The Use of Controlled Flow Cavitation (CFC™) to Enhance Biofuel Processing
Installed 2011
Capacity increase > 10%
Catalyst reduction > 25%
Report savings in catalyst cost of $450k to $1.35MM USD/year
MG reduced to be always in spec
Still using the same pump
No issues with the CFC™ device
“Arisdyne's system is easily installed without the need for production shut down, saving about three weeks of production output”
Continuous Biodiesel Production Using Controlled Flow Cavitation
Hydrodynamic Cavitation

Increase of speed leads to reduction of pressure

Reduced pressure leads to evaporation and vapor bubbles
CFC™ - cause & control cavitation

Compare ‘Controlled’ vs. ‘Uncontrolled’ Cavitation Demo at www.arisdyne.com
Adjustable Device
25+ years of design experience

No Recycle! No Maintenance!

No CIP! Anti-Clogging!

US 6502979 B1: Device and method for creating hydrodynamic cavitation in fluids
# CFC™ Operational Advantages

## CFC™ Technology

### Adjustable Capacity?
- ✓ Always < 2.3 kWh/mt
- ✗ Dependent on recycle rate

### Anti-Clogging Design?
- ✓ No dark material buildup
- ✗ CIP required

### Pressure Sensitivity?
- ✓ Works equally well in range of pressure
- ✗ Fixed pressure necessary

## Trad. Cavitation

## Diagrams

- CFC™ Technology diagram
- Trad. Cavitation diagram
Anticipated Improvements
With CFC™ Transesterification

- Increase in Capacity: 10-20% (Reaction efficiency >99%)
- Reduction in Catalyst Consumption: 15-30% (Typical 4.5-5 kg/mt as 100% w/ 6:1 molar ratio of methanol to glycerides)
- Reduction in Monoglycerides: 15-60% (Typical < 0.3% Mono Content)
- Adjustable Device for Optimum Performance at Different Capacities
- No Production Downtime for Installation
Small Footprint, Simple Design
Small Footprint, Simple Design
Durable and Low Maintenance

No Seals!

Only Annual Maintenance:
Check Valves and Diaphragms
# Industrial Scale Example

## Biodiesel Production

<table>
<thead>
<tr>
<th>FEED</th>
<th>FFA (%)</th>
<th>Moist (%)</th>
<th>Catalyst Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>UCO, Tallow, Grease, SBO, CNO</td>
<td>&lt; 0.15</td>
<td>&lt; 0.05</td>
<td>30% NaOCH₃</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Transesterification</th>
<th>Feed Rate [kg/min]</th>
<th>Catalyst Usage [%]</th>
<th>Mono Content [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional</td>
<td>317</td>
<td>1.8</td>
<td>0.59</td>
</tr>
<tr>
<td><strong>CFC™</strong></td>
<td>363</td>
<td>1.5</td>
<td>0.28</td>
</tr>
<tr>
<td>(achieved at 272 kg/min flowrate and 1.8% catalyst usage)</td>
<td>(achieved at 363 lbs/min and 1.5% catalyst usage)</td>
<td>Avg. &lt; 0.45</td>
<td></td>
</tr>
</tbody>
</table>
CFC™ - over 25 successful years

- First applications: Reaction enhancement, Nanomaterials synthesis,
- Strong IP: 40+ issued patent families, 250+ patents and patent applications
- Currently more than 15% of all soy, canola and sun oil is produced with CFC™
- Non-Confidential Blue-Chip Customers:
Thank You For Your Time

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