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# Vision Based Ethernet Applications in Oil, Gas, Tar Sand and Refining

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# Vision Applications

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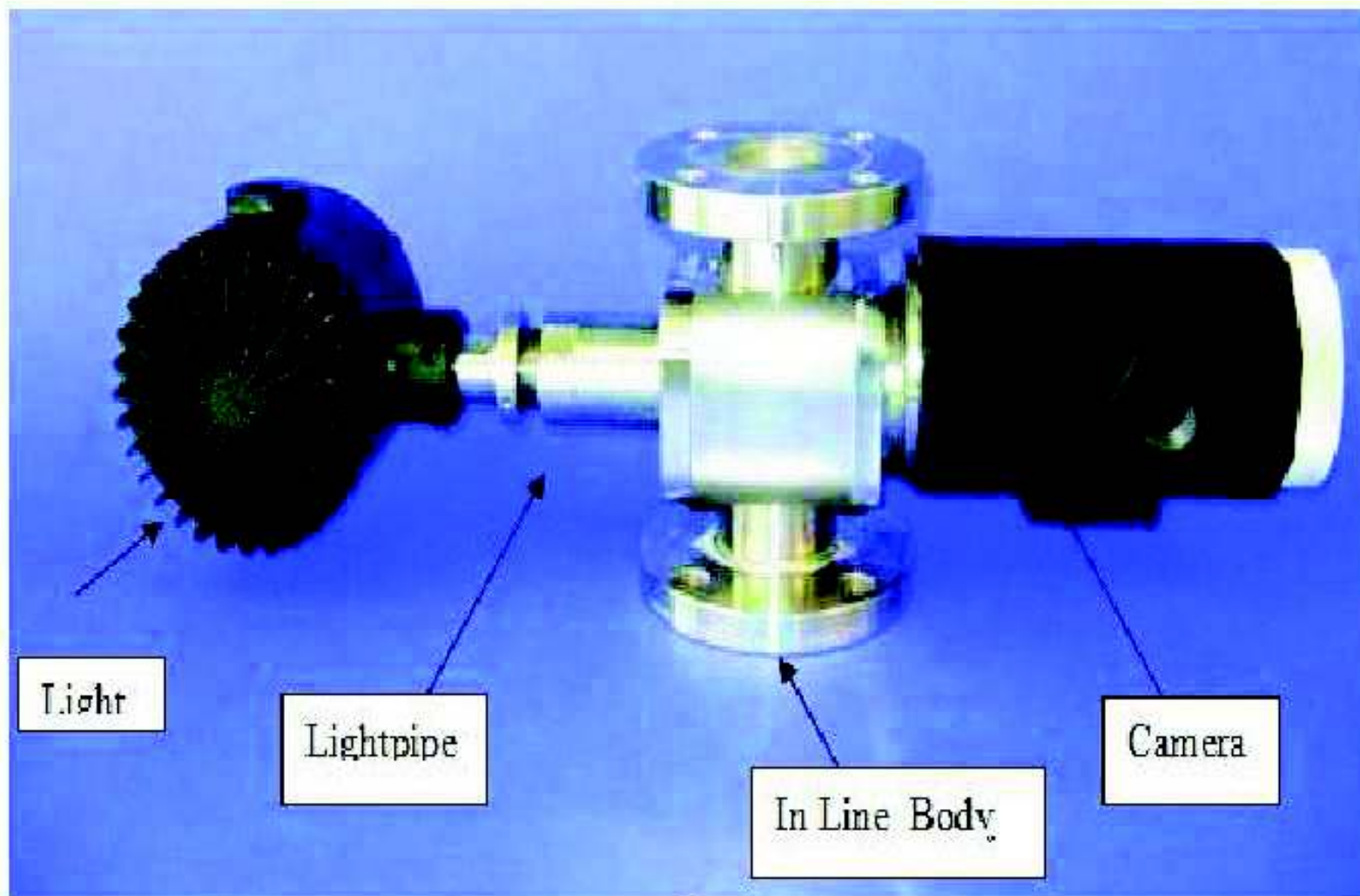
- Produced Water Concentrations
- Water in Oil Analysis
- Oil In Water Analysis for Discharge
- Multi-cut Sand
- Flame and Tube Analysis in Furnaces

