GREEN PLAINS SUPERIOR, LLC.

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COMPANY BACKGROUND

Green Plains Superior, LLC. is a 50 million gallon per year dry-grind ethanol plant located in Superior, Iowa. In addition to producing ethanol, the facility refines and sells fermentation co-products as distillers grains, syrup, and corn oil. Green Plains Superior, LLC is a subsidiary of Green Plains Renewable Energy Inc., a vertically integrated bio-ethanol company consisting of three primary segments: ethanol production, agribusiness, and marketing and distribution. The ethanol production segment consists of nine ethanol plants with an annual production capacity of 740 million gallons.

PROJECT BACKGROUND

The ethanol industry has made significant strides over the last decade to reduce water consumption, but water availability may inhibit continued industry growth if additional water reduction methodologies are not developed and implemented. Green Plains Superior, LLC has been continually working on increasing water efficiency and aims to reduce total water usage by 10 percent in 2012.

INCENTIVES TO CHANGE

Average water usage at Green Plains Superior, LLC is 4.10 gallons of water per gallon of ethanol produced. A unique challenge is that the well influent contains high concentrations of calcium, sulfate, and iron. This requires the facility to have an extensive water treatment process that produces large volumes of wastewater, discharged to the Des Moines River. The remainder of the water leaves the plant through evaporation or is contained in the co-products. Any reduction in water use during water treatment or production processes would significantly reduce the environmental impact of the facility.

