
THE BIOREFINERY DREAM, HERE TODAY?

Product diversification in a dry grind facility, the secret to shareholder value, and financial sustainability in uncertain and low margin ethanol markets.

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Ethanol Production and the Winds of Change

Improvements in ethanol plant efficiency and expansion will continue to have downward pressure on ethanol margins. Electric cars, EPA political forces, API – Big Oil, and greenfield expansions in the U.S. and around the world compete (and sometimes fight) against ethanol margins. Include tariffs and other political factors and the time is right for ethanol plants to make a strategic expansion in their revenue streams and embrace an uncontested revenue strategy.

Vertical integration of products derived from common inputs gives ethanol producers a competitive advantage against these uncertainties. Just as ethanol production from dry grind plants created income opportunities and a market for grains early on, now the next value-added products are available for production at ethanol plants. High value protein separation, low cost sugar production and fiber rich products are all commercially proven technologies available today.

A revenue diversity strategy may not be for every plant. Successful players understand more gallons are not always the answer to every plant's success. These management teams and boards must embrace investment for the higher proven returns associated with diversifying revenue streams. These are bold moves, which when tempered against a strategic plan with sound research and fact checking, can set up a plant for top- and bottom-line revenue increases, resulting in further separation from the commodity pack. The move away from producing DDGs revenue to individualized co-products with higher residual value and profits can be accomplished within 12 to 18 months of implementation.

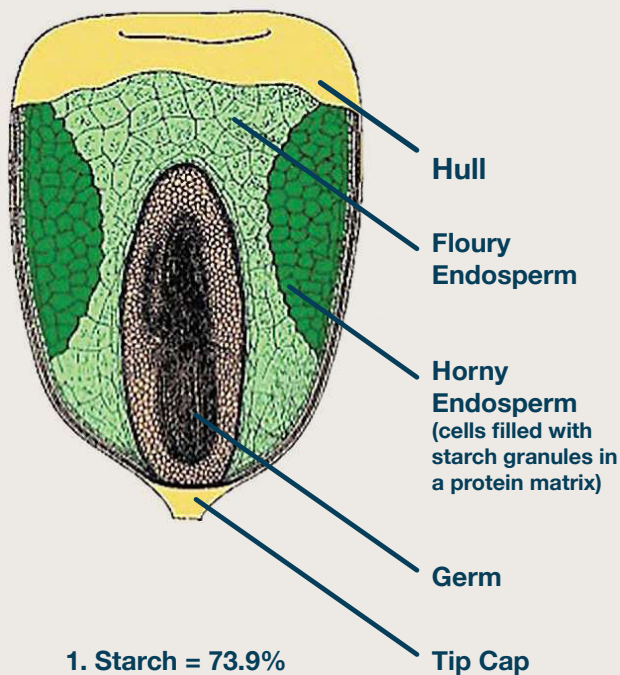
Research is critical to a diversification strategy for ethanol facilities; lessons from corn wet mills are where the industry can learn the most. Although not new, the dry grind industry is young in diversifying its product portfolio. Corn wet mill co-products result in ethanol being one of the lowest value products produced at the wet mill. Applying the co-product mindset to the dry grind plant produces improved and sustainable revenue streams.

The Wet Mill Process-Well; Refined Since 1844

The Corn Wet Mill can produce over 200 different unique products from the corn kernel. Traditionally, the dry mill only produces two or three products. There are significant opportunities for dry mills to produce more products and diversify their revenue stream, many that have a cost advantage over wet mill products.

The process of extracting various corn components is similar in both the wet and dry process, with distinct advantages going to the dry mill for OPEX and corn basis. These opportunities create an effective way of returning value and helping to sustain rural economies for years to come.

4 simple components, endless opportunities



1. Starch = 73.9%
2. Fiber = 11.3%
3. Protein = 8.9%
4. Germ (Oil) = 4.4%

Technologies Here Today

Wet mill technology and equipment are successfully being incorporated into ethanol facilities to produce additional co-products. With low hanging capital projects to increase ethanol production efficiencies, yields and savings all but plucked, the dry grind industry is looking to gain more value from the processed corn, hedging against input (corn) costs and output (ethanol) market fluctuations.

The modified dry mill is the direction ethanol plants are heading. Wet mills never produced DDGs, as they separated every part of the corn kernel to gain the highest value.

The technology exists today to all but eliminate the DDGs pile and increase a plant's revenue by 2x, 3x, even 10x.

Natural Hedges Through Diversification

The base design of a dry grind plant allows for bolt-on technologies to be incorporated into the production of ethanol while producing other corn-based products from the same base process. For example, the DDGs of the dry mill contains three products which the wet mill separates and sells at high values: germ meal, corn gluten meal, and corn gluten feed. These products can be separated at the dry mill using commercially proven technology and equipment similar to what's used in the wet mills. These additional co-products sell at a premium to standard DDGs and trade in a market isolated from ethanol. These products are tied to corn and soybean pricing. As corn prices go up, so does the value of these products, providing a natural hedge against rising input costs for a dry grind ethanol facility. The most readily marketable co-product for an ethanol plant is the separation of protein from the distillers grains. Mechanical separation of protein through particle size and density provides an efficient protein source.

In the Fluid Quip Technologies' MSC™ protein separation system, resulting revenue gains are produced not only from the additional protein products created, but also via the increased efficiencies and throughput gains in the plant.

