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Ethanol Plant Stops Motor Bearing Damage

Proper shaft grounding thwarts premature failures

By Kent Glasser, Red Trail Energy

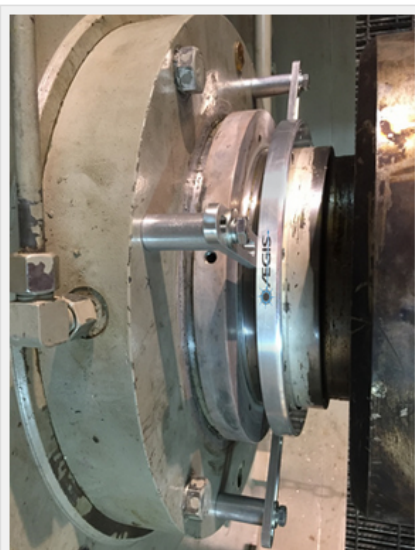
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Something was destroying the motor bearings of the centrifuges and thermal oxidizer fan at Red Trail Energy's ethanol plant in Richardson, N.D. Maintenance personnel realized the bearings on these large motors were failing long before they should. The high cost of replacing the bearings soon caught the attention of the plant manager, who called in a specialist — Scott Fisher of Sustainable Grounding Systems — to determine what was causing the damage.

Fisher had worked at the Red Trail plant before when a North Dakota electrical contractor, Ystaas Electric Services, brought him in to evaluate the plant's grounding systems. Ystaas enlisted Fisher's services when it discovered stray currents on the cabinets of variable frequency drives (VFDs) that control the speeds of various motors in the production process.

An expert on the causes and prevention of equipment damage due to stray currents and inadequate grounding, Fisher is well known for his work with major companies involved in oil exploration, drilling and refining; petrochemical processing; grain elevators; and even the Los Angeles train system. He learned his craft while working in Europe for a company that was involved with grounding systems for various applications, including high-speed rail and military installations.

"Without proper grounding, stray electrical currents can do tremendous damage. In fact, these types of currents are becoming a huge problem and dealing with them is a highly specialized field. Because they are not maintenance-oriented, most electrical contractors don't know how to solve this type of problem. They can get system resistance down to the 25-ohm level required by National Electric Code. I was trained to get systems down to 5 ohms or less," explains Fisher.



Grounding Ring

Figure 1. Installing device on shaft of 400-hp fan motor for thermal oxidizer eliminated problems from stray currents.

The Ethanol Plant

Red Trail Energy's Richardson plant produces 65 million gallons of ethanol annually from 25 million bushels of corn through a dry-milling process. The process generates coproducts including 135,000–140,000 tons of dried distillers grain and 80,000 tons of modified wet cake each year.

The dry-milling process starts by grinding dried corn into flour, which is stirred with water to produce mash. The addition of enzymes to the mash converts starch to dextrose. The mash, after processing in a high-temperature cooker to reduce bacteria levels, goes to fermenters where yeast is added to transform sugar into ethanol and carbon dioxide.

During fermentation, which takes about 40–50 hours, agitation keeps the mash cool and facilitates the activity of the yeast. After fermentation, the resulting "beer" goes to distillation columns to separate the ethanol from the remaining stillage. The ethanol then gets concentrated to 190 proof through conventional distillation and dehydrated to approximately 200 proof in a molecular sieve system.

Next, the stillage passes through a centrifuge that separates coarse grain from solubles, which then are concentrated to about 30% solids through evaporation, resulting in condensed distillers solubles or “syrup.” The coarse grain and syrup then are dried together to produce dried distillers grains with solubles, a high-quality nutritious livestock feed.

Tackling The Problem

When Fisher arrived at the plant in May 2017, he took shaft voltage readings on the 30-hp and 150-hp centrifuge motors and the 400-hp fan motor for the plant’s thermal oxidizer. These motors exhibited premature bearing damage — long before reaching the L10 life of their bearings, i.e., the life that 90% of the bearings should achieve. He knew right away the culprits were stray currents from VFD-induced voltages that were building up on motor shafts and discharging through motor bearings — and just how to deal with them.

VFD-induced shaft currents discharge to ground along the path of least resistance. Without long-term shaft grounding, that path typically is through the motor bearings. So, Fisher recommended installing Aegis shaft grounding rings on all motors controlled by VFDs to channel these harmful discharges away from bearings and safely to ground.

He chose split Aegis SGR Rings for the 30-hp and 150-hp centrifuge motors. These rings come in mating halves that allow fast, easy installation on an in-service motor without having to decouple the motor from attached equipment. After removing any dirt, corrosion and paint that might interfere with adhesion and conductivity, Fisher installed the rings using conductive epoxy.

Because of the 400-hp motor’s large size, Fisher opted for an Aegis Pro Series Ring. Designed for large low- and medium-voltage motors, Pro Series Rings have six rows of conductive microfiber brushes that provide high current capacity. Fisher installed the larger split Pro Ring using universal Pro Series mounting brackets.

Once the installations were completed in July 2017, he took follow-up readings on the running motors to check shaft voltage levels. Readings that were as high as 19 volts before had dropped to less than 1.3 volts (too low to cause premature bearing damage) after the installation of the rings.

In addition, Fisher recommended the added protection of electrically “bonding” all motors to an electrolytic deep-well ground rod system that would guarantee stable resistance through the changing seasons.

“Red Trail has not had any problems since we installed the Aegis rings — no more high-pitched squealing from damaged bearings,” notes Fisher. “And costly downtime has been minimized.”

Fast Payback

Red Trail Energy has initiated an ongoing program to improve control of its production process by running all motors on VFDs. This not only will assist operators in fine-tuning the process but also will allow “soft” starting of motors after a process shutdown. Red Trail has found through experience that the stresses from restarting the system can lead to critical events with unforeseen consequences. Using VFDs to soft start motors can minimize these stresses. In addition, protecting VFD-controlled motors with Aegis rings forestalls unplanned shutdowns due to motor bearing failures.

A shutdown due to the failure of a key motor could result in the loss of one or more batches, costing hundreds of thousands of dollars in lost revenue. The considerable savings from avoiding such shutdowns have convinced Red Trail’s management to put Aegis rings on critical process motors. Installing the rings makes sense from both an operational and financial standpoint, notes Fisher: “They pay for themselves in short order.”

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