Compiled by the Corn Refiners Association based on 2006 data from the U.S. Department of Agriculture, LMC Commodity Studies, Renewable Fuels Association, and industry data compiled for CRA by VERIS Consulting, LLC.*

especially that which comes from countries with terrorist regimes.

On another front, we are working hard to expand market access for our agricultural products. In my home state of Indiana, for example, 30% of what we raise goes into the international marketplace. Just imagine what our world would be like if all of a sudden that 30% had no where to go? In Indiana alone, that $2 billion of exports supports about 25,600 jobs, both on and off the farm, in food processing, storage and transportation.

Any new market access will simply add to that export total. And that's what we've been trying to achieve through the multilateral and bilateral processes. We will continue to urge other countries to match the ambition the U.S. has shown to bring the Doha Development Round to a successful conclusion.

In addition to multilateral negotiations, the Bush Administration has aggressively pursued new bilateral agreements. Four that are pending as I write this letter are agreements with Peru, Colombia, Panama and South Korea. If all are approved, we will gain duty free access to these growing markets with a combined population of about 75 million people and a GDP of about $575 billion.

Here at home, we are very focused on the 2007 Farm Bill. We have a tremendous opportunity to craft farm policy that supports American agriculture into the future. But the challenge now is not so much about next year because projections tell us next year is going to be a good year for agriculture. The challenge is crafting policy that will sustain this strength five and ten years down the road.

I firmly believe that the Administration's Farm Bill proposal is the answer. It reflects many of the suggestions we received during our 52 USDA Farm Bill Forums across the country. We propose investing $1.6 billion in renewable energy, $7.8 billion in conservation and providing support to beginning farmers. It strengthens the farm safety net and better targets support to real farmers instead of wealthy investors.

We will always have ups and downs in the agricultural economy, but we are seeking farm policy that will moderate those swings while allowing markets to put resources to their best use. We appreciate your contributions to this vibrant economy and your interest in public policy.

## Corn: Supply & Disappearance

| | SUPPLY | | | | DISAPPEARANCE | | | | | | ENDING STOCKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Year Beginning September 1 | Beginning Stocks | Production | Imports | Total | Food, Alcohol and Industrial | Seed | Feed and Residual | Total | Exports | Total Disappearance | Total |
| 1997/98 | 883.2 | 9,206.8 | 8.8 | 10,098.8 | 1,784.4 | 20.4 | 5,481.8 | 7,286.6 | 1,504.4 | 8,791.0 | 1,307.8 |
| 1998/99 | 1,307.8 | 9,758.7 | 18.8 | 11,085.3 | 1,826.5 | 19.8 | 5,467.8 | 7,314.1 | 1,984.2 | 9,298.3 | 1,787.0 |
| 1999/00 | 1,787.0 | 9,430.6 | 14.7 | 11,232.3 | 1,893.0 | 20.3 | 5,664.9 | 7,578.2 | 1,936.6 | 9,514.8 | 1,717.5 |
| 2000/01 | 1,717.5 | 9,915.1 | 6.8 | 11,639.4 | 1,937.6 | 19.3 | 5,842.1 | 7,799.0 | 1,941.3 | 9,740.3 | 1,899.1 |
| 2001/02 | 1,899.1 | 9,502.6 | 10.1 | 11,411.8 | 2,026.3 | 20.1 | 5,864.2 | 7,910.6 | 1,904.8 | 9,815.4 | 1,596.4 |
| 2002/03 | 1,596.4 | 8,966.8 | 14.5 | 10,577.7 | 2,320.2 | 20.0 | 5,562.9 | 7,903.1 | 1,587.9 | 9,491.0 | 1,086.7 |
| 2003/04 | 1,086.7 | 10,089.2 | 14.1 | 11,190.0 | 2,516.7 | 20.6 | 5,794.9 | 8,332.1 | 1,899.8 | 10,231.9 | 958.1 |
| 2004/05 | 958.1 | 11,807.1 | 10.8 | 12,776.0 | 2,666.1 | 20.8 | 6,157.1 | 8,844.0 | 1,818.1 | 10,662.0 | 2,114.0 |
| 2005/06 | 2,114.0 | 11,114.1 | 8.8 | 13,236.9 | 2,961.3 | 19.9 | 6,154.7 | 9,135.9 | 2,133.8 | 11,269.7 | 1,967.2 |
| 2006/07* | 1,967.2 | 10,534.9 | 12.0 | 12,514.0 | 3,464.3 | 23.6 | 5,597.7 | 9,085.6 | 2,124.7 | 11,210.3 | 1,303.8 |
| 2007/08** | 1,303.8 | 13,167.7 | 15.0 | 14,486.5 | 4,567.3 | 22.7 | 5,650.0 | 10,240.0 | 2,350.0 | 12,590.0 | 1,896.5 |

*Million Bushels*
*Source: USDA – Economic Research Service * Preliminary ** Projected*

# Refined Corn Products: Growing Markets Around the World

Take a look at the list of plant locations owned and operated by members of the U.S. corn refining industry and you will see a world of opportunity. Corn wet milling plants provide value added products to people throughout the world. While the U.S. corn refining industry is primarily a domestic supplier of ingredients and industrial inputs, many overseas markets have come to rely on the quality, value and availability of our products. Never satisfied with the status quo, the industry has long been a beacon of technological advancement in the area of product quality and development. Many of our overseas customers recognize this and choose U.S. refined corn products over alternatives.

