

Made in America:

Corn Refined Products Help U.S. Industries Thrive

Corn Refiners Association 2012 Annual Report



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Foreword

Audrae Erickson, President, Corn Refiners Association



For generations, refined corn has been a primary ingredient in thousands of products used by American consumers. From the corn starch first produced generations ago to the syrups, oils, animal feed ingredients, plastics and numerous other products made from the corn refining process today, these “made in America” staples have fueled economic activity in our country since pre-revolutionary times.

The positive economic impacts generated by the corn refining industry are vast. From greater economic strength in rural and urban cities, to well-paying jobs across America, the corn refining industry makes invaluable contributions to communities around the country. When one considers the key ingredients made by our industry and how they become further inputs used by thousands of U.S. industries in the manufacturing chain, it is easy to see how refined corn is a mainstay of commerce across the nation. Thanks to these ingredients, consumers do not have to think twice about finding high quality, affordable foods and beverages in grocery stores, personal care products in pharmacies, and hundreds of everyday-use items like toothpaste, candles, batteries, laundry detergent and envelopes.

This edition of the *Corn Annual* highlights the integral role that our member companies and their products play in the fabric of our nation. We are proud of the contributions they make and their products that contribute meaningfully to the high quality of life many Americans enjoy. We are equally proud of the people who work in our industry and their commitment to quality, safety, and their communities.

On the eve of the 100th anniversary of our trade association, and in commemoration of the generations that have benefited from the products made from refined corn, we salute an industry that enables other businesses to make a multitude of American industrial and consumer products. Starch is truly a cornerstone of our economy. Nearly ninety percent of the starch used by Americans comes from corn refining, containing a wondrous variety of forms and functional properties. As this *Corn Annual* so aptly portrays, within each corn kernel is a treasure of raw materials from which thousands of products are made.

SHIPMENTS OF PRODUCTS OF THE CORN REFINING INDUSTRY – 2011

Starch Products <i>(includes corn starch, modified starch and dextrans)</i>	6,042,446,000
Refinery Products <i>(includes glucose syrup, high fructose corn syrup, dextrose, corn syrup solids, maltodextrins)</i>	30,038,964,000
High Fructose Corn Syrup 42%	7,898,491,000
High Fructose Corn Syrup 55% and Above	11,591,481,000
Total High Fructose Corn Syrup	19,489,972,000
Total — Domestic Basic Products	36,081,410,000
Total — Export Basic Products	5,398,052,000
Corn Oil — Crude and Refined	1,549,453,000
Corn Gluten Feed and Corn Oil Meal	10,993,164,000
Corn Gluten Meal	2,392,387,000
Steepwater	1,655,213,000

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

Refined Corn Products: Helping American Industry Thrive

Richard N. Kyle, Chairman, Corn Refiners Association

Vice President, Strategic Business Planning, Ingredion Incorporated



Many of the products produced by the corn wet milling industry, such as corn starch, syrup and oil, are easily-recognized ingredients used in many common foods Americans

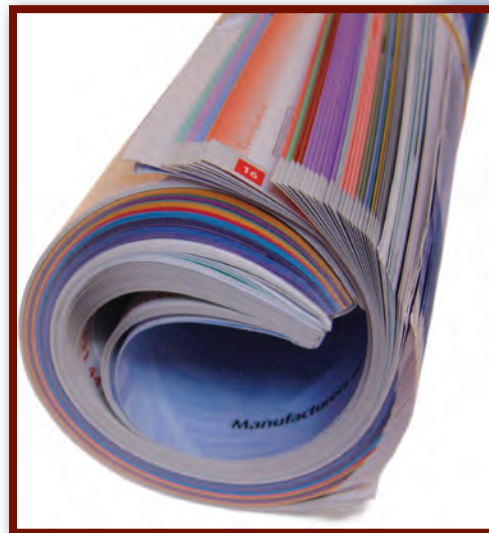
enjoy. Other refined corn products are also used as ingredients in final products, but they are often overlooked or are not well understood. Without them, however, many food and consumer products would lose the characteristics we frequently take for granted. Many of these same products also play a similar “silent” role in industrial applications. Numerous industries rely on refined corn products due to their consistent quality and superior performance, qualities that are essential to produce the multitude of products that we use in our daily lives. Many U.S. industries are able to thrive, in part, because of the versatility, functionality and affordability of the refined corn ingredients they require.