Additional benefits include:

- Oil extraction (+20-30%)
- Throughput gains (+10%)
- Decreasing back set solids (to less than 3%)
- Decreased evaporator load (20% less load)
- Decreases DDGs dryer loads by 40-50% (which is a current major bottleneck for plants)

It makes perfect sense to pull as many products from the DDGs pile as possible. DDGs is a commodity product which trades based on the energy value in feed rations.

Alternately, high protein feed products trade in the specialty feed markets that are traded on unique growth and nutrition benefits in feed rations.

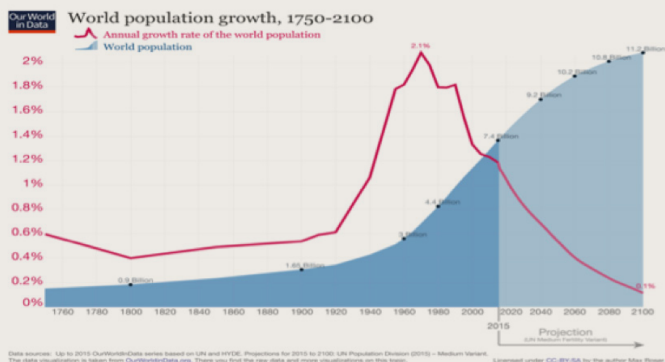
For example, FQT's 50 percent purity protein product produced from dry grind ethanol plants, trades above soybean meal because of the additional nutritional components such as yeast bodies and its highly digestible amino acids.

High Value Protein, Not All are Created the Same

Creation of high value proteins in the dry grind ethanol industry has been the focus of many technology companies over the last decade. Many have approached this technology from different angles, with differing results.

One common obstacle has provided a barrier to success: the creation of the market for the products the technology creates. Until recently, high value protein markets have not been established for these co-products resulting in a small premium over DDGs, which makes the ROI for these technologies unattainable. Demonstrated value through product classification and proven research (via feed trials and nutritional analysis) needs to be established before value can be determined for specific products. Secondly, it has been shown that a 48+ percent protein purity (parity to soybean meal) is required to achieve a marketable value difference to move above and away from DDGs markets.

Global Protein Shortage = Protein Need



Protein Product Trends

Soy is the fastest-expanding protein crop in the world, mainly used in feed for animal meat and dairy production. The European Union and Southeast Asia rely heavily on imported soybean meal, but there are already several questions with respect to this reliance within specific animal species. Soy has an inflammatory effect in the gut of fish, which limits the amount of soy that can replace expensive fish meal. Meeting the increasing world demand for meats, and the proteins to grow these meats, has led to the rise in poultry and aquaculture as sustainable meat sources, as the protein inputs equal the output on a one-to-one basis, in these species.

Continued growth in aquaculture to meet rising food demands is viewed as the only real alternative to these increasing needs. Corn protein is a socially responsible alternative — grown throughout the U.S., fueling local economies. Over half of corn protein from the ethanol production process has been tested extensively in animal feed trials. The results have shown the real potential of 50 percent protein. Specifically, the 50 percent corn protein product produced from the FQT MSC™ protein separation process has shown replacement factors up to 1:1 for soybean meal, corn gluten meal and fish meal. These products currently are trading at a 2x to 10x value of DDGs.

Additional Diversification Options

Although protein is leading the way in co-product diversification, there are additional options as well. These include renewable diesel production, corn fiber separation, and renewable chemical production.

Renewable diesel production can be installed as a bolt-on to ethanol facilities or designed as an aggregating facility receiving multiple plants' distillers corn oil as a feedstock. These produce a drop-in diesel fuel product.

Corn fiber separation can be achieved pre or post fermentation. FQT offers the Fiber By-Pass (FBP)[™] technology to separate fiber before fermentation, expanding fermentation efficiency and capacity while also producing a 'clean' fiber product which can be used as a cellulosic ethanol feedstock or for other applications.

Renewable chemical production of various bio-chemicals or biofuels can diversify ethanol plants. FQT's patented Clean Sugar Technology (CST)[™] produces industrial sugar streams for use in bio-chemical fermentation processes. A standard CST installation takes a slip stream of ethanol plant liquefaction slurry and can produce a clean sugar stream to produce a myriad of high value bio-chemicals on-site or can be sold to bio-chemical producers as base chemicals for the quickly growing green consumer products market. These bio-chemicals and products are not tied to ethanol or fuels markets. The technology is fully operational and bio-chemical companies worldwide are seeking this low cost sugar feedstock stream.

Conclusion

As the ethanol industry continues to mature, the need for diversification is important given the limited and volatile market. Ethanol is still approximately 75 percent of a typical plant's revenue and is held captive to government regulations and external market influences, as is DDGs given its commodity nature. New products, markets and opportunities are here today.

FQT has developed a suite of commercially proven technologies that take ethanol plants to the next level of diversified revenue. The production of protein at a dry grind ethanol plant makes economic sense. Bolt-on technology to separate this protein typically has a ROI of under three years and provides opportunities to hedge against rising corn prices and falling ethanol prices.

Protein production from ethanol facilities is creating a non-contested marketplace for additional products and a diversified revenue stream which ethanol facilities can quickly and definitively implement.

Any ethanol plant can execute a diversification strategy. The technology and the market exists for high value protein co-products, today.

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