

## Corn Ethanol Production Efficiencies – Water

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### Introduction

Water is an essential resource in the ethanol industry that is often taken for granted. Many plants were constructed at a time and location where water supplies seemed limitless.

Although a typical paper mill will consume 10 times more water on a pound per pound basis, it is ethanol plants that have recently come under increasing scrutiny for water consumption.

Evidence of water table drawdown coupled with the sheer number of ethanol plants sited in the Midwest has generated concerns over groundwater depletion, conflicts with livestock production and regional drought susceptibility.

With increasing population pressures and environmental regulations, industrial water users risk losing the availability of classic water resources such as river water or groundwater.

Although this situation can be planned for in the long term, sometimes things can go wrong and production is affected. Drought can reduce river or groundwater volumes to a point where priority must be given to the community potable water supply and industrial water intake permits may become either seasonal – curtailing production - or even permanently withdrawn, forcing plant closure.

In addition to optimizing water consumption, water supply reliability can be improved from recycling and re-use of internal water sources and alternative external sources.

### Water Consumption

In a typical ethanol plant, more than 70% of all water use is by the cooling tower in the form of evaporative losses and blowdown to wastewater while 20% goes directly into the process and remains unrecovered. Ethanol plants report a wide range of water use – from 3-1/2 to 6 gallons of water consumed per gallon of ethanol produced with typical water consumption in the range of 4 to 5 gallons.

Most existing ethanol plants had less water and energy integration considerations taken into account in their initial design. Some new plant designs boast fresh make-up water rates of only 1.5 gallons per gallon of ethanol produced. However, this technology comes at a premium for new installations and is particularly expensive to implement at existing plants because of the requirement to demo and replace large, key pieces of process equipment.



## **Recovering Water Within the Plant**

Industrial water re-use is a growing practice in non-potable industrial applications. In addition to population pressures and environmental compliance issues limiting water intake and wastewater discharge, increasing water and wastewater costs have helped drive this trend. In some cases, plants have resorted to reusing all available wastewater streams via treatment and concentration to the extent that they become zero-liquid discharge (ZLD) facilities.

These internal sources are usually reliable both in volume and quality and can be more efficiently treated than wild external sources of varying quality. Maximizing internal re-use can also reinforce a good relationship with the local community by making more potable water available for public consumption and reducing or eliminating wastewater discharge.

Although cooling tower evaporation cannot be retained, cooling tower blowdown can be treated and re-used. Additionally, much of the water that enters the fermentation process is not recovered because it winds up in the whole stillage which, in turn, if not collected in the thin stillage evaporation process, ends up driven off in the distiller's grains dryer - forever lost to the atmosphere.

Typical syrup from thin stillage concentration exits the evaporators at ~30% total solids (TS) whereas technology exists today to further concentrate the syrup to levels as high as 50% by adding an additional high-efficiency concentrator. For a typical ethanol plant, this can "recycle" as much as 1 lb. of water per lb. of ethanol produced.

As an added benefit, shifting the burden of evaporation from the dryer to an efficient evaporator can yield big energy savings - enough savings that the ROI for this capital investment can cover its cost and installation in 2-3 years.

## **Alternative Water Sources**

Fuel ethanol does not require potable water, so lower quality external water resources may be utilized. It is not necessary to draw from dwindling ground water or river inventory.

Treated wastewater, stormwater, municipal wastewater discharge, reclaimed groundwater, animal feedlot run-off and power plant cooling pond effluent are among the sources of water that have been treated, cleaned and used in chemical processing.

If it is necessary to apply reverse osmosis (RO) for treatment of these sources, in some cases it may be possible to send the rejects - typically 30% of the ingress - directly to municipal wastewater treatment while using the permeate directly, without further treatment. This arrangement can represent a win-win for both the ethanol producer and a municipal



treatment facility over-burdened by excessive wastewater volume. The RO system acts like a concentrator for dissolved solids and minerals leaving the relatively pure permeate for ethanol production.

### **Reducing the Cooling Tower Factor**

In order to reduce evaporative losses in the cooling tower, the overall cooling water demand must be reduced.

This may be possible if the entire plant is reviewed for cooling water consumption and a thorough energy analysis is performed.

Air-cooled heat exchangers may be an option in some circumstances and may be a requirement in a de-bottlenecking or capacity expansion where any further water intake is not permitted.

### **Summary**

The landscape of ethanol production is changing. Ethanol plants have recently come under increasing public scrutiny for water consumption. In some areas, increasing water and wastewater costs have spurred interest in reducing water intake and wastewater discharge. Population pressures and environmental compliance issues are increasingly a factor in limiting water intake and plant effluent as well.

Whatever factors may motivate a particular ethanol producer to alter their water consumption habits, there are engineering solutions available today that can help them achieve their goals.

### **About Harris Group Inc.'s Biorefining Unit:**

Harris Group Inc.'s biorefining unit provides full-service engineering and consulting services in the production of energy and chemicals from renewable feedstocks through sustainable technologies.

Our experience encompasses developing biomass processes that convert purpose-grown feedstocks or waste streams into ethanol, biodiesel, biogas (methane), commodity chemicals, and other saleable products and byproducts.

Harris Group Inc. provides strategic support on new projects from feasibility through plant start-up with a core service of engineering and plant design and on existing plants through plant optimization and process improvement. Specialty services include program management, process conceptualization and development, research management and coordination, basic and detailed engineering, owner's engineering, financial due diligence



and independent engineering, feasibility evaluation, process improvement and control systems integration.

For more information on how Harris Group can help with your existing alternative fuels facility or plans with your new facility, please contact:

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