Exports of refined corn products account for over 20% of total shipments—a healthy figure especially given the domestic nature of the industry. We saw an encouraging 13% increase in the value of exports of refined corn products in 2006 over the previous year. Exports during the first three quarters of 2007 were up 18% over the same period in 2006.

Tracking exports of refined corn products over the past twenty years provides a glimpse into the growth capacity of this segment of the industry's business. As the world's population grows and many areas experience increased economic prosperity, U.S. corn refiners are in a strong position to provide the ingredients to enable regional food and beverage manufacturers to meet the increasing sophistication of consumer needs and palates. Additionally, refined corn products are essential to a number of industrial products that will see increased demand as economies expand.

## Exports: The Ups and Downs

Exports of refined corn products saw a healthy rate of growth in the late 1980s and most of the 1990s (see page 8). The average annual rate of growth during this period was 6%. Then in the late 1990s, we began to see a decline in exports. Much of this can be attributed to a decrease in exports to the European Union.

For many years, U.S. corn refiners were exporting about 5 million tons of corn gluten feed to Europe annually under a zero-duty binding negotiated in the 1960s. We began to see this market shrink when tensions between the European Union and the United States increased over biotech corn varieties. While the U.S. quickly embraced the new technology, the European Union was much slower to do so and imposed restrictions on the types of corn that could be imported. Refined corn feed product exports to the European Union dropped to 2.24 million metric tons in 2006 from 5 million metric tons ten years earlier, a decline of $474 million.

The barriers to biotech corn in the European Union have had the greatest impact on feed products, but we have seen a reduction in markets for all refined corn products to the European Union. In October 2007, the European Union authorized three biotech corn varieties for import increasing the list of approved varieties to 10 for food use and 14 for feed use. These are the first approvals since the European Union ended a six-year moratorium on new biotech products in 2004.

However, the European Union is facing a significant shortage of feed products due to natural disasters that significantly reduced regional production. It is estimated that Europe will need 17 to 18 million metric tons of feed grains next year. The slow pace of approvals of new biotech varieties threatens to turn the European Union into a net meat importing region of the world as early as 2009 given this projected feed shortage.

## Regional Trade Agreements

Regional trade agreements have been and will be a significant factor in expanding export markets. Exports of refined corn products to the Western Hemisphere should increase significantly due to implementation of the United States-Central American-Dominican Republic Free Trade Agreement (CAFTA-DR). Tariffs on corn starch, corn oil, glucose and dextrose, and corn gluten feed and meal were eliminated when CAFTA-DR was implemented in 2005. Exports to CAFTA-DR countries increased nearly 60% between 2005 and 2006 to about $36 million. If the first three quarters of 2007 are indicative of the expected growth rate for 2007, again we will

*James P. Zallie*
*Chairman of the Board*
*Corn Refiners Association*

*Group Vice President,*
*National Starch and*
*Chemical Company*

see a better-than-50% increase in exports of refined corn products to this region this year.

It is hoped that Congress will further boost U.S. food and agricultural exports by ratifying agreements with Peru, Colombia, Panama and South Korea. While the House has passed the agreement with Peru, Senate passage must be secured to implement it. When the Peru FTA becomes effective, tariffs on corn gluten feed and meal will be reduced to zero. Duties on other corn products, including corn oil, corn sweeteners and corn starch will be phased out over the life of the agreement. U.S. exports of refined corn products to Peru have averaged $830,000 over the past five years, but are expected to increase significantly under the deal.

Since the North American Free Trade Agreement (NAFTA) was implemented, exports of refined corn products to Canada have increased two and a half times from a value of about $71 million to $178 million. And while corn sweetener exports were hampered for several years due to a longstanding sweetener dispute, overall exports to Mexico of refined corn products have nearly doubled since the passage of the NAFTA in 1994 from about $118 million to $237 million.

