Water Sustainability & Conservation in an Exhaust Cooling Discharge System
Case Study

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Component Research Air Facility (CRAF)

- Simulates high altitude conditions for aircraft and aviation fuels research
- Exhaust >3000 F at flows >36,000 cfm
- Cooled by water to 100 F
- Up to 1000 gpm water flow
Challenge

- Design an Exhaust Cooling Discharge System (ECDS)
  - Treat free product
  - Treat emulsified fuel in water
  - Treat 300,000 gallons of water/research effort
  - Efficiently cool while limiting wastes
  - Determine viability of using fuel contaminated water to cool
  - Determine ability to recycle the water
  - Work within existing infrastructure
Technologies Evaluated

• Oil/Water Separator (OWS)
• Air-Sparged Hydrocyclone
• Direct Sanitary Discharge
• Diffused Air Flotation (DAF)
• OWS & Clay Towers – discharge to storm or sanitary
• OWS & Clay Towers – closed loop system
Ranking Parameters

- Initial cost
- Recurring annual cost
- Installation cost
- Risk
Oil/Water Separator

- Mechanical separation of oil and water
- Pros
  - Separates free product
- Cons
  - Cannot separate emulsified fuels
Air-Sparged Hydrocyclone

• Removes hydrophobic particles from aqueous solutions
• Vehicle wash racks & engine test cells
• Pros
  – High removal of oil & grease
• Cons
  – Low flows 20 gpm – 250 gpm
Direct Sanitary Discharge

• OWS – Separates free product – discharge to sanitary

• Pros
  – No EPA compliance monitoring
  – No waste disposal
  – No chemical handling

• Cons
  – Existing line too small
  – Disposal costs for sewage (present & future)
  – Lack of water conservation
Diffused Air Flotation

- Chemicals used to flocculate emulsified fuels
- Air bubbles raise fuel to surface

**Pros**
- Meets compliance levels for storm water discharge

**Cons**
- Large footprint needed
- Recurring waste production – sludge disposal
- EPA compliance monitoring (storm water)
- Chemical purchases and handling

17 June 2010
OWS & Clay Towers – Discharge to Storm or Sanitary

- OWS – removes free product
- Clay towers – remove emulsified fuel
- Pros
  - Can meet storm water compliance
  - No chemical handling
- Cons
  - Replacement of clay & waste disposal
  - Compliance monitoring
  - Freezing problems
• OWS – removes free product
• Clay towers – remove emulsified fuel

• Pros
  – Recycles water
  – Can meet storm water compliance or can discharge to existing sanitary
  – No chemical handling

• Cons
  – Replacement of clay & waste disposal
  – Freezing problems
  – Fuel in recycled water
## Selection Parameters
(1 Lowest , 4 Highest)

<table>
<thead>
<tr>
<th></th>
<th>Initial Costs</th>
<th>Annual/Recurring</th>
<th>Installation months</th>
<th>Risk</th>
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<tbody>
<tr>
<td><strong>Sanitary Line</strong></td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>1</td>
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<tr>
<td><strong>Closed Loop</strong></td>
<td>2</td>
<td>3</td>
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<tr>
<td><strong>OWS with Clay</strong></td>
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<td>3</td>
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<tr>
<td><strong>DAF</strong></td>
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</table>
Preferred Option

• Closed Loop
  – Can it actually be accomplished?

• Additional Details
  – Estimate fuel concentration in recycled water
    • Can it safely be recycled to cool exhaust?
    • Can water be recycled without clay?
  – Can existing sanitary line be used?
  – How much water needs to be stored for release to sanitary?
  – Infrastructure limitations
Fuel Concentration

• 4000 ppm average (200 gal fuel, 50,000 gal water)
• Not to exceed 15,000 ppm
• Measured concentration in trial run
  — 600 ppm time 0
  — 250 ppm time 2hrs
• Water with emulsified fuel can be recycled safely without clay polishing
Sanitary Line

- OWS ensures free product capture
- Sanitary line survey conducted
  - Existing line - <200 gpm discharge acceptable
- Flashpoint test
  - > 140 F for emulsified fuel
- Discharge temperature
  - < 70 F
- Existing line can be used for discharge

17 June 2010
Water Storage

• 60,000 - 100,000 gallons
• 2 or 3 tanks 35,000 gallons each
Infrastructure Limitations

- Location of 1500 gpm OWS
- Location of 35,000 gallon towers
Conclusion

• Closed Loop System can be accomplished
  — Unique combination of OWS, two-35,000 gallon storage tanks, recirculation of water to cool the exhaust and low flow controlled discharge to sanitary sewer
• Recirculation saves approximately 20M gallons of water/year