Paper

Starch is one of the paper industry’s most important ingredients. Starch gives paper its smooth feel, strength, brightness and ink adhesion properties. Several other important properties are improved by starch including burst and tensile strength improvement, folding endurance improvement and water repellence/erasability improvement.

Starch is used in four major steps of the paper making process: the wet-end, surface sizing, calender stack and coating. The wet-end is the initial step in paper making, where water-based slurry is mixed using wood pulp or fiber from recycled paper and fillers. Starch is added to replace the natural binding agents the wood pulp loses during processing.

Starch is even more important in making recycled paper products. Recycled fiber is weaker than virgin fiber and needs the bonding strength that starch provides. Starch has the ability to fill in the cavities on the sheet, giving a smoother, more resistant surface. Not only does the ability to transform more recycled content into quality papers benefit the environment, the starch increases fiber retention, so the end product performs better; and the manufacturing process is cleaner and more efficient. Use of cationic starches can also reduce the level of suspended solids in wastewater.



Starch is an important component of coating formulations to improve the printing and optical properties of paper. During the coating process, pigments, additives and binders are added to impart physical properties such as whiteness, brightness, gloss and opacity. Starches are used as the adhesive for paper coating colors. They act as co-binders for the latexes and proteins commonly used in coatings.

Adhesives

Starches are used for a variety of adhesive applications, particularly when bonding papers to one another or to other materials; literally hundreds of adhesive applications are made possible by corn starches

The corrugated board industry is one of the largest markets for starch-based adhesives. After pulp, starch is the largest input. Starch helps provide strength to the board, aids in processing speeds and forms strong

water-resistant bonds. Something to think about next time an important package in a cardboard box is delivered in the rain or snow.

Paper bag manufacture is another industry that relies on starch-based adhesives. Strong seams and bottom seals are the result of starch-based adhesives. Layers of plies in multiwall bags, like those used for pet food, concrete or grass seed, are secured with starch-based adhesives.

Some of the other main uses for starch-based adhesives are carton/case sealing, tube winding, bottle labeling, flat gumming and leather pasting. Starches are also used in adhesives for envelope seams, poster and school pastes.

Even corn sweeteners are used in other types of adhesives to improve stability, provide flow control and prevent wrapping.



Textiles

The textile industry uses starch in warp-sizing and finishing operations. In the warp-sizing operation, a protective coating is applied to the yarn to enable it to withstand the abrasive action of the weaving process. This is designed to minimize breaks and shedding, which result in costly reductions in weaving efficiency and defects in the fabric.

Textile finishes are applied to impart or enhance desirable properties such as crease-resistance, shrink-resistance, softness, hand

and draping properties and a few other characteristics. Starches are used as sizing or weighting agents to produce desired hand. They also provide film clarity, which contributes to the brightness and sparkle of colored fabrics, and film flexibility, which ensures smoothness to the touch.

The textile printing process requires thickeners for the dyes used. Modified starches are frequently used in dye paste

SAFETY PROGRAM AWARD WINNERS

Incident Rate Excellence Award

(formerly the Outstanding Safety Award)

Archer Daniels Midland Company
- Marshall, MN

Cargill, Incorporated
- Blair, NE
- Cedar Rapids, IA
- Dayton, OH

Tate & Lyle Americas
- Decatur, IL
- Lafayette - Sagamore, IN

One Million Hour Award

(formerly the Distinguished Safety Award)

Archer Daniels Midland Company
- Marshall, MN

Cargill, Incorporated
- Blair, NE

Roquette Americas
- Keokuk, IA

Zero Lost Workdays Award

(formerly the Safety Achievement Award)

Archer Daniels Midland Company
- Marshall, MN

Cargill, Incorporated
- Blair, NE
- Cedar Rapids, IA
- Dayton, OH
- Eddyville, IA
- Hammond, IN
- Memphis, TN
- Wahpeton, ND

Ingredion Incorporated
- Stockton, CA
- Winston-Salem, NC

Roquette Americas
- Keokuk, IA

Tate & Lyle Americas
- Decatur, IL
- Lafayette - Sagamore, IN
- Loudon, TN

formulation to provide good dispersion, controlled transfer of the design to the cloth and good color value.