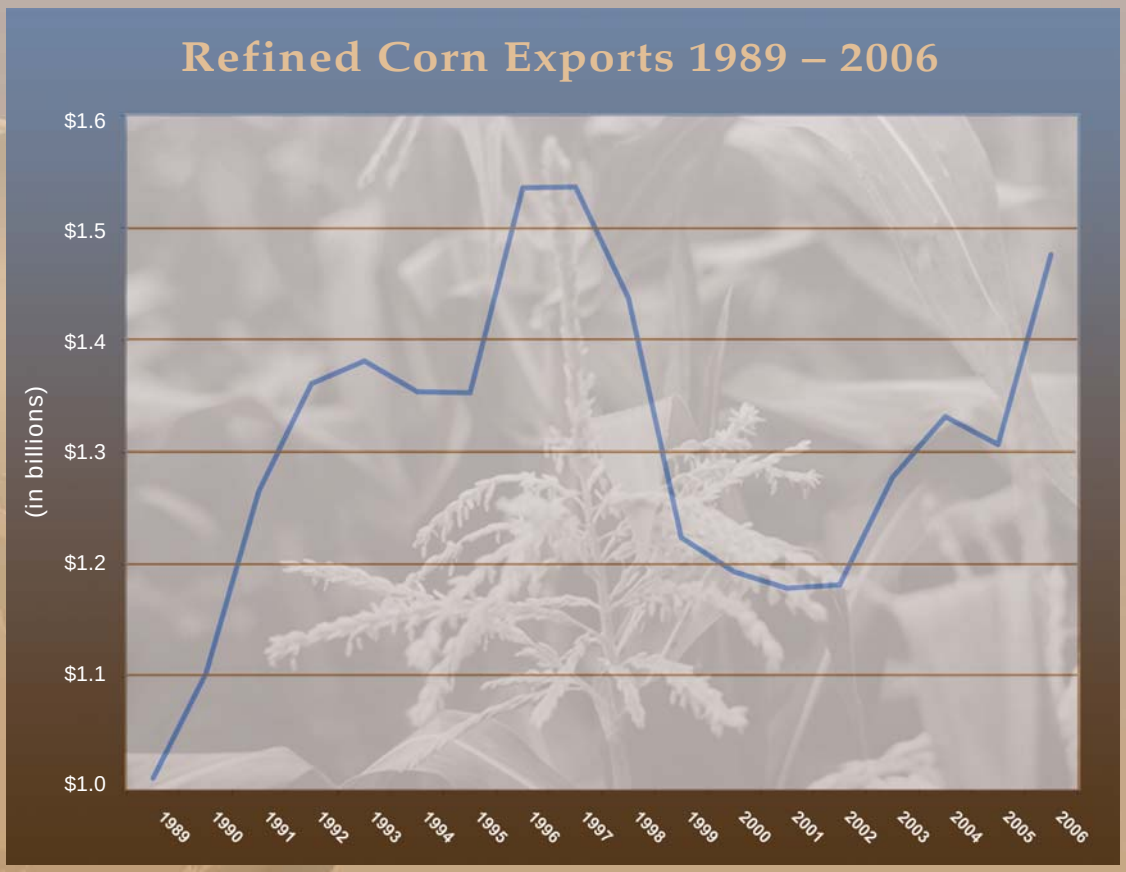
## Value of the Dollar

The decline of the value of the U.S. dollar against the Euro and major international currencies in Asia will continue to bode well for exports of U.S. refined corn products. Even though the rise in the price of corn has led to an increase in prices for refined corn products, importing countries find U.S. exports attractive due to the relative value of the dollar.

U.S. farm exports as a whole are growing exponentially. This year they are at a record $79 billion, up more than $25 billion from five years earlier. The U.S. Department of Agriculture has raised its projection of U.S. agricultural exports for the year 2015 from $84 billion to $93 billion.

## Global Developments

When taking a look at potential export markets poised for growth, China must be considered. The rate of growth of China's own corn refining industry has been phenomenal. In



2001, China's corn refiners had a capacity of 2.8 million tons. It is estimated that China's corn refining capacity will reach 24.5 million tons this year, which is about 20% of the country's corn production. The industry has evolved at such a swift pace that the government has imposed restrictions on any new or planned construction. Through 2010, the Chinese government has set a limit on the proportion of national corn output that can be processed to 26%.

Over the past 10 years, the value of U.S. refined corn exports to China has increased significantly, from about $8.5 million in 1996 to nearly $29.5 million in 2006. China does have a strong corn refining industry and nearby reliable suppliers of starch (tapioca starch from Thailand and Vietnam). However, food costs in China are surging and the Chinese government is determined to control food inflation for social stability and managed growth. If China's corn refining industry cannot sustain growth and locally produced food inflation bites consumers, the Chinese government will intervene by subsidizing imports of refined corn products from the United States. Given the rate at which the Chinese economy is growing, opportunities to grow this export market are apparent.

## Outlook

The outlook for growth in refined corn exports is positive due to a number of factors. The U.S. industry has a stable supply of high quality corn—a critical factor in the productivity of corn wet millers, the quality of our products and the ability to meet customer demand. Our industry continues to invest in product development to meet the needs of our customers, both domestic and international. Regional free trade agreements reduce barriers and present real opportunities for export growth. The value of the U.S. dollar makes exports of high-quality products exceptionally attractive to countries shopping for ingredients to increase the quality of their food supply. These factors, combined with the economic and population growth expected in many parts of the world, present a clear signal that exports of the U.S. corn refining industry are headed up.

## World Corn Production, Consumption & Stocks

| PRODUCTION | 2005/06 | 2006/07 |
|---|---|---|
| Argentina | 15,800 | 22,500 |
| Brazil | 41,700 | 51,000 |
| Canada | 9,361 | 8,990 |
| China | 139,365 | 145,480 |
| Egypt | 5,932 | 5,940 |
| Ethiopia | 4,000 | 5,000 |
| EU-27 | 61,153 | 54,647 |
| India | 14,710 | 14,980 |
| Indonesia | 6,500 | 6,700 |
| Mexico | 19,500 | 22,000 |
| Nigeria | 7,000 | 7,800 |
| Philippines | 5,884 | 6,230 |
| Republic of South Africa | 6,935 | 6,700 |
| Ukraine | 7,150 | 6,400 |
| Vietnam | 3,818 | 4,312 |
| Others | 65,245 | 67,169 |
| United States | 282,311 | 267,598 |
| TOTAL | 696,364 | 703,446 |
| **CONSUMPTION** | | |
| Argentina | 6,200 | 6,700 |
| Brazil | 39,500 | 41,000 |
| Canada | 10,837 | 11,436 |
| China | 137,000 | 143,000 |
| Egypt | 10,100 | 10,500 |
| EU-27 | 61,500 | 61,100 |
| India | 14,200 | 14,600 |
| Indonesia | 7,900 | 7,900 |
| Japan | 16,700 | 16,500 |
| Republic of Korea | 8,579 | 8,833 |
| Mexico | 27,900 | 30,300 |
| Nigeria | 6,800 | 7,600 |
| Philippines | 5,800 | 6,300 |
| Republic of South Africa | 8,200 | 8,600 |
| Ukraine | 5,100 | 5,250 |
| Others | 104,189 | 108,509 |
| United States | 232,063 | 230,783 |
| TOTAL | 704,029 | 721,482 |
| **ENDING STOCKS** | | |
| Brazil | 3,015 | 4,215 |
| Canada | 2,001 | 1,343 |
| China | 35,255 | 32,482 |
| EU-27 | 9,934 | 9,831 |
| Iran | 1,313 | 1,713 |
| Mexico | 2,707 | 3,207 |
| Republic of South Africa | 2,308 | 1,308 |
| Others | 16,518 | 17,767 |
| United States | 49,968 | 33,117 |
| TOTAL | 123,019 | 104,983 |

