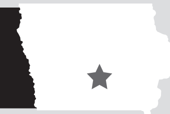
KEMIN INDUSTRIES



COMPANY PROFILE:

Kemin Industries is a biotechnology company and ingredient provider to a wide range of industries across the world. Kemin employs more than 3,000 people in more than 90 different countries. More than 600 staff people work at Kemin's Des Moines, Iowa, campus. Kemin is a science-based, data driven company. "Compelled by Curiosity" (Kemin's tagline), Kemin's scientists seek out sustainable customer centric solutions for the markets they serve. Kemin's continued growth will require sustainable process solutions as it provides high quality efficacious products to its customers.

AUSTIN JONES
SCHOOL: The University of Iowa
MAJOR: Chemical Engineering

PROJECT BACKGROUND

One of Kemin's largest products is a protein product manufactured in Verona, Missouri, and commonly utilized as a pet food ingredient. Raw materials are manufactured into an intermediate mixture (feedstock) with a high moisture content and then must be dried to a finished product powder using various dryer technologies. The drying process can be an energy intensive process, and optimization of the dryer steps has the potential for significant reductions in energy use, carbon emissions and operating costs. To aid in these efforts, the intern was tasked with optimizing the composition of the feedstock ready for the first drying step.

INCENTIVES TO CHANGE

Kemin's vision is to sustainably transform 80 percent of the people in the world with one of its products or services every day. To sustainably transform 80 percent of the people in the world,

Kemin must efficiently and sustainably manufacture innovative products for its customers. Using a triple lens approach, (healthy people, planet, and company) Kemin's plan is to continually improve its products, services, and manufacturing practices to reduce its carbon emissions to reach its aspirational goal of net zero carbon emissions by 2050. One step among many is to optimize energy use in its drying technology in Verona, Missouri.

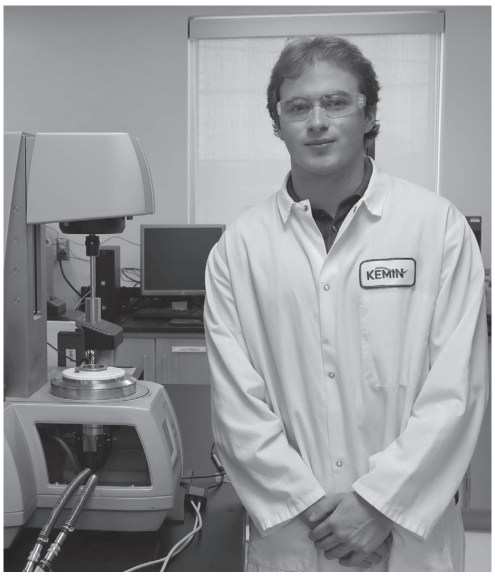
RESULTS

The optimization project started with extensive lab scale testing in Des Moines after fully understanding the production and drying process in Verona. The protein feedstock has a large moisture content that must be removed to create the dry powder finished product. In the current process, the high-moisture feedstock is sent to step one of the drying process. Approximately half of the moisture is removed in the first step. The remaining moisture is removed in the final step of the drying process, consuming significant amounts of hydrocarbon fuel sources. Step 1 of the drying process is a more energy efficient way of drying when compared to step 2 based on heat transfer calculations for both drying steps. If step 1 removes too much moisture, the protein feedstock will become highly viscous, impeding product flow rates. In order to identify opportunities for energy savings and optimizing the drying process, the feedstock itself was analyzed to identify possible ways of reducing its moisture content before reaching step 1 in the drying process.

Centrifugation Before Dryer Step 1

There is a large amount of water bound to the solids in the feedstock mixture. A mechanical solution to remove water would be desirable due to energy consumption and water reduction efficiency. If this solution is successful, dryer step 1 will also be more efficient and enable further moisture reduction before the feedstock mixture is moved to dryer step 2. Working with the Kemin team, a hypothesis was developed proposing that centrifugation of the feedstock mixture would reduce moisture and other material in the feedstock. This process contributing to a higher viscosity level in the feedstock material. Removal of this material should reduce the drying time in dryer step 1 and 2. In order to prove this hypothesis, extensive lab-scale feasibility testing was conducted using centrifugation to reduce moisture and solids and calculate the potential energy savings.

First, a feedstock sample provided from the Verona plant was diluted down to the same level that would be seen in typical production operations. The sample was split into bottles and centrifuged, separating the liquid-heavy and solid-heavy fractions. A rotary evaporator was then used to concentrate the liquid-heavy fraction under vacuum pressure. The sample was concentrated down to a higher solids percentage while still flowing, but additional trials demonstrated that ultimately a slightly lower solids percentage seemed to achieve the best results. When recombined with the solid-heavy fraction, the feed to the last drying step would be more concentrated than what is observed currently.



A rheometer was used to evaluate the viscosity of samples with and without use of the centrifuge. The centrifuged sample exhibited a lower viscosity after the first drying step, which would cause reduced downtime and further cost savings.

Since the data from the lab scale work was compelling, the next step was to scale and run pilot trials to confirm the lab scale data. A pilot scale centrifuge was commissioned for the next phase of the experimental work.

Other Drying Steps

Considering the data resulting from this study, Kemin may need to invest in drying technology better suited for higher viscosity feedstock flow or additional units to drive more moisture out of the feedstock before the final drying step. As a result, further savings could potentially be achieved if another evaporation step is added before the last dryer step. Dryer technology designs for the food industry are specifically designed to handle highly viscous and fouling material and would be readily adaptable to handling the feedstock manufactured in Verona. Even a moderate increase in the solids concentration of the feedstock could result in significant energy savings, but uncertainty remains over how much energy demand an evaporator unit like this would have. Additional research will need to be performed to determine the viability of adding a different type of evaporator to the process.

ENVIRONMENTAL AND ECONOMIC SAVINGS TABLE

PROJECT	ANNUAL COST SAVINGS	ANNUAL ENVIRONMENTAL RESULTS	STATUS
CENTRIFUGATION BEFORE DRYER STEP 1	$44,473	65,659 kWh 83,654 therms 471 tCO2	RECOMMENDED
OTHER DRYING STEPS	TBD	TBD	FURTHER RESEARCH NEEDED