# Vision System Components

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- Rugged Hardware Package
- Intense, Controlled Illumination
- Controlled Measurement Zone
- Well Designed Optical Package
- Ethernet Connectivity
- Robust Software

# Typical In-Line System



# Vision System Fundamentals

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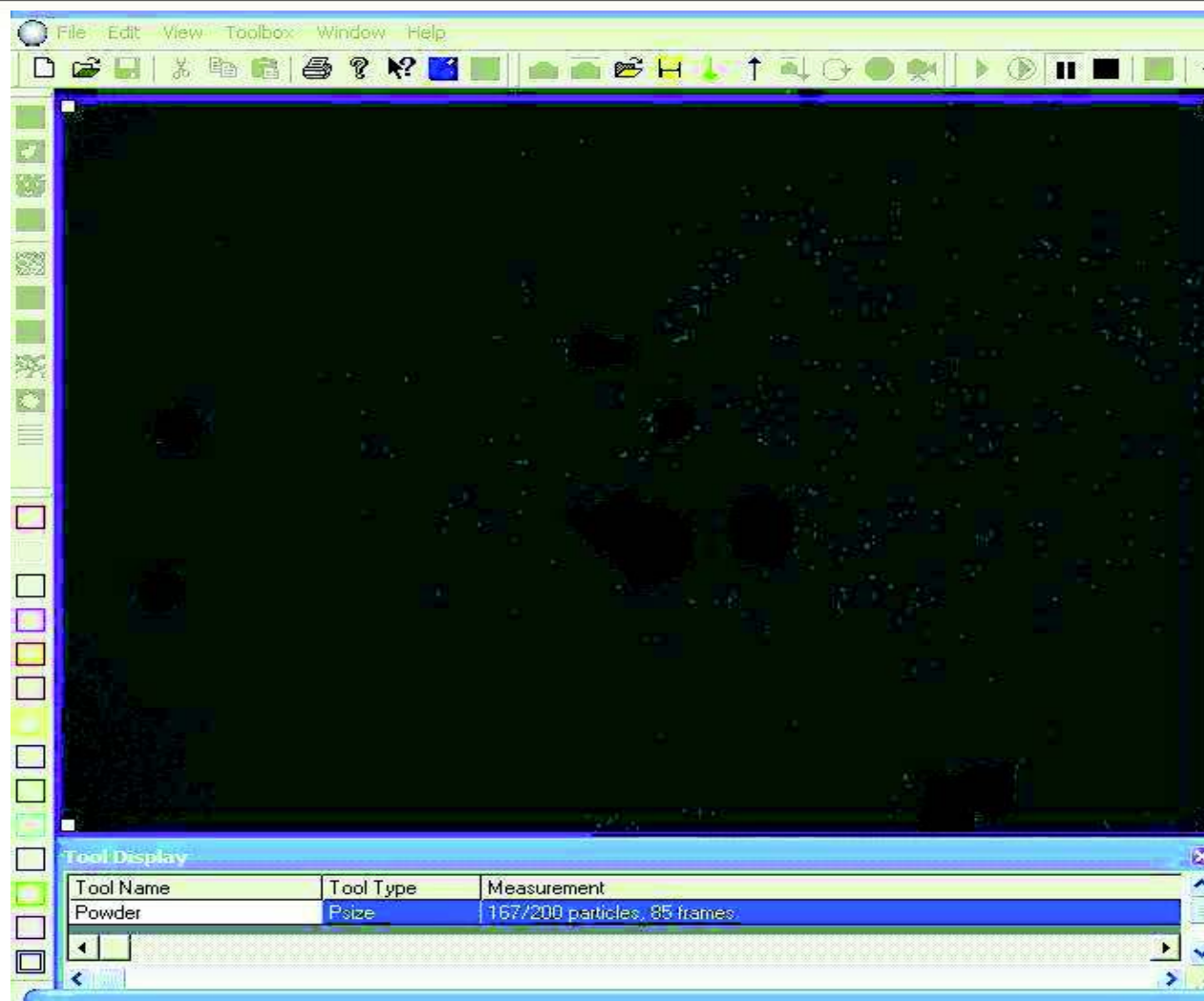
- Operating Principle: Mimic Human Eye-Brain
- Visual Verification
- Illumination
- Full 2-D Shape Analysis Capabilities Including:
  - Aspect Ratio
  - Major/Minor Dia
  - Area
  - Average Chord
  - Perimeter
  - Circularity