*Source: USDA, Foreign Agricultural Service*
*Based on local marketing years in thousands of metric tons.*

# A Global Outlook for Refined Corn Products

*Sakharam K. Patil, Ph.D.*
*President, S.K. Patil & Associates*

Thomas L. Friedman, author of "The World is Flat: A Brief History of the Twenty First Century," theorized that we inhabit a "flat" world where globalization has leveled the playing field between industrial and emerging market countries for efficient economical and technological transformation. This has created unprecedented growth opportunities for the economic and industrial infrastructure around the world. When I left India in the late 1960s, the country was in a dismal state with per capita income of approximately 50 dollars per year with very little hope for a rural boy such as myself. However, today I have seen change in every field and economic structure. According to Forbes, India's GDP has surpassed 1 trillion dollars and the gross purchasing power is greater than 3 trillion dollars growing at a rate of 9% annually. The immigrants who came for new opportunities from India to the United States are now participating in a reverse migration.

My personal story aside, the emerging power of high income segments of China, India and other parts of world has created enormous demands for energy, consumer and industrial products to meet the needs of higher standards of living that call for convenience and comfort only available so far to the western developed world. Broad-based economic growth resulting from rising incomes, rapid urbanization and relatively high population growth result in a higher propensity to consume in the developing markets, where changes in dietary habits are leading to demands on processed foods and industrial products. The corn refining industry is poised to be at the forefront of this change.

## Biorefineries: An Important Link in the Global Economy

Biobased products from corn using corn wet milling technology and other similar bioprocess technologies from renewable plant and ocean sources have the most promising growth potential globally. The most striking examples are ethanol for fuel and food sweeteners. Besides theses high volume commodity products, corn refining plants are highly sophisticated bioprocess operations that produce a range of products such as citric acids, lactic acids, amino acids, xanthan gums, polyols and a variety of other products. In addition, corn refiners have the ability to produce a number of items that help reduce our dependence on petroleum-based products such as 1,3 propendiol (PDO) a monomer for 3 GT used to create synthetic fiber, polylactic acid (PLA) used to make biodegradable film to replace plastic film and plyhydroxyalkanoates (PHAs), which are polymers that can be formed much like traditional plastic. There will be many more to come as the science matures.

Carbohydrate-based products have the potential to improve the sustainability of natural resources, environmental quality and national security while competing economically to expand the U.S. and world industrial base. Biobased products have a wide range of uses in energy and intermediate chemicals for food, industrial, consumer and pharmaceutical applications. Agricultural producing rural areas are well positioned to support regional processing facilities dependent on locally grown crops.

Corn refineries possess the qualities to comprise the front end of an industrial complex that produces food, specialty chemicals, industrial products, fuels and pharmaceuticals. Such an expanded biorefinery would provide cleaner and more economical processes for producing existing products, new intermediates for manufacturing new products and an expanded stable market for wet millers and for corn farmers. A large corn wet-milling plant with its own steam and electric cogeneration station can form the nucleus for several other plants. The wet mill is the source of materials for plants that produce industrial enzymes, organic acids, amino acids and ethanol. The enzymes are then used to convert starch to lower molecular-weight products, principally various maltodextrins and syrups. The organic acids are used in processed foods, detergents and polymers. The amino acids are used as feed and food supplements and, in the case of phenylalanine, to make aspartame. The ethanol is used as a fuel or an industrial solvent.

## Factors That Will Impact Growth of the Industry

The recent growth of the corn wet milling industry has slowed in the United States compared to the frantic pace in the 1980s when food and beverage manufacturers were discovering the benefits of high fructose corn syrup and ethanol began to replace MTBE. While ethanol production is currently growing faster than other product segments, it is the food and pharmaceutical markets that are expected to be the most important to the corn refining industry in the United States.

Globally, Asia, Eastern Europe and South America are growing at a fast pace, which is expected to continue for the next several years. In these regions, food as well as industrial products will be important growth markets for refined corn products. Asia will be the largest growth area due to its sheer population size. The most surprising development has been the growth of the paper industry in China with very limited forest resources. China's paper industry growth was born out of imported recycled fiber, but now plantations will fuel the paper and corrugating industry expansion. U.S. corn refiners are in a good position to utilize their technological advantage and participate in the global growth for food and industrial products.

