Water and Energy Efficiency in Ethanol Production

Minnesota Ground Water Association Spring Conference
May 8, 2008

Presented by:
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Minnesota Technical Assistance Program

- Technical Assistance by phone or site visits
- Intern Program
- Materials Exchange
- Fact sheets, Case Studies, Checklists on Pollution Prevention and Energy Conservation
MnTAP Ethanol Benchmarking Study

Energy
Water Efficiency
and
Water Quality
Process Benchmarking – Areas not Included

- Wet mill plants
- Feedstocks other than corn
- Cellulosic processes
- Increased corn production
- Plants started up in 2007
Understanding a Process through Benchmarking

- Definitions
- Data Collection
- Results
- Examples of Best Practices
You Manage What You Measure

**Benchmarks:** numerical standards for comparison

- Thermal Energy Use - 35,000 Btu/gallon ethanol
- Electrical Energy Use - 0.8 kWh/gallon ethanol
- Water Use - 4.2 gallons water/gallon ethanol

**Best Practices:** demonstrated techniques or process modifications

- Combined Heat and Power to Recover Waste Steam
- No Contact Steam Systems to reduce water use
- Biomethanators to improve water quality
- Recycling non-contact waste water
Data Collection Process

Plant Supplied Data:
- 15 Dry Mill Plants
- 3 Site Visits
- 3 Phone/Email Interviews

Other Data:
- Emission Inventory Reports
- Water Permits and Reports
- Water Use Reports
- EAWs
- Trade Journals
- Research Articles
- Conferences
Thermal Energy Use Index

2006 Thermal Energy Use Index
(Avg 34,800)

Old Plant Avg = 37,000
New Plant Avg = 29,000
2007 Manf Guarantee = 32,000

Facility - Randomized (newer facilities represented by double letters)
Ethanol Gas Use: Annual Energy Savings Potential

Current Benchmark Old Plants: 37,000 Btu/gal
- Avg Plant Size: 32 MGY
- Gas Use = 37,000 Btu/gal x 32 x 10^6 gal = 1,184,000 MMBtu
- Gas Cost @ $8/MMBtu = 8 x 1,184,000 = $ 9.5 million

Goal: New Benchmark of 34,000 Btu/gal
- Savings of 3,000 Btu/gal
- Gas Use = 34,000 Btu/gal x 32 x 10^6 gal = 1,088,000 MMBtu
- Gas Cost @ $8/MMBtu = 8 x 1,088,000 = $ 8.75 million
- Cost Savings @ $8/MMBtu = $9.5 – $8.75 million = $750,000
**Electrical Energy Use Index**

*Electrical data was not publicly available*
Water Quality and Use

Ethanol Facilities in Minnesota - Present and Future
August 22, 2007

Facility Status
- Existing
- Under Construction
- Proposed
- Tentative

Capacity in millions of gallons

Potential Availability of Ground Water for High Capacity Uses
- Ground water available – Multiple regional aquifers
- Ground water available from near-surface glacial sediments
- Ground water limited, available only in isolated aquifers
- Ground water generally not available

Minnesota Pollution Control Agency

Minnesota Technical Assistance Program

University of Minnesota
Water Efficiency

2006 Water Efficiency
(Based on Undenatured)

Facility - Randomized (newer facilities represented by double letters)

Avg = 4.6
Avg = 3.4
*2007 ~ 2.7
Water Quality vs. Efficiency - Issues and Trends

Variability in Quality of Water Supply

Dissolved Solids Levels Increase with Recycling Rates

Chemical Additives used

Multiple Water Quality Standards Related to Dissolved Solids Pollutants

First Generation
• Limits on BOD and TSS

Second Generation
• Increased Monitoring of Dissolved Solids or Phosphorus

New Construction
• More Limits and Zero Liquid Discharge Systems
The Water Cycle and Related Best Practices

- Public Records
- Resource Planning
- Upgrade Treatment Equipment
- Dry Cooling Tower or Recover Evaporation
- Recycle Non-Contact Cooling Water
- Recover Evaporation

Flow rates and volumes are indicated in gallons per minute (GPM) and millions of gallons per year (MMgal).
Energy Best Practices

Diagram from Midwest Ethanol Producers LLC
What Was Learned from Benchmarking

- Water Quality is a significant issue
- Water use will go down as energy use is reduced
- Retrofits are happening at old plants
- Large investments can be justified
- Innovation is common
MnTAP Summer Intern Projects

Granite Falls Energy – Installation of a Steam Turbine in parallel with the Pressure Reducing Valve

Minnesota Energy – Reuse of non-contact utility waste water through improved water treatment