# Visual Confirmation of Settings

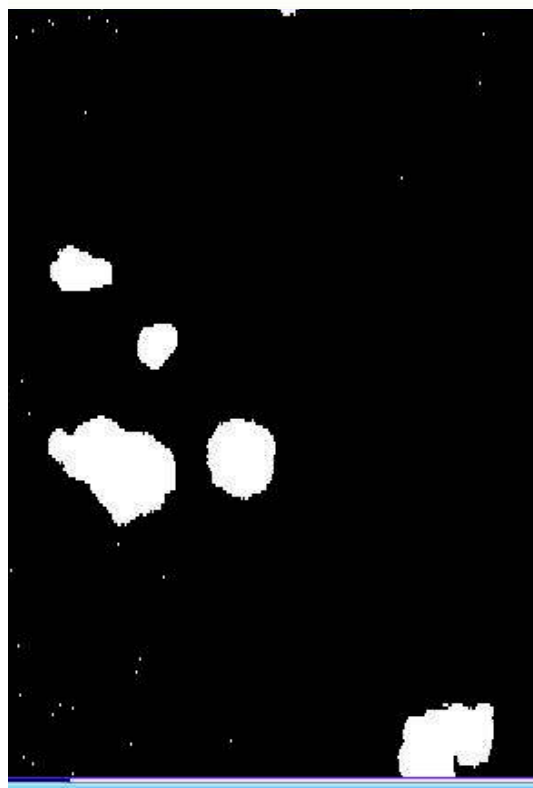
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- The following images show how visual verification assists the operator in properly defining detected particles.
- The first image shows actual process view.
- Subsequent images show the digitization of the particles with one image being correct and the other two showing particles too large or too small. These settings are made through software control panel.