### *Health and Nutrition*

The worldwide obesity epidemic has become a major health concern along with diabetes. Unfortunately, carbohydrates are frequently, and erroneously, uniquely blamed for both. Another major health issue is gut health, an area of science which focuses on the promotion of the normal function of the gastrointestinal tract and the prevention of serious diseases in the long term.

Great opportunities exist for corn refiners to offer solutions to the problem by developing starches that offer low or slow digestibility and

## Corn: Food & Industrial Uses

| Year | HFCS | Glucose & Dextrose | Starch | Fuel Alcohol | Beverage Alcohol | Cereals & Other Products | Total |
|---|---|---|---|---|---|---|---|
| 1990 | 379 | 200 | 219 | 349 | 135 | 124 | 1,406 |
| 1991 | 392 | 210 | 225 | 398 | 161 | 128 | 1,514 |
| 1992 | 415 | 214 | 218 | 426 | 136 | 129 | 1,538 |
| 1993 | 441 | 219 | 225 | 458 | 110 | 140 | 1,593 |
| 1994 | 459 | 224 | 230 | 533 | 100 | 150 | 1,696 |
| 1995 | 473 | 227 | 226 | 396 | 125 | 161 | 1,608 |
| 1996 | 492 | 233 | 238 | 429 | 130 | 172 | 1,694 |
| 1997 | 513 | 229 | 246 | 481 | 133 | 182 | 1,784 |
| 1998 | 530 | 219 | 240 | 526 | 127 | 184 | 1,826 |
| 1999 | 540 | 222 | 251 | 566 | 130 | 185 | 1,894 |
| 2000 | 530 | 218 | 247 | 628 | 130 | 185 | 1,938 |
| 2001 | 541 | 217 | 246 | 706 | 131 | 186 | 2,027 |
| 2002 | 532 | 219 | 256 | 996 | 131 | 187 | 2,321 |
| 2003 | 530 | 228 | 271 | 1,168 | 132 | 187 | 2,516 |
| 2004 | 521 | 222 | 279 | 1,323 | 133 | 189 | 2,667 |
| 2005 | 529 | 229 | 275 | 1,603 | 135 | 190 | 2,961 |
| 2006 | 510 | 239 | 272 | 2,117 | 136 | 190 | 3,464 |
| 2007 | 515 | 243 | 280 | 3,200 | 137 | 193 | 4,568 |

*In million bushels*

*Source: USDA - Economic Research Service. Year beginning Sept. 1.*

low glycemic response to combat obesity and diabetes. The World Health Organization estimates globally there were 1.6 billion adults overweight in 2005 and at least 400 million were obese. The WHO further projects that by 2015, 2.3 billion adults will be overweight and more than 700 million will be obese globally.

Starch is generally classified as rapidly digestible (RDS), slowly digestible (SDS) and resistant starch (RS). Development of SDS has drawn attention due to its benefits in controlled and sustained release of glucose into the blood stream. This is important for people with Type II diabetes who suffer from inconsistent insulin response after consumption of readily digestible starch.

RS escapes digestion in the small intestine, is insoluble, is fermented in the large intestine and is a prebiotic fiber, providing some of the health benefits of both soluble and insoluble fiber. As a prebiotic fiber, RS selectively increases beneficial bacteria for maintaining or improving digestive health. RS can be used in food and beverages for diabetics to effectively reduce serum blood glucose and insulin levels. Recent studies also suggest that RS may increase fat oxidation after a meal, an important tool in weight management.

Opportunities for developing economic sources and main stream applications of RS and SDS remain attractive. The challenge for corn refiners, grain/flour and tuber processors, is to incorporate RS and SDS properties into grain and flour as mainstream large volume commodities to offer solutions world wide. Obesity and diabetes in the United States and abroad cannot be solved by offering niche high price ingredients. Advancement in the knowledge of genetic control of starch synthesizing enzymes and their biosynthetic pathways can improve mainstream commodities such a grains, flour, syrups and starches and can create tremendous opportunities for refined corn products.

### *Biotechnology*

Biotechnology holds great promise to enhance our lives and the planet. With a world population expected to reach nearly nine billion by 2050, biotechnology offers new potential for sustainable living, healthy eating and battling diseases while reducing our footprint on the planet. Genetic engineering and plant breeding techniques permit the redesign of crops for easier processing and creation of new types of raw materials. Source plants can be modified or selected for characteristics that enhance their conversion to useful industrial products. Through genetic engineering, plant cellular processes and components can be altered in ways that increase the value or uses of the modified crop. This capability has no parallel in petroleum-based feedstock systems and is a major advantage of biobased industrial products.

There are developments under way via genomic routes to create starch with properties similar to chemically modified starches eliminating the need for chemical modifications. One example is starch with high monophosphate that can enhance viscosity, film forming and other novel functions for food, paper and adhesive applications. Similar developments can produce encapsulation and emulsification properties for starches to be used in controlled delivery of drugs, skin care and many similar applications.

### Future Outlook

Biorefineries to convert corn into a myriad of value added products have to follow a petrochemical business and operating model to economically produce several products efficiently. There are parallels between the petroleum refineries and corn wet milling. Petroleum refineries invariably produce more and more products from the same feedstock over time, thereby diversifying outputs; refineries are flexible and can shift outputs in response to market needs, processes in refineries improve incrementally over time; and process improvement invariably makes the cost of raw material the dominant factor in overall system economics.

