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Automation of Separation for More Bottom of the Barrel Return

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Abstract

- The Search for better “bottom of the barrel”
- Particle Sensor Introduction
- FCC/RFCC
- Slurry Oil products
- Solid Removals option
- Slurry Yields and Properties
- Mechanical vs. Electrostatic Separation
- Economics
- Conclusions

Maximize Your Return from Every Barrel

- **Heavier Crudes**
  - Residual upgrading
  - Increased catalyst use
- **Catalyst Concerns**
  - Refiners are seeking to add value to Residual Fuel Oil
    - Have to remove catalyst
  - Downstream Catalyst in fuel oil and feedstock increases maintenance and fouling
    - Heavy Oil Processing
  - Higher concentrations of catalyst in clarified oil presents only a narrow range of applications
  - Build up of sludge in downstream refinery processes
  - Loss of catalyst in deteriorating FCC units
    - Catalyst contains Rare Earth Metals and ZSM5

FCC/RFCC

- Heavier crudes increase FCC catalyst consumption.
- FCC vital in the growing demand for propylene
- Increased economic demands require more residual to be sent to the FCC/RFCC
- Degrading FCC reactor side cyclone efficiency increases Catalyst lost , Recovery is key
- FCC/RFCC units approx. 20-25 tons of catalyst per day turnover with petrochemical driver.
- Catalyst removal from Fractionator bottoms:
  - Upgrade in (CSO) quality/ value
  - Hazardous waste reduction
  - Decrease in downstream maintenance, downtime
  - Reduction in landfill and catalyst loss

The Real Deal – What is it Worth?

- FCCU 80,000 B/D – SLURRY AVERAGE 6%
- Removal of fines <5 microns at 3000ppm to <100ppm
- 5 tons/ day of fines removed from settling tanks
- Separation of fines upgrades CSO value
- Assuming $4.0 per barrel product increase
- Waste Savings $1.8Million/year
- 4800 BPD*365*$4.0/ BPD =$7.0 Million/ year

- Think Millions!

CSO Value – More Valuable End Products

- Average FBO/CSO Differential: $**4.00 - $6.00 USD Per Barrel**
- Related Annual Increased Revenue: $**4.7M USD Per Year**
- CSO Payout from Increased Revenues**: 7.7 Months**

CSO Market	Clarified Slurry Oil (CSO) Clarity (PPM)
Carbon Black Feedstock	**100 – 500**
Refinery Fuel	**50 -150**
Marine Fuel	**50 - 100**
Pitch Feedstock	**25 -100**
Needle Coke Feedstock	**25 - 100**
Hydrotreater Feedstock	**10 - 50**
Carbon Fiber Feedstock	**5 - 10**

Solids Removal Options

- **Decant Oil – Settling Tanks**
  - Time vs. cost
  - Settling agents
  - Hazardous waste
- **Mechanical Filtration/ Centrifuge**
  - Limited filtration size.
    - ≥ 100ppm
  - Susceptible to plugging with Asphaltenes, waxes
  - Deterioration of liners Q2yrs= increased cost
  - Membrane filters
- **Electrostatic Separation**
  - Effective on particle sizes <5μ
  - Not susceptible to blockage
  - Increased throughput