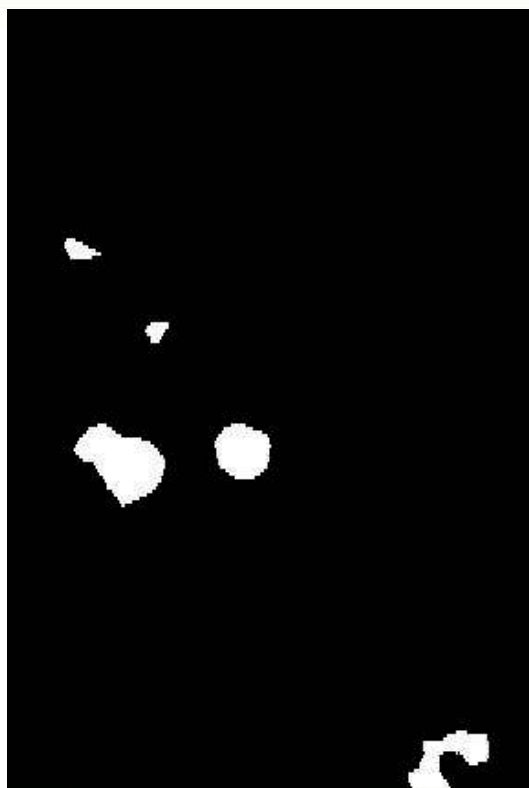
# Live Process Image



# Digitized Process Images



**TOO LARGE**



**TOO SMALL**



**CORRECT SIZE**



# Produced Water Analysis

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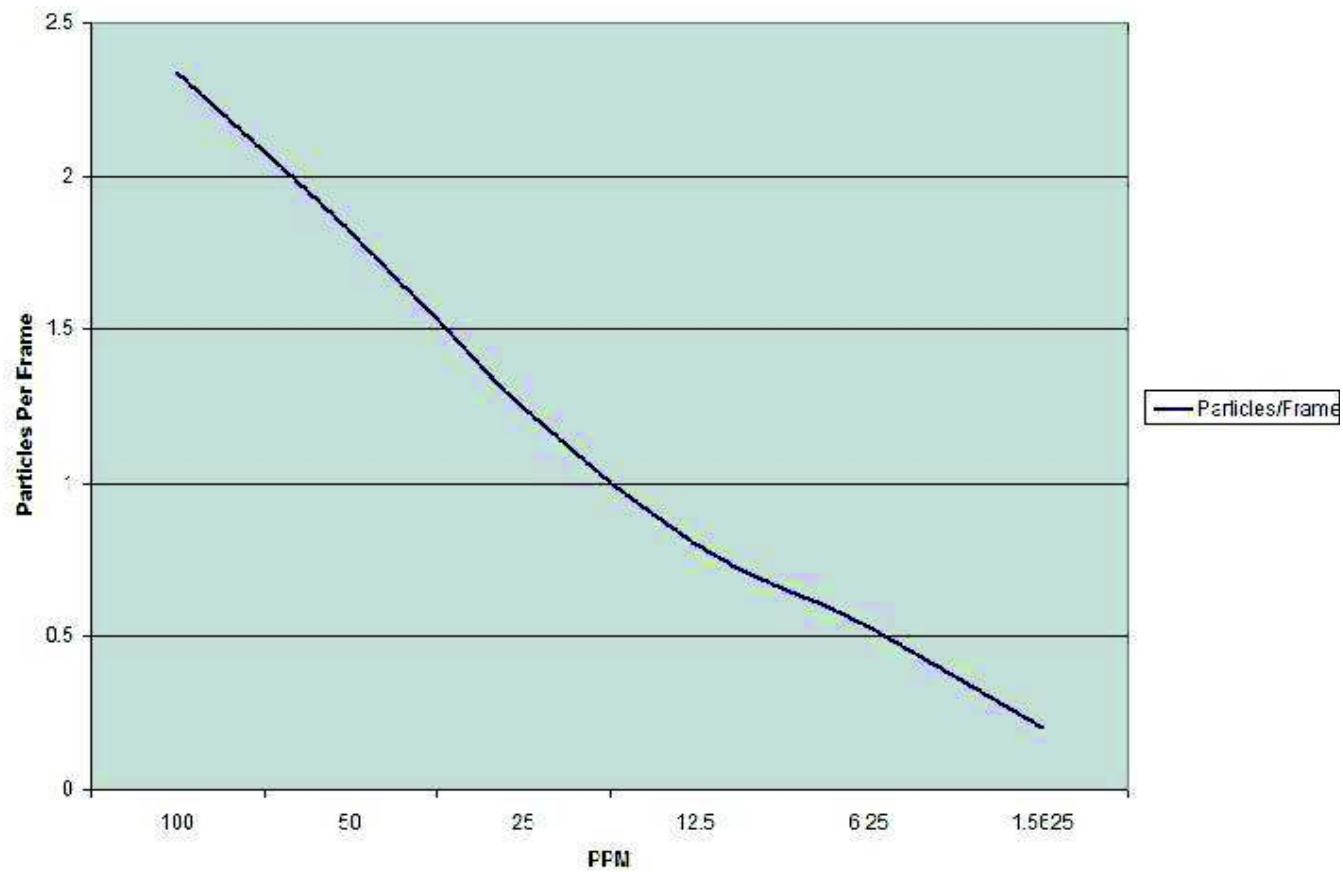
- Produced water can be re-injected or dumped to environment. Re-injection may require treatment and off loading to surface environment requires cleaning and monitoring.
- In-Line Oil in Water Vision provides for count of contamination, but also visual analysis of the various constituents that may exist in produced water.

# Analysis of Oil in Water

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- In order to demonstrate the detection capability of vision, several samples were prepared of oil in water concentrations ranging from 1.56 ppm to 100 ppm. These concentrations were run through a piping system fitted with a typical Oil in Water analyzer. The results are displayed in the following frame.