Corn wet mill operations have a single feed stock, corn. Product selection is based on market demand, availability of feed stock, processing equipment and process engineering

# Corn for Grain: Yield and Production

| State | AREA HARVESTED Thousand Acres | | | YIELD Bushel Per Acre | | | PRODUCTION Thousand Bushels | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2004 | 2005 | 2006 | 2004 | 2005 | 2006 | 2004 | 2005 | 2006 |
| AL | 195 | 200 | 165 | 123 | 119 | 72 | 23,985 | 23,800 | 11,880 |
| AZ | 27 | 22 | 18 | 180 | 195 | 170 | 4,860 | 4,290 | 3,060 |
| AR | 305 | 230 | 180 | 140 | 131 | 146 | 42,700 | 30,130 | 26,280 |
| CA | 150 | 110 | 110 | 175 | 172 | 165 | 26,250 | 18,920 | 18,150 |
| CO | 1,040 | 950 | 860 | 135 | 148 | 156 | 140,400 | 140,600 | 134,160 |
| DE | 153 | 154 | 161 | 152 | 143 | 145 | 23,256 | 22,022 | 23,345 |
| FL | 32 | 28 | 30 | 90 | 94 | 82 | 2,880 | 2,632 | 2,460 |
| GA | 280 | 230 | 225 | 130 | 129 | 112 | 36,400 | 29,670 | 25,200 |
| ID | 75 | 60 | 65 | 170 | 170 | 170 | 12,750 | 10,200 | 11,050 |
| IL | 11,600 | 11,950 | 11,150 | 180 | 143 | 163 | 2,088,000 | 1,708,850 | 1,817,450 |
| IN | 5,530 | 5,770 | 5,380 | 168 | 154 | 157 | 929,040 | 888,580 | 844,660 |
| IA | 12,400 | 12,500 | 12,350 | 181 | 173 | 166 | 2,244,400 | 2,162,500 | 2,050,100 |
| KS | 2,880 | 3,450 | 3,000 | 150 | 135 | 115 | 432,000 | 465,750 | 345,000 |
| KY | 1,140 | 1,180 | 1,040 | 152 | 132 | 146 | 173,280 | 155,760 | 151,840 |
| LA | 410 | 330 | 290 | 135 | 136 | 140 | 55,350 | 44,880 | 40,600 |
| MD | 425 | 400 | 425 | 153 | 135 | 142 | 65,025 | 54,000 | 60,350 |
| MI | 1,920 | 2,020 | 1,960 | 134 | 143 | 147 | 257,280 | 288,860 | 288,120 |
| MN | 7,050 | 6,850 | 6,850 | 159 | 174 | 161 | 1,120,950 | 1,191,900 | 1,102,850 |
| MS | 440 | 365 | 325 | 136 | 129 | 110 | 59,840 | 47,085 | 35,750 |
| MO | 2,880 | 2,970 | 2,630 | 162 | 111 | 138 | 466,560 | 329,670 | 362,940 |
| MT | 15 | 17 | 18 | 143 | 148 | 146 | 2,145 | 2,516 | 2,628 |
| NE | 7,950 | 8,250 | 7,750 | 166 | 154 | 152 | 1,319,700 | 1,270,500 | 1,178,000 |
| NJ | 72 | 62 | 64 | 143 | 122 | 129 | 10,296 | 7,564 | 8,256 |
| NM | 58 | 55 | 45 | 180 | 175 | 185 | 10,440 | 9,625 | 8,325 |
| NY | 500 | 460 | 480 | 122 | 124 | 129 | 61,000 | 57,040 | 61,920 |
| NC | 740 | 700 | 740 | 117 | 120 | 132 | 86,580 | 84,000 | 97,680 |
| ND | 1,150 | 1,200 | 1,400 | 105 | 129 | 111 | 120,750 | 154,800 | 155,400 |
| OH | 3,110 | 3,250 | 2,960 | 158 | 143 | 159 | 491,380 | 464,750 | 470,640 |
| OK | 200 | 250 | 220 | 150 | 115 | 105 | 30,000 | 28,750 | 23,100 |
| OR | 28 | 25 | 29 | 170 | 160 | 180 | 4,760 | 4,000 | 5,220 |
| PA | 980 | 960 | 960 | 140 | 122 | 122 | 137,200 | 117,120 | 117,120 |
| SC | 295 | 285 | 290 | 100 | 116 | 110 | 29,500 | 33,060 | 31,900 |
| SD | 4,150 | 3,950 | 3,220 | 130 | 119 | 97 | 539,500 | 470,050 | 312,340 |
| TN | 615 | 595 | 500 | 140 | 130 | 125 | 86,100 | 77,350 | 62,500 |
| TX | 1,680 | 1,850 | 1,450 | 139 | 114 | 121 | 233,520 | 210,900 | 175,450 |
| UT | 12 | 12 | 17 | 155 | 163 | 157 | 1,860 | 1,956 | 2,669 |
| VA | 360 | 360 | 345 | 145 | 118 | 120 | 52,200 | 42,480 | 41,400 |
| WA | 105 | 80 | 75 | 200 | 205 | 210 | 21,000 | 16,400 | 15,750 |
| WV | 29 | 28 | 26 | 131 | 109 | 120 | 3,799 | 3,052 | 3,120 |
| WI | 2,600 | 2,900 | 2,800 | 136 | 148 | 143 | 353,600 | 429,200 | 400,400 |
| WY | 50 | 49 | 45 | 131 | 140 | 129 | 6,550 | 6,860 | 5,805 |
| **US** | **73,631** | **75,107** | **70,648** | **160.4** | **147.9** | **149.1** | **11,807,086** | **11,112,072** | **10,534,868** |