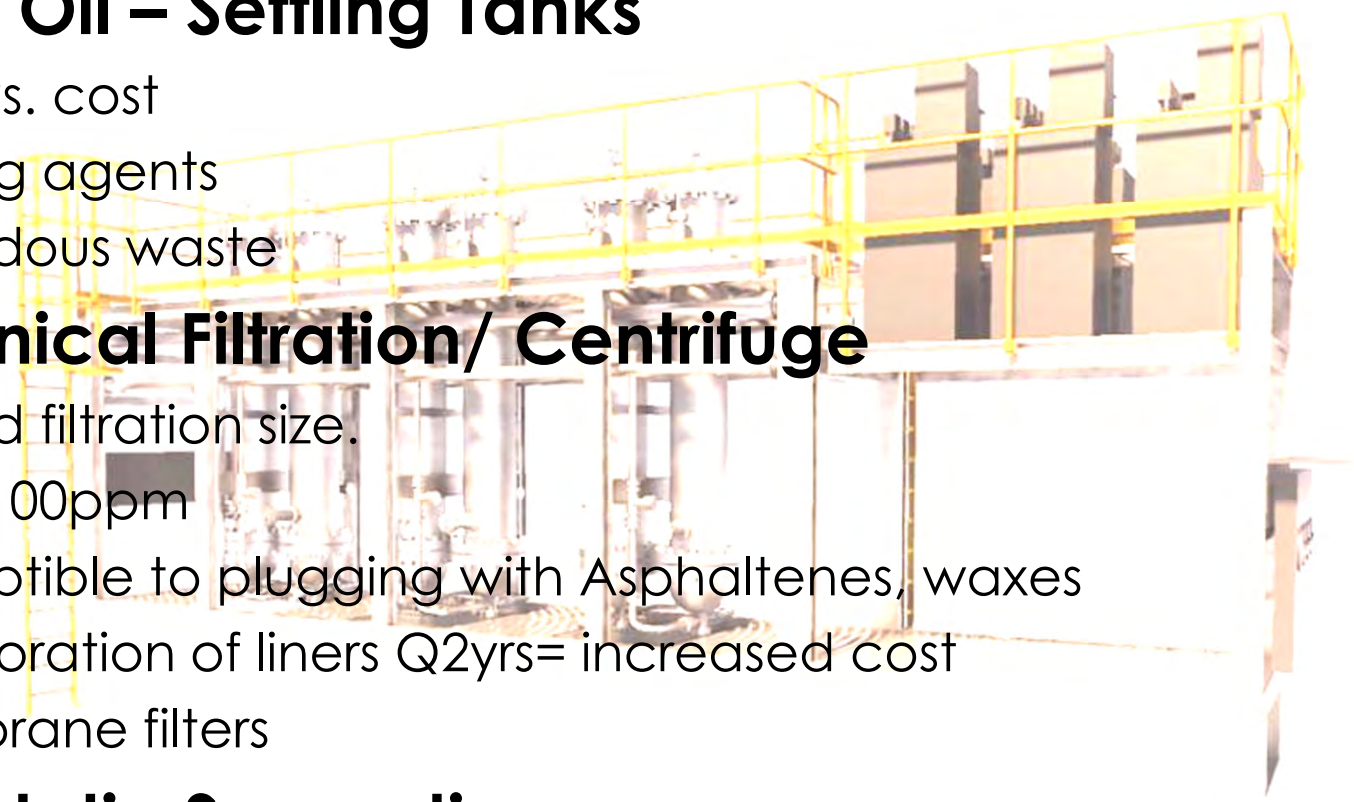

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