

POUNDS THAT PAY

Corn oil may be the smallest fraction of production by weight, but it's also the most valuable.

By Susanne Retka Schill



BOTTLED UP: The value of corn oil has been beneficial in industry downturns, including the current one. Plants and technology providers are working to increase the amount, and value, of oil extracted from ethanol plants.

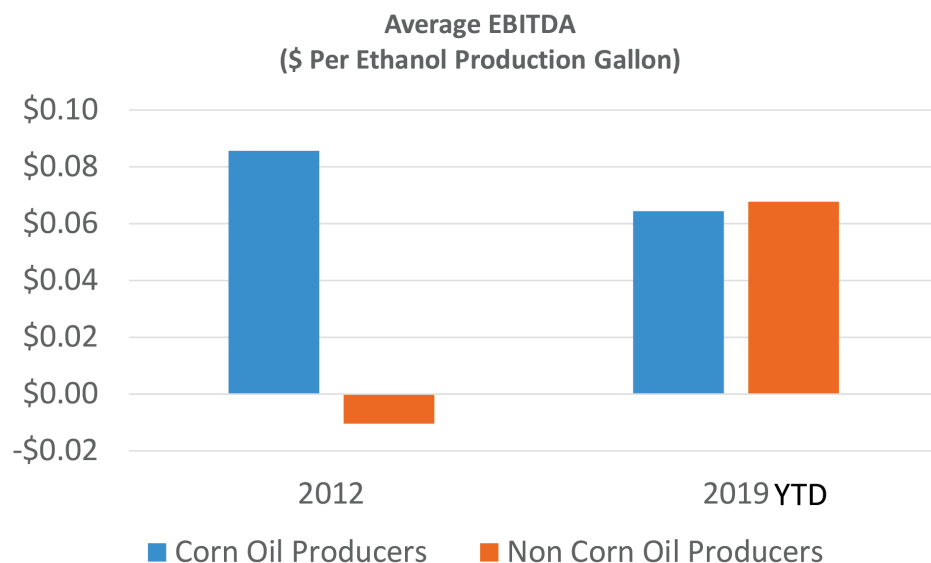
PHOTO: MARQUIS ENERGY

COPRODUCTS

At \$500 a ton, corn oil is the most valuable product an ethanol plant makes, even topping ethanol at its current low price and far outpacing DDGS at around \$150 a ton. “Getting more corn oil is a worthy endeavor,” says Jason Marquis, chief operations officer of Marquis Energy. “Even though on a mass basis there’s less oil coming in, the value of that oil is a major contributor to the bottom line.”

Christianson PLLP benchmarking data confirms corn oil sales are just as important in this extended downturn as they were during the last one in 2012. During that downturn, plants in the benchmarking program that were extracting oil were averaging corn oil sales of 6.9 cents per gallon of ethanol produced. That’s just slightly higher than the first half of 2019 when corn oil sales averaged 6.8 cents per gallon of ethanol. In both years, the average corn oil sales nearly matched the average EBITDA (earnings before income taxes, depreciation and amortization) per gallon of ethanol. Without corn oil, average earnings would have been zero.

In 2012, corn oil extraction was a relatively new technology that was performing well for the early adopters. “Corn oil revenue was a real differentiator in 2012,” says Connie Lindstrom, Christianson biofuels analyst. Corn oil producers were realizing 8.5 cents average EBITDA per gallon of ethanol compared to an average negative 1 cent EBITDA per gal-



OIL ADVANTAGE: Christianson PLLP data shows the handful of plants not extracting oil in 2019 are no longer as disadvantaged as nonproducers were in 2012, when the early adopters were clearly benefiting from sales of the new coproduct.

SOURCE: CHRISTIANSON PLLP

lon of ethanol for those not spinning oil out. Today, nearly all plants extract oil and the few that don’t have an average EBITDA per gallon nearly the same as those who extract.

“The contribution of corn oil has remained steady over time for plants that extract it, and it’s practically essential to operating a profitable plant at this point,” Lindstrom says. “However, it’s no longer a differentiator, because everyone has run the numbers on adding this capability, and those for whom it makes

economic sense to do so have already added it. And, the few that don’t do it are seeing, on average, a similar EBITDA outlook to those that do produce it.”

Pushing Up Pounds

Today, the focus for most plants is extracting as much oil as they can, says Kevin Moore, vice president of Trucent’s advanced separations group. “We’re hearing from producers and experts that removing DCO (distillers



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BENCHMARKS: Since the industry began extracting oil around 2012, the drop in price shown in Chart 1 has been offset by the increase in yield shown in Chart 2. Christianson benchmarking data covers plants in a range of sizes and organizational structures, serving as a representative sample of the industry.