*AK, CT, HI, ME, MA, NV, NH, RI, VT not estimated*

*Source: USDA - National Agricultural Statistics Service*

to operate efficiently and cost effectively. Continuous process improvements are essential to operate efficiently where the cost of raw material remains a dominant factor. The benefits of some of these biobased products are well known (e.g., enzymes). At the same time, rapid advances occurring in the life and materials sciences will lead to discoveries of plant compounds that cannot be produced with petroleum feed stocks. Industry will vigorously pursue the most promising candidates for further development and commercialization.

Plant sizes and scale of operations in new developing economies are small and inefficient. U.S. companies have started investing in these regions with more efficient operations and technologies. Opportunities for biotechnology will remain strong, especially to create novel technologies using biosynthetic pathways and to create new carbohydrate polymers to meet the demands of global and demographic changes outside western societies.

Refined corn ingredients can meet the needs of health conscious and convenience driven segments of large populations in Asia, South America and Africa. The U.S. corn refining industry has the expertise, technologies and the ability to produce new products for food, nutrition and industrial applications to capture the opportunities worldwide.

*Dr. Patil has more than 30 years of experience in quality assurance, research, product development, marketing and technology transfer in the corn wet milling industry.*

## Exports of Products From Corn – 2006

| Product | 2006 | Units | Value |
|---|---|---|---|
| Corn meal | 369,632,350 | Kilograms | $69,945,550 |
| Corn starch | 134,507,439 | Kilograms | $60,258,587 |
| Corn oil, crude | 188,885,189 | Kilograms | $120,361,561 |
| Corn oil, once refined | 11,192,051 | Kilograms | $10,626,957 |
| Corn oil, fully refined | 157,044,857 | Kilograms | $115,174,303 |
| Glucose (dextrose) | 100,947,361 | Kilograms | $52,161,822 |
| Glucose syrup not containing fructose or containing in the dry state less than 20% fructose | 294,960,186 | Kilograms | $86,373,598 |
| Glucose syrup with 20-50% fructose | 70,295,696 | Kilograms | $19,123,253 |
| Chemically pure fructose | 98,704,359 | Kilograms | $73,046,366 |
| Fructose syrup with 50%+ fructose | 384,422,697 | Kilograms | $102,549,362 |
| Fructose solids containing more than 50% fructose | 7,595,186 | Kilograms | $24,805,540 |
| Bran, sharps and other residues | 143,973 | Metric tons | $16,967,702 |
| Corn gluten feed | 2,387,836 | Metric tons | $231,316,148 |
| Corn gluten meal | 924,055 | Metric tons | $292,034,892 |
| Other residues of starch manufacturing | 243,625 | Metric tons | $28,784,509 |
| Corn oil cake | 10,309,715 | Kilograms | $1,262,616 |
| Dextrins | 25,391,455 | Kilograms | $19,525,735 |
| Modified starches derived from corn starch | 209,053,043 | Kilograms | $151,989,595 |

*Source: U.S. Department of Commerce*

# Corn Refiners Association Member Company Products

| | Archer Daniels Midland Company | Cargill, Incorporated | Corn Products International, Inc. | National Starch and Chemical Company | Penford Corporation | Roquette America, Inc. | Tate & Lyle Ingredients Americas, Inc. |
|---|---|---|---|---|---|---|---|
| **STARCH PRODUCTS** | | | | | | | |
| Unmodified, food | ● | ● | ● | ● | ● | ● | ● |
| Unmodified, industrial | ● | ● | ● | ● | ● | ● | ● |
| Modified, food | | ● | ● | ● | ● | ● | ● |
| Modified, industrial | ● | ● | ● | ● | ● | ● | ● |
| Dextrins | ● | ● | ● | ● | ● | ● | ● |
| Cyclodextrins | | | | | | ● | |
| **REFINERY PRODUCTS** | | | | | | | |
| Glucose syrups | ● | ● | ● | | ● | ● | ● |
| Maltodextrins | ● | ● | ● | | ● | ● | ● |
| Dextrose monohydrate | ● | ● | ● | | ● | ● | ● |
| Dextrose anhydrous | | ● | ● | | | ● | |
| HFCS-42 | ● | ● | ● | | | ● | ● |
| HFCS-55 | ● | ● | ● | | | ● | ● |
| Crystalline fructose | ● | | | | | | ● |
| **CO-PRODUCTS** | | | | | | | |
| Crude Oil | ● | ● | ● | | | | |
| Refined Oil | ● | ● | ● | | | | |
| Corn gluten feed | ● | ● | ● | ● | ● | ● | ● |
| Corn gluten meal | ● | ● | ● | ● | ● | ● | ● |
| Corn germ or corn germ meal | ● | ● | ● | ● | ● | ● | ● |
| Steepwater (CFCE) | ● | ● | ● | ● | ● | ● | ● |
| Carbon dioxide | ● | | | | | | ● |
| **FERMENTATION AND OTHER CHEMICALS** | | | | | | | |
| Citric acid | ● | ● | | | | | ● |
| Lactic acid | ● | ● | | | | | |
| Lysine | ● | | | | | | |
| Threonine | ● | | | | | | |
| Xanthan gum | ● | ● | | | | | ● |
| Erythritol | | ● | | | | | |
| Sorbitol | ● | ● | ● | | | ● | |
| Xylitol | | | | | | ● | |
| Mannitol | ● | ● | | | | ● | |
| Maltitol | ● | ● | | | | ● | |
| Hydrogenated starch hydrolysates | | | | | | ● | |
| Glucose hydrolysates | | | | | | ● | |
| **OTHER** | | | | | | | |
| Ethanol, fuel/industrial | ● | ● | | | | | ● |
| Ethanol, beverage | ● | | | | | | |