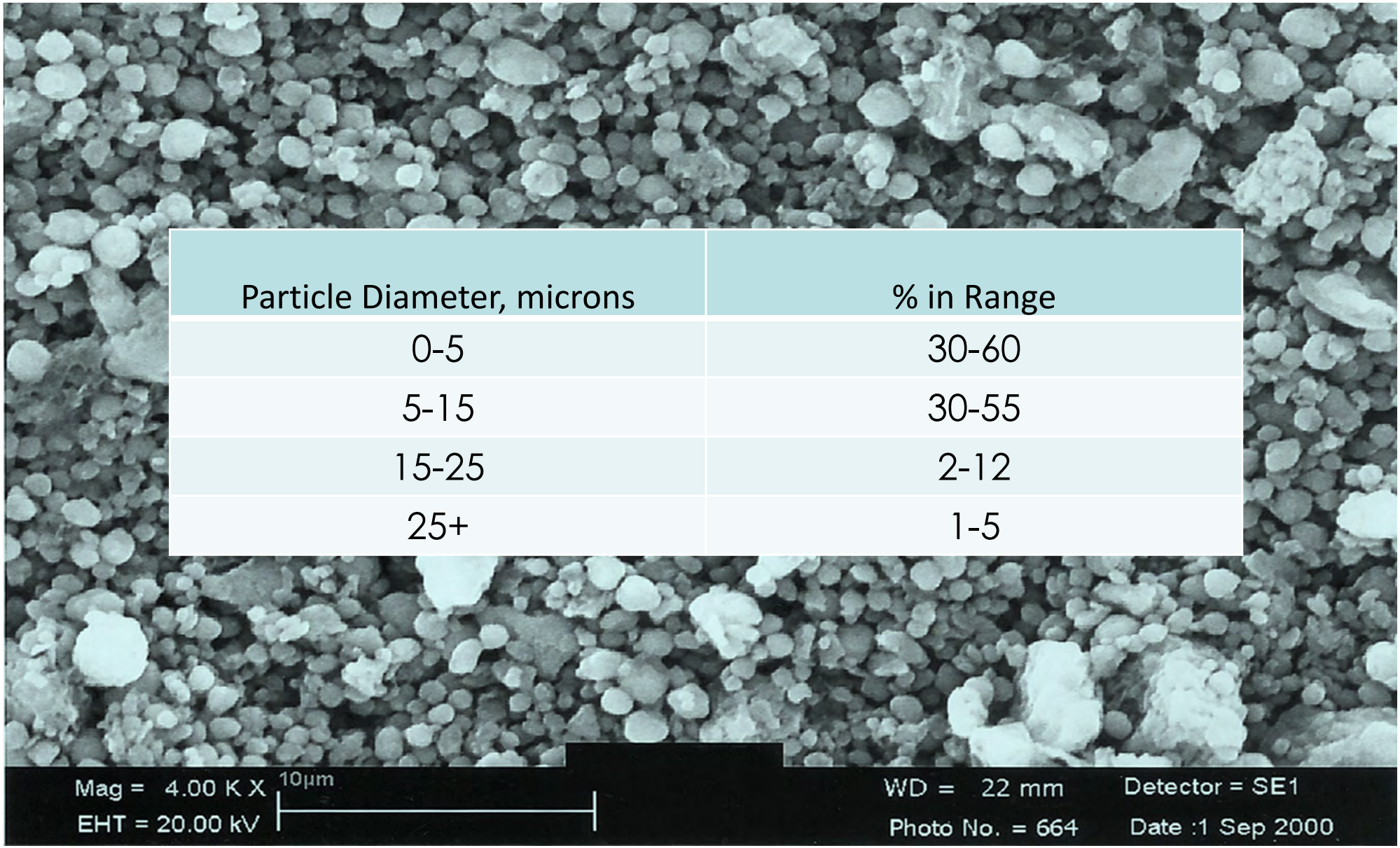
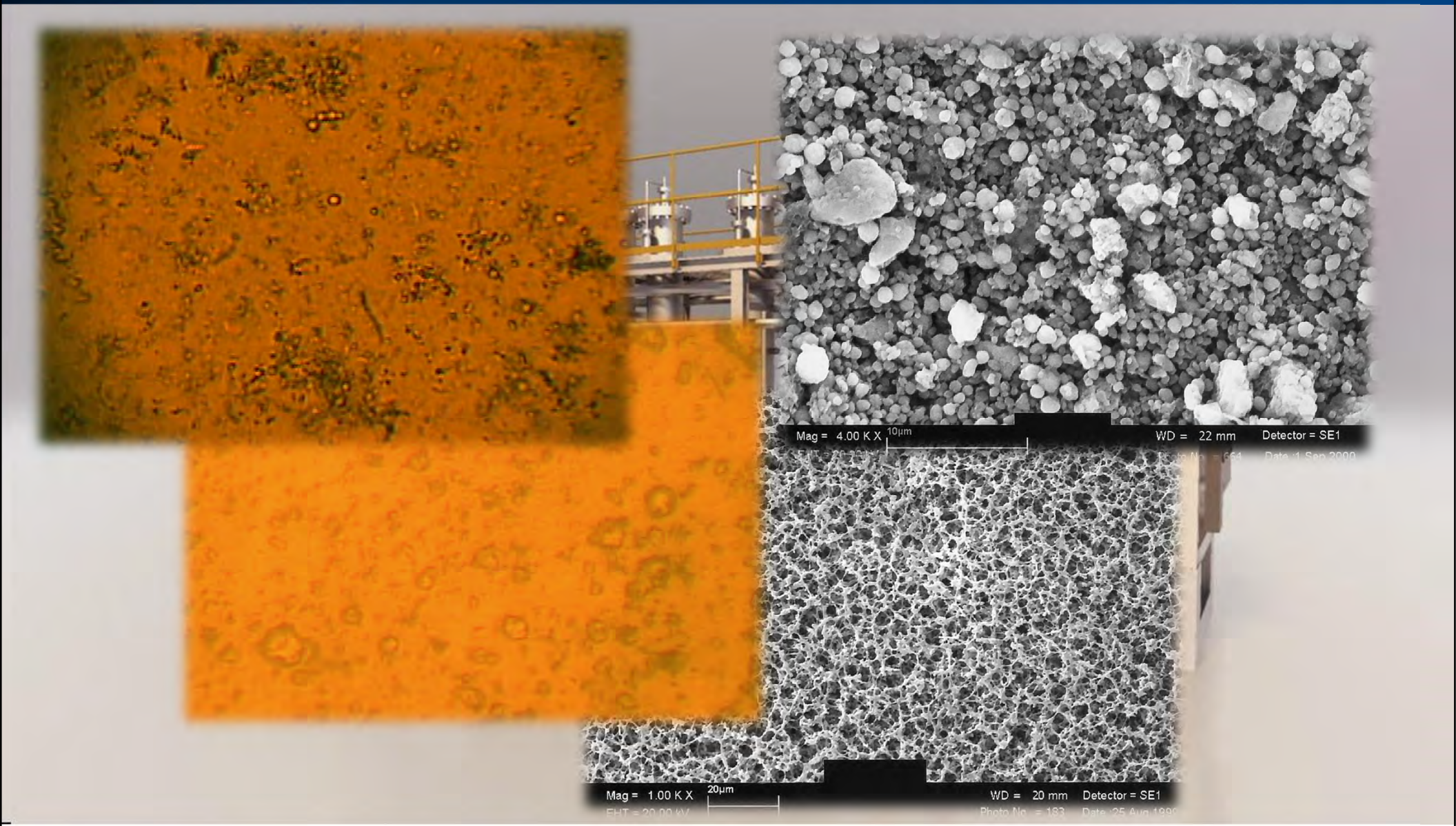
Table 2 Typical Particle Size Distribution in Slurry oils