Home Improvement & Building

Corn starches are used as thickeners and binders in building products, such as wall-joint compounds, floor leveling compounds and tile grouts. Starch is used in the production of wallboard, and corn sweeteners are used as humectants to control water release and prevent brittle edges. In paints and coatings, starches function as binders, rheology modifiers, dispersants, flocculants, film formers and gloss agents.

In foundry and ceramic applications starches serve as die mold release agents, green strength additives, fillers and binders, and can be used as anti-cracking additives to maintain even distribution of liquids and solids.

Sweeteners used in the manufacture of tiles and bricks reduce cracking by regulating the migration of water during drying. They reduce brittleness and deformation of the brick or tile. Corn sweeteners are also used to retard setting in concrete.

Oil Refining & Mining

Corn starches are used in the search for oil as part of the “drilling mud,” which cools down superheated oil drilling bits.

In oil drilling fluids, corn-derived ascorbic acid helps protect against iron corrosion in the drilling apparatus and prevents the formation of ferric oxide.

The mining industry uses starches as foam control agents to improve the efficiency of certain ore separation processes.



U.S. Corn Refining Industry at a Glance — 2011

Corn Refining Plants	26
Location	11 states
Corn Grind	1.8 billion bushels
Value of Corn Purchased	\$11.8 billion
Number of Corn Suppliers	41,000
Employment by CRA Member Companies	65,300*
Capital Investment (<i>replacement value</i>)	\$17.8 billion
Major Products (<i>estimated</i>)	
Sweeteners (<i>dry weight</i>)	26.2 billion pounds
Starches	6.5 billion pounds
Ethanol	1.8 billion gallons
Co-products	30.9 billion pounds
Value Added by Manufacture	\$10 billion

*Includes employees that provide services in non-corn refining areas.

Compiled by the Corn Refiners Association based on 2011 data from the U.S. Department of Agriculture, LMC Commodity Studies, Renewable Fuels Association and industry data compiled for CRA by Veris Consulting, Inc.

Pharmaceuticals

Pharmaceutical companies depend on high-quality refined corn ingredients to produce traditional medicines and develop better drug delivery systems. Refined corn products are used in pharmaceuticals as excipients to enhance drug delivery, and as



binders, diluents, tableting agents and coating agents. They can physically mobilize drugs that would otherwise be impractical to use. They are also important ingredients in the formulation of intravenous injection

solutions and clinical nutrition products.

Hospitals and other care facilities rely on products made with refined corn ingredients for patients who have difficulty swallowing (dysphagia), who require a liquid diet or who are diabetic. The corn refining industry and the pharmaceutical industry work closely to bring consumers better, more effective products to meet their health care needs.

The examples above merely scratch the surface of how the corn wet milling industry provides ingredients that help other U.S. industries produce quality products. In many cases, refined corn products make other products possible. You might say that we're the glue that keeps it all together. The corn wet milling industry will continue to help other U.S. industries thrive through development of better products, dependable supply of quality inputs and collaboration.

EXPORTS OF PRODUCTS FROM CORN – 2011

Product	Volume	Units	Value
Corn meal	159,094,943	Kilograms	\$84,187,532
Corn starch	129,726,877	Kilograms	\$81,149,931
Corn oil, crude	204,633,792	Kilograms	\$283,882,333
Corn oil, once refined	25,637,437	Kilograms	\$39,478,958
Corn oil, fully refined	164,158,022	Kilograms	\$251,574,285
Glucose (dextrose)	106,610,855	Kilograms	\$71,203,661
Glucose syrup not containing fructose or containing in the dry state less than 20% fructose	588,769,930	Kilograms	\$250,928,909
Glucose syrup with 20–50% fructose	218,762,418	Kilograms	\$73,621,972
Chemically pure fructose	71,905,216	Kilograms	\$61,741,978
Fructose syrup with 50%+ fructose	1,355,055,663	Kilograms	\$500,048,567
Fructose solids containing more than 50% fructose	11,098,899	Kilograms	\$23,189,730
Bran, sharps, and other residues	170,373	Metric tons	\$20,420,675
Corn gluten feed	1,385,122	Metric tons	\$269,677,489
Corn gluten meal	764,020	Metric tons	\$460,716,211
Other residues of starch manufacturing	88,379	Metric tons	\$23,349,610
Corn oil cake	78,332,994	Kilograms	\$22,700,075
Dextrins	33,084,880	Kilograms	\$24,256,302
Modified starches derived from corn starch	347,471,829	Kilograms	\$284,277,715