*Product lists are accurate as of publication date, but may change with time.*
*Also available online at http://www.corn.org/memberproductlines.htm.*

# Corn Refiners Association Member Company Domestic and International Plant Locations

## Archer Daniels Midland Company

P.O. Box 1470
Decatur, Illinois 62525

***Domestic Plants:***

Cedar Rapids, Iowa 52404
Clinton, Iowa 52732
Columbus, Nebraska 68601
Decatur, Illinois 62525
Marshall, Minnesota 56258-2744

***International Plant:***

Guadalajara, Jalisco, Mexico

## Cargill, Incorporated

P.O. Box 5662/MS62
Minneapolis, Minnesota 55440-5662

***Domestic Plants:***

Blair, Nebraska 68008-2649
Cedar Rapids, Iowa 52406-2638
Dayton, Ohio 45413-8001
Decatur, Alabama 35601
Eddyville, Iowa 52553-5000
Hammond, Indiana 46320-1094
Memphis, Tennessee 38113-0368
Wahpeton, North Dakota 58075

***International Plants:***

Uberlandia, Minas Gerais, Brazil
Song Yuan, China
Haubourdin, Pas-de-Calais, France
Krefeld, Nordrhein-Westfalen, Germany
Castelmassa, Veneto, Italy
Martorell, Barcelona, Spain
Efremov, Tula, Russia
Bergen Op Zoom, Noord-Brabant, The Netherlands
Sas van Gent, Zeeland, The Netherlands
Orhangasi, Bursa, Turkey
Manchester, England, United Kingdom

## Corn Products International, Inc.

5 Westbrook Corporate Center
Westchester, Illinois 60154

***Domestic Plants:***

Bedford Park, Illinois 60501-1933
Stockton, California 95206-0129
Winston-Salem, North Carolina 27107

***International Plants:***

Cardinal, Ontario, Canada
London, Ontario, Canada
Port Colborne, Ontario, Canada
Guadalajara, Jalisco, Mexico
San Juan del Rio, Queretaro, Mexico
Tlalnepantla, Mexico State, Mexico
Baradero, Buenos Aires, Argentina
Chacabuco, Buenos Aires, Argentina
Balsa Nova, Parana, Brazil
Cabo, Pernambuco, Brazil
Mogi-Guacu, Sao Paulo, Brazil
Llay-Llay, Valparaiso, Chile
Cali, Valle del Cauca, Colombia
Lima, Peru
Eldoret, Rift Valley, Kenya
Icheon, Kyungigi-do, South Korea
Incheon, Bupyong-ku, South Korea
Faisalabad, Punjab, Pakistan
Cornwala, Punjab, Pakistan

## National Starch and Chemical Company

10 Finderne Avenue
Bridgewater, New Jersey 08807-0500

***Domestic Plants:***

Indianapolis, Indiana 46221
North Kansas City, Missouri 64116

***International Plants:***

Trombudo Central, Brazil
Hamburg, Germany

## Penford Products Co.

(A company of Penford Corporation)
P.O. Box 428
Cedar Rapids, Iowa 52406-0428

***Domestic Plant:***

Cedar Rapids, Iowa 52404-2175

***International Plants:***

Lane Cove, Sydney, Australia
Onehunga, Auckland, New Zealand

## Roquette America, Inc.

1417 Exchange Street
P.O. Box 6647
Keokuk, Iowa 52632-6647

***Domestic Plant:***

Keokuk, Iowa 52632-6647

***International Plants:***

Lestrem, Pas-de-Calais, France
Beinheim, Bas-Rhin, France
Cassano Spinola, Alessandria, Italy
Benifayo, Valencia, Spain
Calafat, Dolj, Romania

## Tate & Lyle Ingredients Americas, Inc.

(A subsidiary of Tate & Lyle, PLC)
P.O. Box 151
Decatur, Illinois 62525

***Domestic Plants:***

Decatur, Illinois 62521
Fort Dodge, Iowa 50501
Lafayette, Indiana 47902
Lafayette, Indiana 47905
Loudon, Tennessee 37774

***International Plant:***

Guadalajara, Jalisco, Mexico

## Honorary Directors

**Martin Andreas**
*Archer Daniels Midland Company*

**Fred M. Ash**
*Cerestar USA, Inc.*

**C.G. Caldwell**
*National Starch and Chemical Company*

**Paul E. Grunder**
*CPC International Inc.*

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**John Rice**
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CORN REFINERS ASSOCIATION

Corn Refiners Association • 1701 Pennsylvania Ave., N.W. • Suite 950 • Washington, D.C. 20006-5805
tel. (202) 331-1634 • fax (202) 331-2054 • www.corn.org
www.HFCSfacts.com