Particle Diameter, microns	% in Range
0-5	30-60
5-15	30-55
15-25	2-12
25+	1-5

Dark Oil Particle Sensor and Analyzer

Electrostatic Separation Results with Particle Sensor Automation



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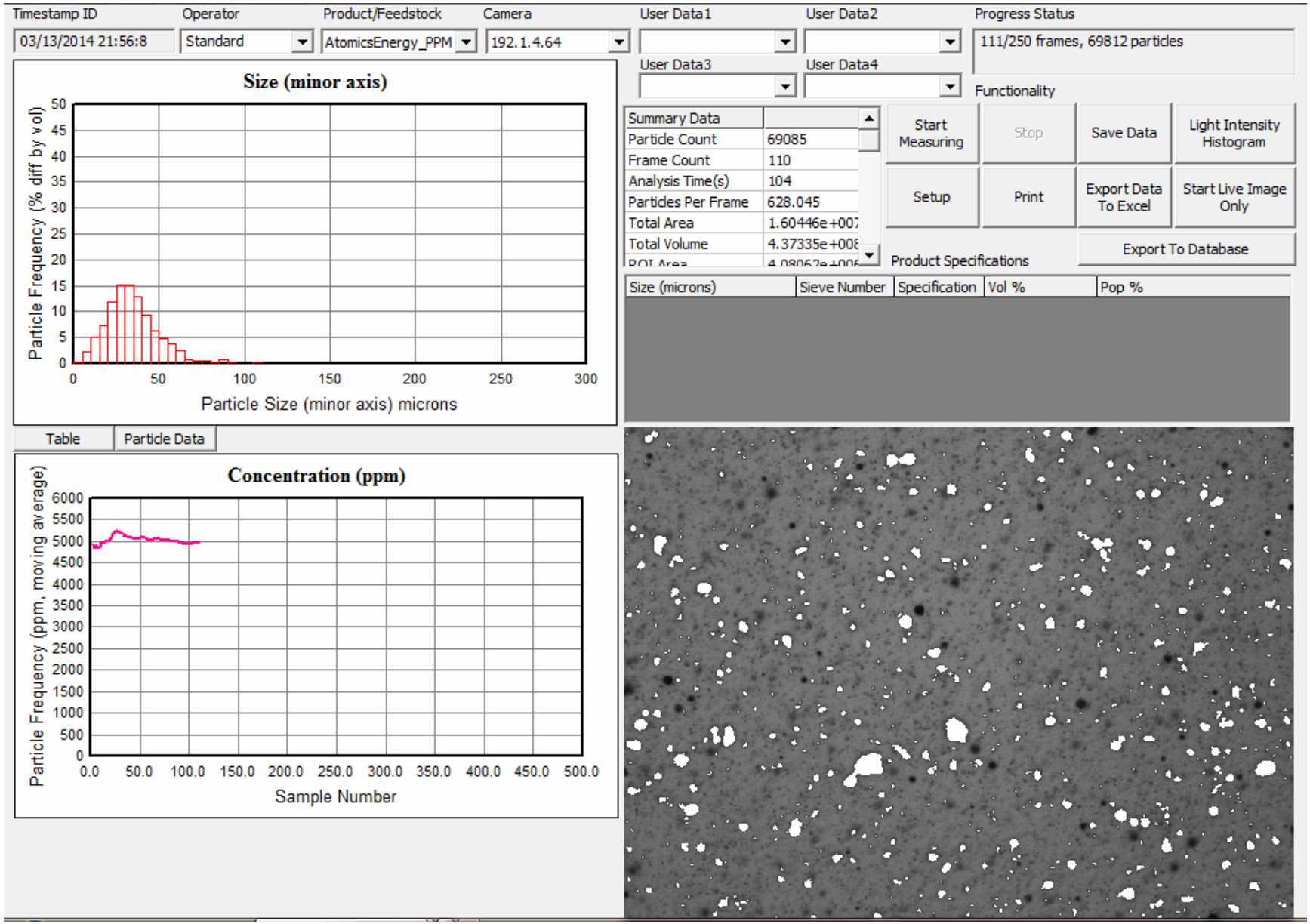
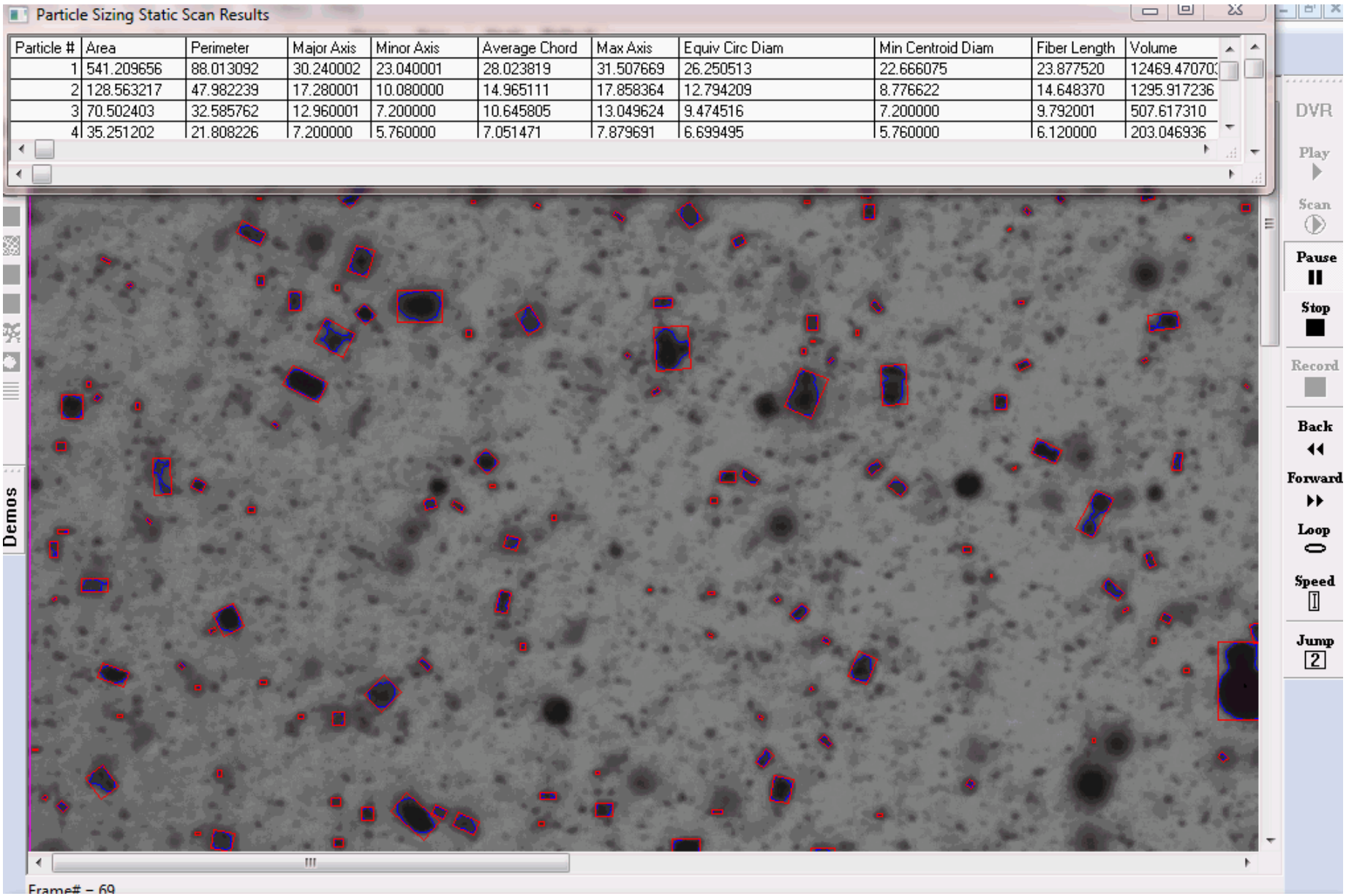
Dark Oil Particle Sensor Automation Results