Part des/Frame



# Particle Identification

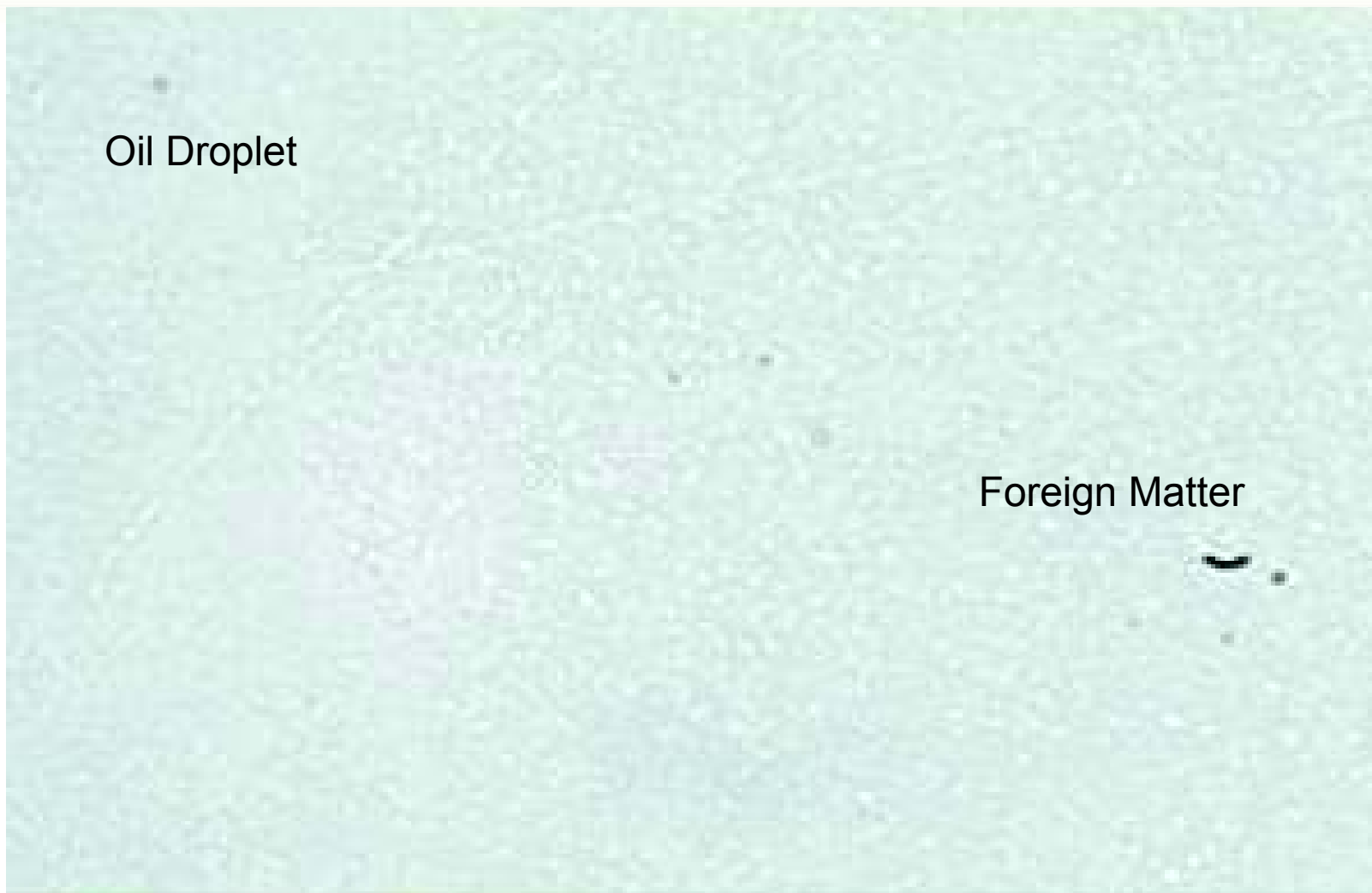
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- In addition to detection, particle identification is also possible. This inherent feature enables droplets to be distinguished from non spherical particles such as crystalline structures or other shapes of particulate that may be present.