SOURCE: CHRISTIANSON PLLP

corn oil) hasn't destroyed the value of DDGS and producers have gone ahead and pulled more and more out." Although the majority of Trucent customers pull as much oil out as they can, Moore says there are some who stick to a number to satisfy customer relationships, and those operators have gotten better at controlling the extraction rate.

Demand for DCO is likely to keep pace with these yield increases, Moore suggests. "There's been tremendous announcements of new capacity for renewable diesel in North America, to the tune of several billion gallons," he says. "DCO is going to be a preferred feedstock, largely due to its favorable carbon intensity score in California. We see forecasts for a significant demand driver for DCO as these renewable diesel plants come online."

Moore reports some producers are now pushing their oil extraction rates over 1 pound per bushel of corn. In addition to using enzyme technologies and other process enhancements that free up more oil, producers implementing new technologies for high-protein feeds are also seeing much higher corn oil yields. The protein technology providers, he says, "are advertising 1.2, or even as high as 1.5 pounds per bushel."

By implementing several strategies, the Marquis plant in Hennepin, Illinois, increased its extraction rate from about 0.8 pounds of DCO per bushel of corn, just above the industry average, to about 1.2 pounds per bushel. The company has developed its own protein extraction technology, which it calls ProCap (short for protein capture). "One of the benefits of the system is up to a 50 percent increase in the amount of corn oil the plant is taking out," Marquis says. The second benefit is that by removing the oil, the concentration of the protein increases, measuring over 50 percent crude protein. With DCO valued at \$500 a ton and the high-protein feed around \$300 ton, Marquis Energy is working to optimize these high-value coproducts.

Marquis Energy has implemented other strategies to improve corn oil extraction, Marquis adds, with one focused on cleaning recycle streams. "By removing the oil and solids from

CHART 1 Corn Oil Netback per Ton

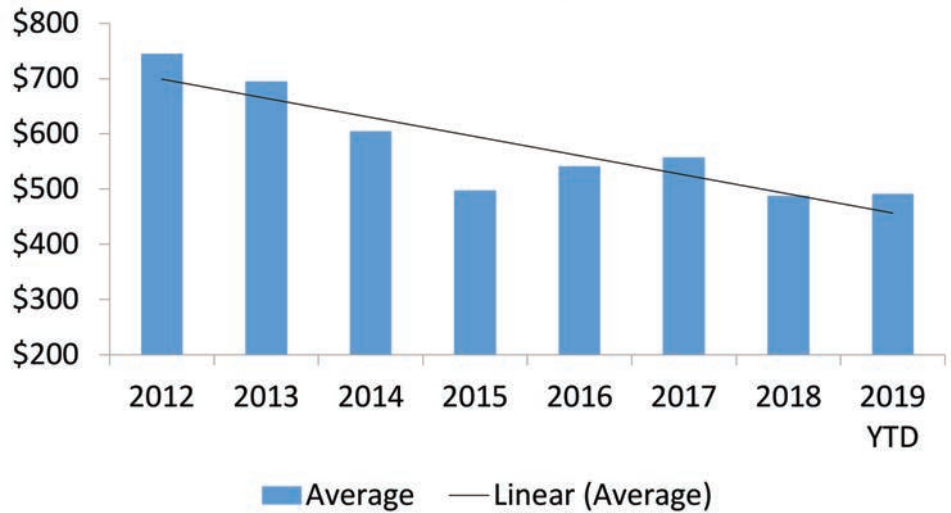
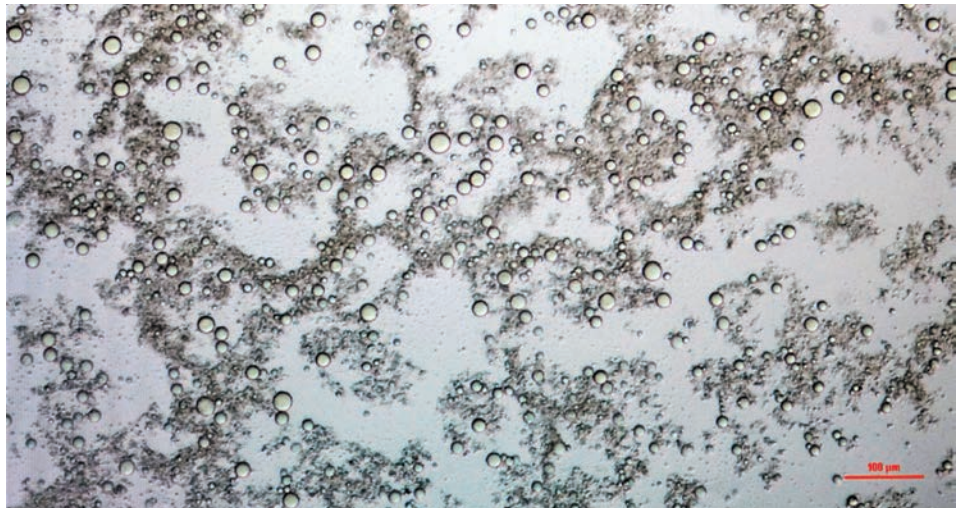
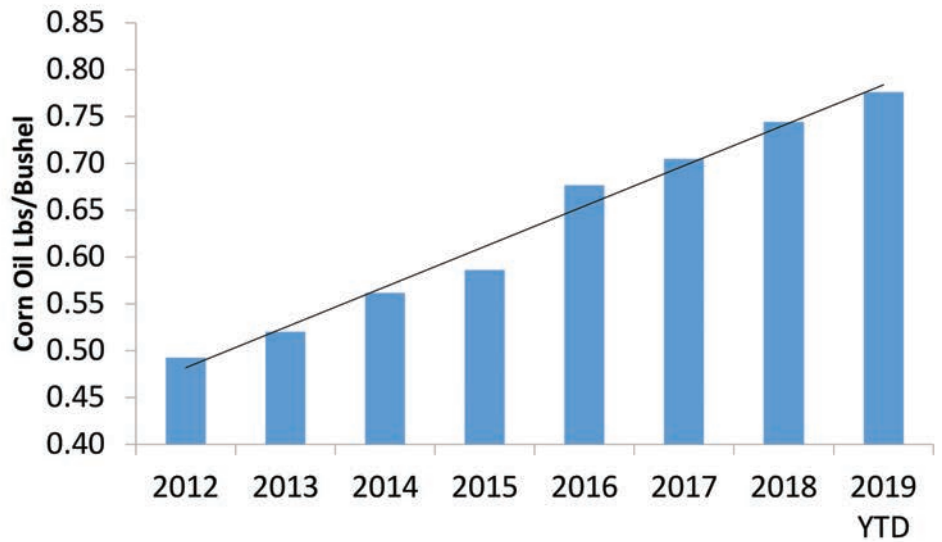