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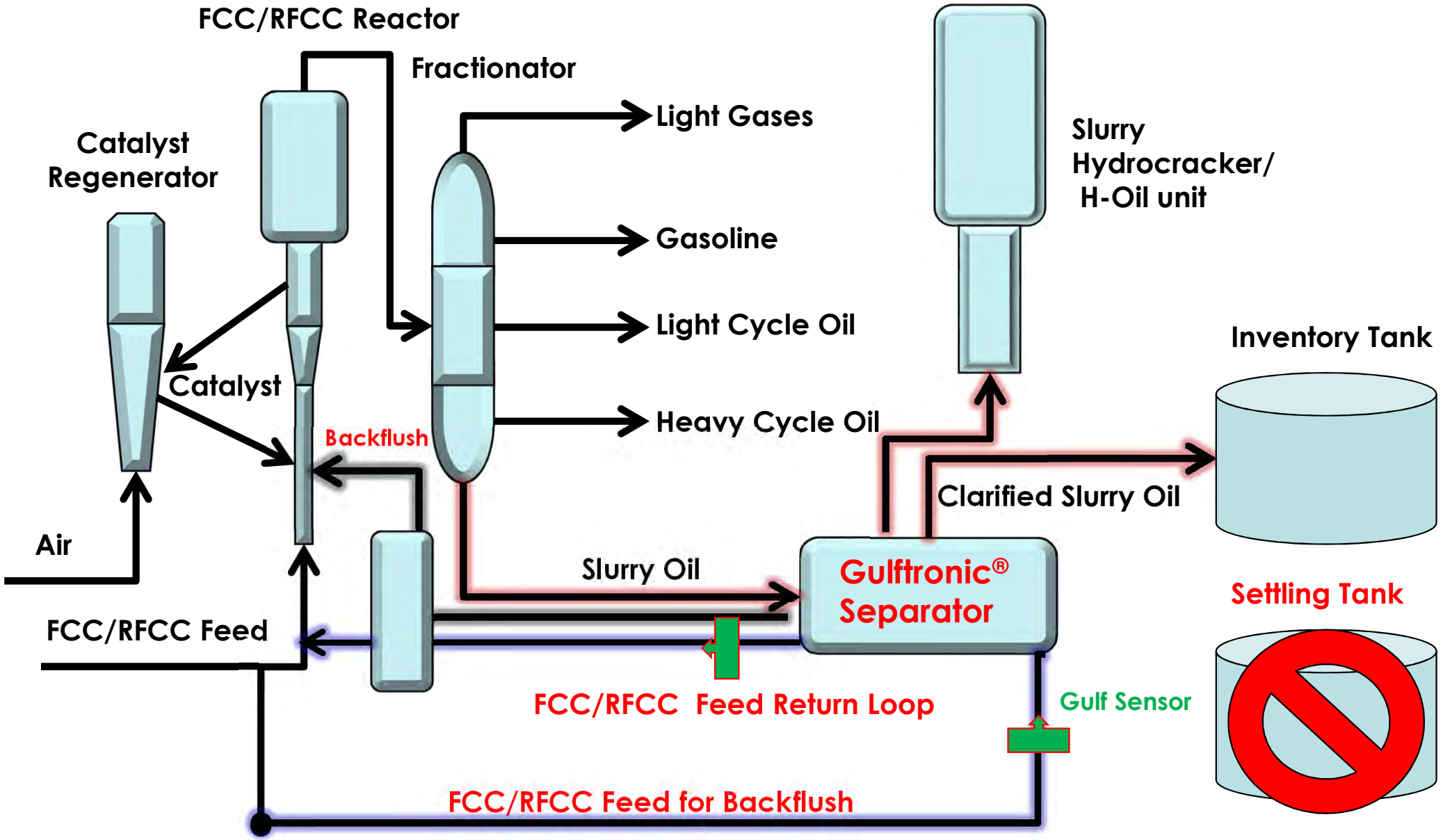
Electronic Separators – Increased Value



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Conclusions

- Drive to more resid FCC favor solution to recover catalyst without coking and Asphaltenes.
- Heavier Crude slates has inevitably effected every FCC/RFCC operation and increase in Catalyst fines during processing
- Increased profit is lost without proper catalyst recovery.
- Mechanical Filtration is questionable with new refinery demands in safety and processing.
- Electrostatic Separation; Safe, Reliable and Effective.