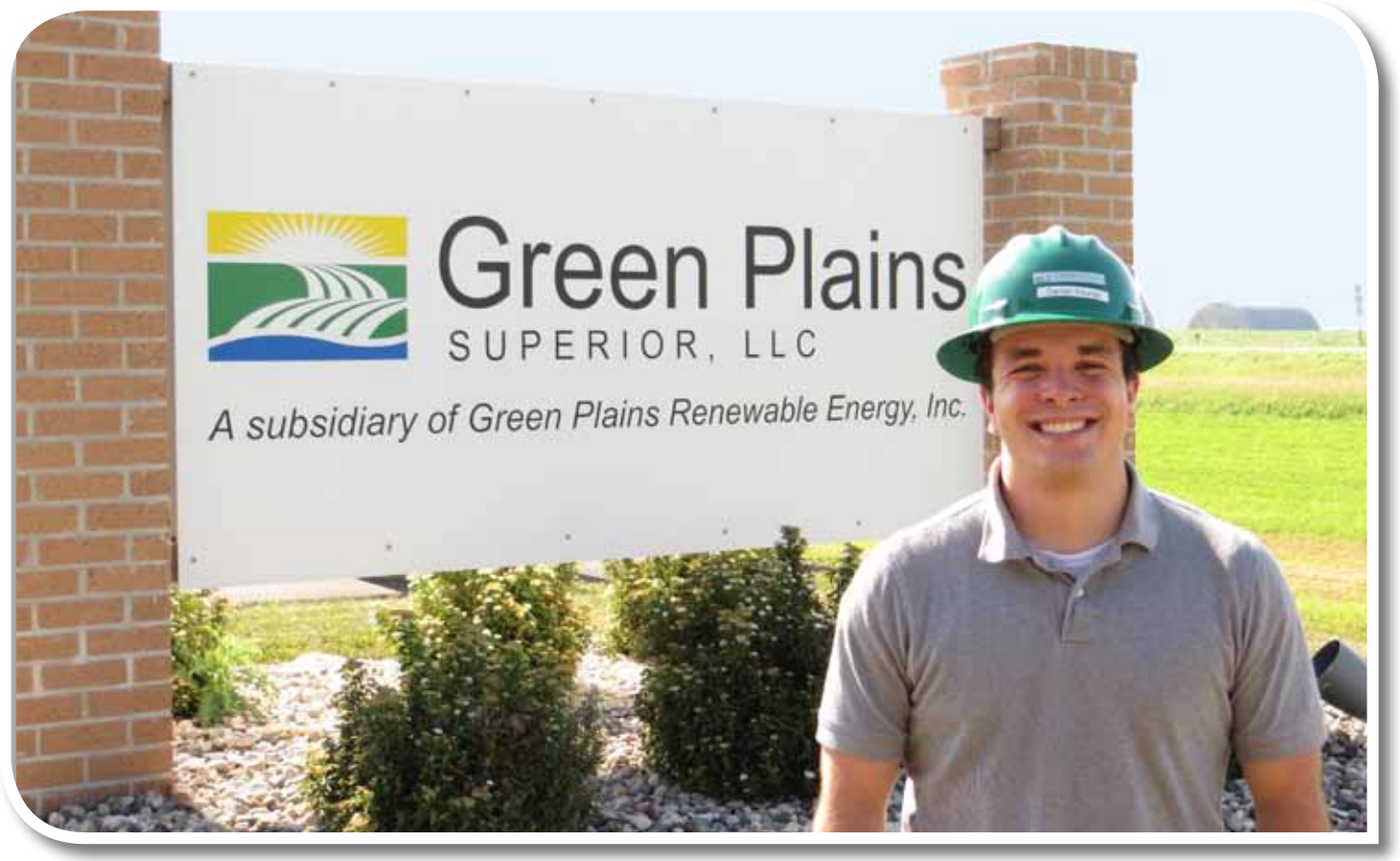
RESULTS

Sulfate Precipitation: The reverse osmosis retentate stream contains sulfate concentrations exceeding 2,800 ppm and must be diluted to below 1,360 ppm to meet discharge permit specifications. Sulfate precipitation of gypsum through addition of hydrated lime could theoretically reduce sulfate concentration to 1,300 ppm in an additional water treatment process. Precipitation of ettringite, a calcium hydrosulphoaluminate mineral, through the addition of aluminum trihydroxide could further reduce the sulfate concentration below 150 ppm. Implementation of a sulfate precipitation process would eliminate the need for dilution and create the opportunity to investigate becoming a zero liquid discharge facility.

Well Water Dilution: The facility currently dilutes the reverse osmosis retentate stream with softened water. Significant water treatment chemical use could be avoided by diluting the retentate steam with a mixture of untreated well water and soft water. An appropriate ratio of dilution water must be used to ensure iron concentrations are within permit specifications because well influent iron concentrations exceed the discharge concentration limit. Active control of dilution requirements avoids excessive dilution and reduces chemical use in an environmentally friendly and economical manner.

CONVENTIONAL AIR POLLUTANTS AND GREENHOUSE GASES DIVERTED IN STANDARD TONS

Total for all sectors					
CO_2	SO_2	CH_4	N_20	CFC	PM_{10}
1969.08	0.45	368.57	165.36	18.26	0.09



Filter Backwash Recycle: Well influent passes through a cold lime softening process to remove hardness and heavy metals. The softened water passes through sand filters to remove suspended solids carried over from the clarifier. Accumulation of suspended solids in the media results in flow reduction through the filter. A mixture of water and air is backwashed through the filter to fluidize the media, releasing the solids into the backwash water. Installation of a settling tank to separate the suspended solids from the backwash water would allow soft water to be recovered and reused.

Thin Stillage Clarification: Removal of additional suspended solids from thin stillage increases evaporator efficiency, allows for wetcake moisture optimization to reduce natural gas usage, and increases production capacity by removing non-fermentable solids in the backset. Disk nozzle centrifugation and microfiltration were investigated to determine efficacy of solids removal. A disk nozzle centrifuge produces a more concentrated retentate stream allowing for further processing, but operates at a lower suspended solids recovery than a microfiltration unit. Installing a disk nozzle centrifuge is recommended, to provide the greatest operational advantages while minimizing expenses.

PROJECT	ANNUAL COST SAVINGS	ENVIRONMENTAL RESULTS	STATUS
SULFATE PRECIPITATION	$65,410	77.8 MILLION GALLONS OF WATER	RECOMMENDED
WELL WATER DILUTION	$54,506	7.85 MILLION GALLONS OF WATER	IN PROGRESS
FILTER BACKWASH RECYCLE	$2,762	3.28 MILLION GALLONS OF WATER	IN PROGRESS
THIN STILLAGE CLARIFICATION	$145,000	780,000 GALLONS OF WATER 114,700 THERMS	RECOMMENDED