

This dry mill ethanol best practices fact sheet features processes or equipment modifications that can help a facility reduce water use, energy use, and its impact on the environment.

## Best practices for dry mill ethanol plants: water quality and efficiency

Best practices for dry mill ethanol plants leverage opportunities within the local market, such as selling wet distillers grains with solubles (WDGS) instead of dry distillers grains with solubles (DDGS). Now, best practices that were once considered innovative are now considered standard practice in facilities. For example, the mole sieve used in the dehydration process was introduced in the 1990s and significantly reduced energy use. It is now standard equipment in all dry mill facilities.

### Water Quality and Efficiency

#### Water Resource Planning Prior to Site Selection

Water supply and water quality issues are becoming more crucial to the development of new ethanol facilities in Minnesota. Therefore, an accurate, well-defined water balance diagram and water treatment design are important first steps in the ethanol project site selection process. Understanding the water quality issues related to supply and discharge are important to determine the types of equipment needed to treat the water. Additionally, knowing the availability of water supply is critical to obtaining approvals for water appropriations.

#### Public Records of Water Use

Ethanol facilities are just one of the newest users of ground water supplies resulting in a strain on supplies. Minnesota maintains publicly available records of water use by ethanol facilities through the Minnesota Department of Natural Resources (DNR). All active water appropriation permit holders are required to measure monthly water use with an approved measuring device to an accuracy of 10% and report water use yearly. Water use data can be found on the DNR web page: <[www.dnr.state.mn.us/waters/watermgmt\\_section/appropriations/wateruse.html](http://www.dnr.state.mn.us/waters/watermgmt_section/appropriations/wateruse.html)>

#### Recycling Existing Wastewater Discharge Streams

Recycling wastewater in the process stream may

require a change in treatment chemicals; the potential effects to the process must be monitored to ensure no adverse reactions occur. A potential adverse reaction of recycling wastewater would be a decrease in the fermentation rate. Wastewater streams that could be recycled in the process include stormwater, boiler blowdown, reverse osmosis (RO) reject water, softener water, iron filter reject water, and cooling tower blowdown.

#### No-Contact vs. Direct Injection Steam Systems

During the starch conversion process the mash is typically heated by using a direct injection steam system. A more efficient process is the no-contact steam system; the condensed steam is returned to the boiler and reused versus being injected into the process and then later evaporated in the grain drying process.

#### Municipal Wastewater Reuse

An ethanol plant may be able to use the discharge from a municipal wastewater treatment plant (MWWTP) for non-contact cooling water use. However, the wastewater may not be able to be used for process water due to potential concerns about DDGS quality degradation. A study by the Metropolitan Council Environmental Services (MCES) determined that there were enough MWWTPs within 10 miles of ethanol facilities to provide a potential supply of 52 million gallons per day (MGD); the current demand of an ethanol facility is approximately 6 MGD. Reusing municipal wastewater has been demonstrated at other industrial sites in Minnesota. In Mankato a new power plant was built near an existing wastewater plant. By recycling 6 MGD of wastewater from the plant, no additional water was needed for cooling, and the power plant needed to obtain fewer permits.

#### High Efficiency Dryer Technology

Dryers that use superheated steam as the heat source can be sealed better to prevent unwanted

air leakage that occurs in rotary drum dryers. These dryers send the exhaust vapor to the evaporator system to recover the water removed from the WDGS. The water is then treated so that it can be used as cooling tower makeup water. This system has been installed at the 130 MGY Renew Energy facility in Jefferson, Wisconsin which began production in mid-October 2007.

### **Chemically Treating Cooling Tower Water**

HiCycler is a side-stream silica and hardness removal process used in cooling towers to increase the water recycle rate. The increased level of recycling will increase the concentration of Total Dissolved Solids (TDS) in the discharge stream which may adversely impact water quality. This practice is currently in place at an Iowa biodiesel plant.

### **Membrane Technology**

Liquid and gaseous phase membranes can replace existing rectifiers, strippers, and mole sieves to reduce water and energy costs. The membrane system can accept ethanol from the beer column, which is only 40% to 50% ethanol, and complete the dehydration process like the mole sieve. The mole sieve can only accept 95% ethanol. This process has been demonstrated on a pilot scale in an ethanol plant in Canada, but not in a commercial scale facility.

### **On-site Retention of Stormwater**

An on-site stormwater pond allows a facility some flexibility in controlling stormwater runoff. The pond should keep stormwater discharge levels at least equal to the levels before the site was constructed allow for sediment removal before the water flows off site and provide a way to treat dissolved organics and nutrients in stormwater runoff such as nitrogen or phosphorus. Stormwater ponds are not intended to provide secondary containment for spills that may occur during the loading process; facilities should provide separate means for spill containment on site.

### **Zero Discharge of Non-Contact Utility Water**

This practice is commonly called “Zero Liquid Discharge Technology”. Using appropriate equipment, a facility can treat non-contact utility water, resulting in no water discharge. The first ethanol plant to achieve zero liquid discharge in the United States was Pacific Ethanol in Madera County, California. This facility started operations in November 2006 and used Cold Lime Softening (CLS) in combination with RO. The evaporator/

crystallizer system is a more complex alternative than CLS. It requires additional energy to separate the salts from the water and a lined pond for temporary storage of the brine solution. Initial analyses of the salts removed indicate these will be disposed of as a solid waste and not a hazardous waste. One significant result of having zero liquid discharge technology is that the facility does not have a utility wastewater discharge with the associated monitoring and limits.

### **Use of Low or No- Phosphorus Water Treatment Chemicals**

Phosphorus containing water treatment chemicals are typically used in the cooling water treatment systems to control corrosion and scale. Low or no-phosphorus treatment chemicals are available and will reduce the level of phosphorus in the wastewater discharge. There are concerns that these new chemicals will require more knowledgeable plant operators and tighter controls on the water chemistry system. They may also increase corrosion rates.

### **Ultrasonic Water Treatment for Microbiological Control**

Typically, chlorine is used to control microbiological growth in the cooling towers. Ultrasonic treatment applies a low-power, high-frequency ultrasound to control bacteria and biofilm in the cooling tower system. The applicability of the ultrasonic system will depend on the blowdown rate in the cooling tower and the biological loading on the system. The system does not work well on mold but could be used often to limit chlorine use to higher seasonal loading on the system.

### **Additional Resources**

A full report about ethanol production in Minnesota, including references can be obtained by contacting MnTAP at 612.624.1300 or by visiting <[www.mntap.umn.edu](http://www.mntap.umn.edu)>.



### **For More Information**

MnTAP has a variety of technical assistance services available to help Minnesota businesses implement industry-tailored solutions that maximize resource efficiency, prevent pollution, increase energy efficiency and reduce costs. Our information resources are available online at <[mntap.umn.edu](http://mntap.umn.edu)>. For personal assistance call MnTAP at 612.624.1300 or 800.247.0015.