CHART 2 Average Corn Oil Yield



COALESCENCE: Trucent's new Ascent chemistry aims to increase the size of oil droplets, seen here under a microscope.

PHOTO: TRUCENT

COPRODUCTS

the backset and evaporator feed, we're not recycling that oil into fermentation," Marquis explains. Recycled oil is particularly difficult to recover because it creates emulsions that bind it to the wet cake. The recycled oil goes out with the distillers grains, rather than into thin stillage where DCO extraction takes place.

Marquis operators also adjust their centrifuges to have more oil and solids move with the thin stillage stream. "Because you're clarifying that thin stillage, having a dirtier feed isn't detrimental," he says. "It's actually beneficial because you're preferentially moving more material into the thin stillage fraction and less

of that protein and fat is going out in the wet cake."

Every Spot

Learning just what happens to corn oil throughout the ethanol process has been a goal at Trucent, Moore says. "We do tend to focus on the oil centrifuge, but in order to understand all the levers and opportunities for higher DCO yields, we have analytical methods for every spot in the ethanol plant, starting with the corn." After doing a material balance throughout the plant, the Trucent team recommends changes to improve DCO yields.

"The split at the decanter is very important," Moore gives as an example of a key parameter. "We see a range of splits in the amount of oil that goes to the stillage versus the wet cake. Clearly, the plants with the highest oil recovery rates have more oil going to the thin stillage."

Several adjustments can be made once the oil in the thin stillage goes to the oil centrifuge. Stoke's Law defines the relationship of key variables that can be modified to increase separation, such as increasing the droplet size of the oil, altering the density and viscosity of the liquid and optimizing the centrifuge itself by adjusting factors like residence time, surface area and G-force. Demulsifiers can also be added to liberate attached oil and increase the rate of oil droplet coalescence.

This summer, Trucent introduced a new chemistry, trademarked Ascent. "It's a custom chemistry, purposely built for corn oil recovery in dry mills," Moore says. "Ascent is based on Trucent's years of experience in separation and all the benchmarking, round robins and analytical development our technical team did." In addition to developing analytical techniques to track DCO throughout the ethanol process, the team began evaluating the various chemistries being used by the industry and ultimately teamed up with Croda to develop the new, nonpolysorbate chemistry. "The industry has come really far with the incumbent chemistries," Moore says. "But those have been off-the-shelf surfactants that people blended and trialed. Ascent is a brand-new chemistry where our objective was to create larger diameter oil droplets, a driver in Stoke's Law." Multiple plant trials are showing better oil recovery rates at lower doses than the older chemistries, with the best results experienced by plants leaving oil in the heavy phase—the de-oiled syrup—after oil centrifugation.

Getting more oil adds up, Moore says. For a 110 MMgy plant using roughly 38 million bushels of corn annually, achieving the industry average DCO yield of 0.75 pounds per bushel produces about 28 million pounds of corn oil for a net value around \$5 million. "The difference between 0.75 and 1 is a little greater than \$1.5 million in improved revenue."

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