Source: U.S. Department of Commerce

CORN REFINERS ASSOCIATION MEMBER COMPANIES PRODUCTS

	Archer Daniels Midland Company	Cargill, Incorporated	Ingredion Incorporated	Penford Products Co.	Roquette America, Inc.	Tate & Lyle Americas
STARCH PRODUCTS						
Unmodified, food	•	•	•	•	•	•
Unmodified, industrial	•	•	•	•	•	•
Modified, food		•	•	•	•	•
Modified, industrial	•	•	•	•	•	•
Dextrins	•	•	•	•	•	•
Cyclodextrins					•	
REFINERY PRODUCTS						
Glucose syrups	•	•	•		•	•
Maltodextrins	•	•	•		•	•
Dextrose monohydrate	•	•	•		•	•
Dextrose anhydrous		•	•		•	
High Fructose Corn Syrup-42	•	•	•		•	•
High Fructose Corn Syrup-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	•					•
Corn fiber food/industrial ingredients	•	•	•			
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/cra-members/member-products/>.

Corn Refiners Association Member Companies Domestic and International Plant Locations

Archer Daniels Midland Company

P.O. Box 1470
Decatur, Illinois 62525

Domestic Plants:

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

International Plant:

Guadalajara, Jalisco, Mexico

Cargill, Incorporated

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

Domestic Plants:

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

International Plants:

Uberlandia, Minas Gerais, Brazil
Song Yuan, China
Haubourdin, Pas-de-Calais, France
Krefeld, Nordrhein-Westfalen, Germany
Castelmassa, Veneto, Italy
Martorell, Barcelona, Spain
Orhangasi, Bursa, Turkey

Ingredion Incorporated

5 Westbrook Corporate Center
Westchester, Illinois 60154

Domestic Plants:

Stockton, California 95206-0129
Bedford Park, Illinois 60501-1933
Indianapolis, Indiana 46221
North Kansas City, Missouri 64116
Winston-Salem, North Carolina
27107

International Plants:

Baradero, Buenos Aires, Argentina
Chacabuco, Buenos Aires, Argentina
Lane Cove, Sydney, Australia
Balsa Nova, Parana, Brazil
Cabo, Pernambuco, Brazil
Sao Goncalo, Rio de Janeiro, Brazil
Mogi-Guacu, Sao Paulo, Brazil
Trombudo Central, Brazil
Cardinal, Ontario, Canada
London, Ontario, Canada
Port Colborne, Ontario, Canada
Shouguang, Shandong, China
Shanghai, China
Cali, Valle del Cauca, Colombia
Hamburg, Germany
Eldoret, Rift Valley, Kenya
Guadalajara, Jalisco, Mexico
San Juan del Rio, Queretaro, Mexico
Tlalnepantla, Mexico State, Mexico
Faisalabad, Punjab, Pakistan
Cornwala, Punjab, Pakistan
Lima, Peru
Icheon, Kyunggi-do, South Korea
Incheon, Bupyeong-ku, South Korea

Penford Products Co.

(A company of Penford Corporation)

P.O. Box 428
Cedar Rapids, Iowa 52406-0428

Domestic Plant:

Cedar Rapids, Iowa 52404-2175

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
Calafat, Dolj, Romania
Benifayo, Valencia, Spain

Tate & Lyle Americas

(A subsidiary of Tate & Lyle, PLC)

P.O. Box 151
Decatur, Illinois 62525

Domestic Plants:

Decatur, Illinois 62521
Lafayette, Indiana 47902
Lafayette, Indiana 47905
Loudon, Tennessee 37774

International Plants:

Razgrad, Bulgaria
Guadalajara, Jalisco, Mexico
Casablanca, Morocco
Koog aan de Zaan, The Netherlands
Boleraz, Slovakia
Adana, Turkey

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