- System can identify:

Aspect Ratio, Circularity and Transparency

# Particle Images, Low ppm



Oil Droplet

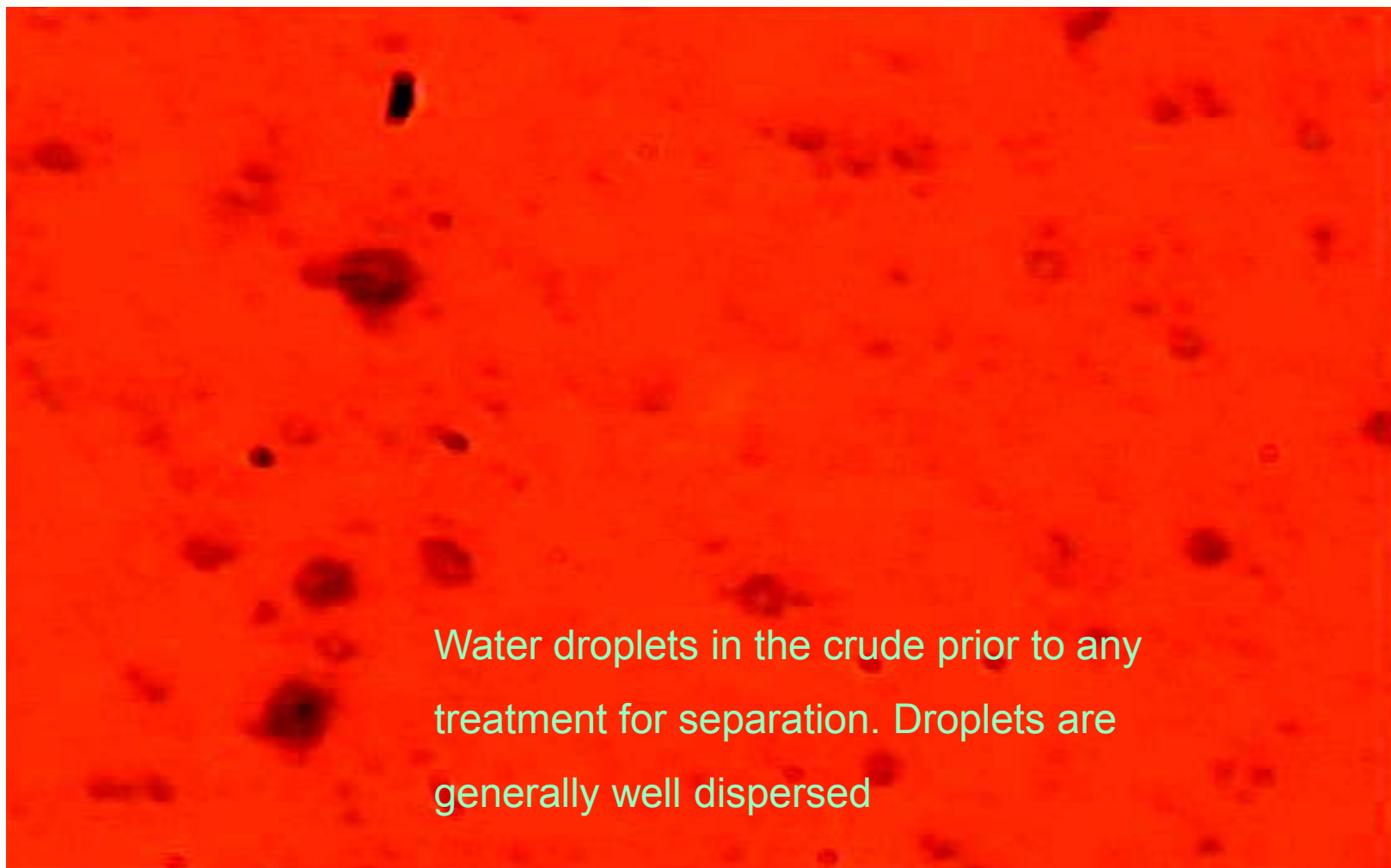
Foreign Matter

# Water in Oil Analysis

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- Monitor Oil – Water Ratio
- Monitor Oil - Water Separation Process
- Application Points:
  - Laboratory → Assess treatment off line
  - Well Head → Oil – Water Ratio
  - Separation Plant → Both Functions

