Benefits of Membranes for Ethanol Dehydration

Whitefox ICE™
Increase Production Rate
Reduce Energy Use
Improve Plant Cooling
It’s Summer! Its Hot! Keeping Cool is on everyone’s mind

Cooling is one of the benefits of Whitefox ICE™

Be One of the Cool Ones
ICE™ approaching 90 MMGPY Installed Capacity in 2018

<table>
<thead>
<tr>
<th>Company</th>
<th>Capacity</th>
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</thead>
<tbody>
<tr>
<td>Delta-T Pacific Ethanol</td>
<td>18,000 GPD</td>
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<tr>
<td>Delta-T Pine Lake Corn Processors</td>
<td>18,000 GPD</td>
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<tr>
<td>Delta-T Fox River Valley Ethanol</td>
<td>36,000 GPD</td>
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<tr>
<td>ICM E Energy Adams</td>
<td>70,000 GPD</td>
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<td>Delta-T United Ethanol</td>
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<tr>
<td>Delta-T Chippewa Valley Ethanol Company</td>
<td>36,000 GPD</td>
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<tr>
<td>Delta-T ACE Ethanol</td>
<td>36,000 GPD</td>
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<td><strong>Total:</strong></td>
<td><strong>250,000 GPD</strong></td>
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Hydrophilic Polymer Hollow Fibre Membrane:

- Dehydrate in vapor phase
- High membrane packing density
- Medium Selectivity - tie-ins to existing vacuum (2.0 – 3.5 psia), no chillers, compressors
- Robust design, low maintenance, long life
Proven Operations in U.S. Corn Ethanol
- Three systems operational (>30,000 hours)
- Five projects in engineering and execution

Whitefox Membranes: Best for Biofuels

Modules
- Scalable cartridge concept
- 3 or 7 cartridges per module
- Compact footprint
- Larger systems = more cartridges

Improves Process
- continuous separation, no swings
- Stabilizes operations, improves control
- No cleaning or regeneration cycles
Benefits of a Whitefox ICE™ Solution for Corn Ethanol Plants

**Improves revenues:**
- Whitefox ICE™ Regen unit produces additional ethanol, 15 – 30% of plant is currently recycled load

**Improving profitability on a total per gallon basis:**
- Steam savings (500 to >2,000 BTU/gal)
- Carbon intensity reduction, LCFS Premiums
- Reduces cooling water use, higher summer production rates
- Improves and stabilizes operations – optimized control of distillation

*Picture Shows 36,000 GPD Whitefox ICE™ System*
18,000 GPD System Design
Energy and Cooling Savings verified by PG&E
First installation in new ARB Pathway, captures CI Premiums
Cooling load reduction led to record-breaking summer production
Pacific Ethanol: Natural Gas Reduction, Capacity Increase

* BTU/gal savings are net of plant energy efficiency increase with run rate
Reduction in CW load correlates to reduction in natural gas consumption, leads to higher summer production rate
Average 33 to 38 mmgy increase, 10% kWh/gal reduction
Cooling benefits allow for record-breaking summer production
>1000 btu/gal average gas savings on partial regen
Expansion underway, New Heat Exchange component increases Gas Savings
Currently producing 20,000 GPD Additional Product.

Gas Savings 1400 btu/gal - 6 mo. average (60% Regen)

Expansion underway – Designed for 100% Regen

Whitefox Vacuum Improvement, Retentate to Beer Preheat
Further improvements by working together

3,000 BTU/gal
Conclusions

- Membranes proven, improve operations, and are the way forward.
- Demonstrated over 30,000 hours of continuous operations in US biofuels plants, production of 25 million gallons of in-spec ethanol.
- Our membranes reduce energy and cooling water use, improve margins.
- Your plant may have already carried out “low hanging fruit” projects, Whitefox now in next stage of significant plant improvements.
- ICE™ up to 3,000 BTU/gal by processing Regen, other Recycled streams.
- ICE-XL™ can more than double that.

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