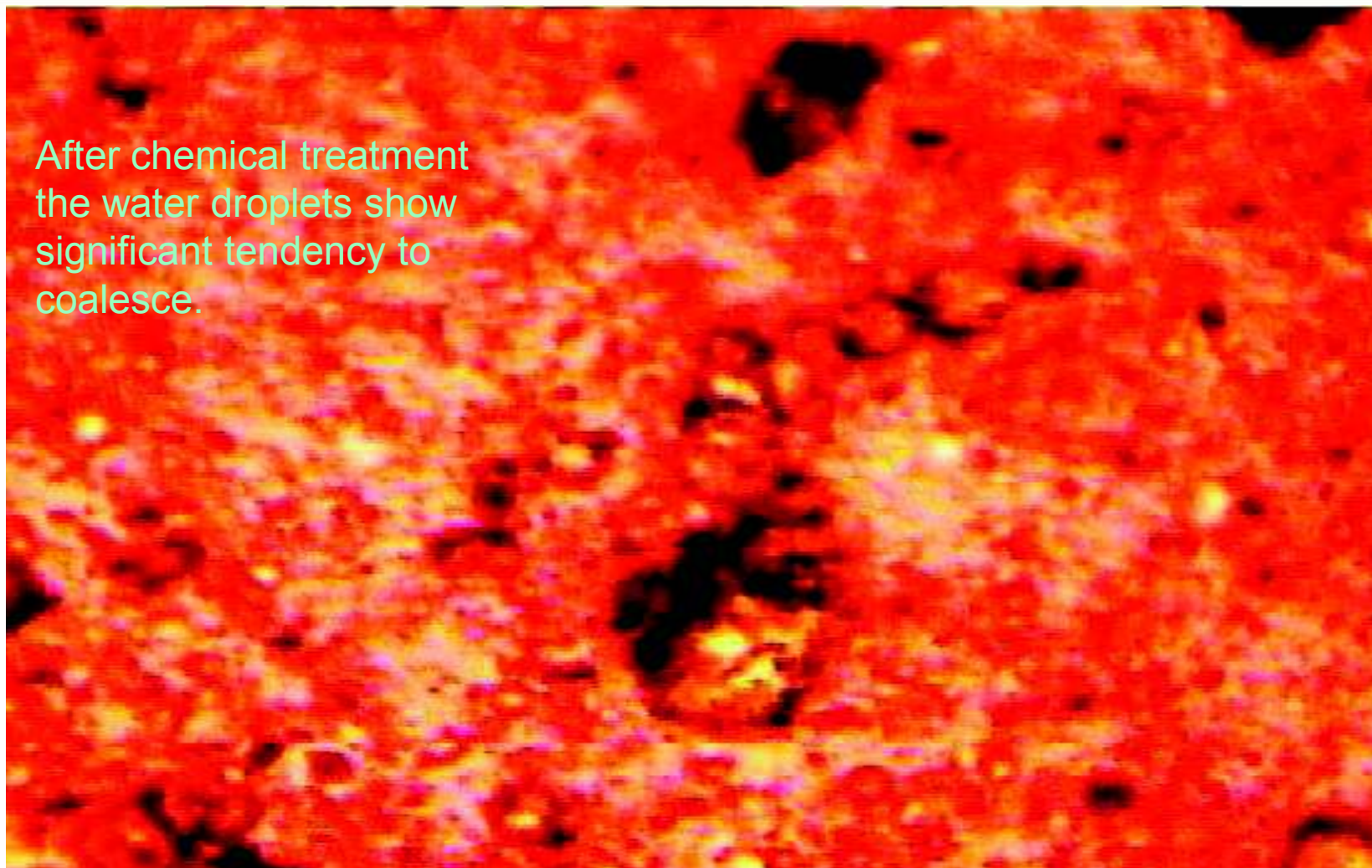
# Water in Oil; Untreated





# Water in Oil; Treated

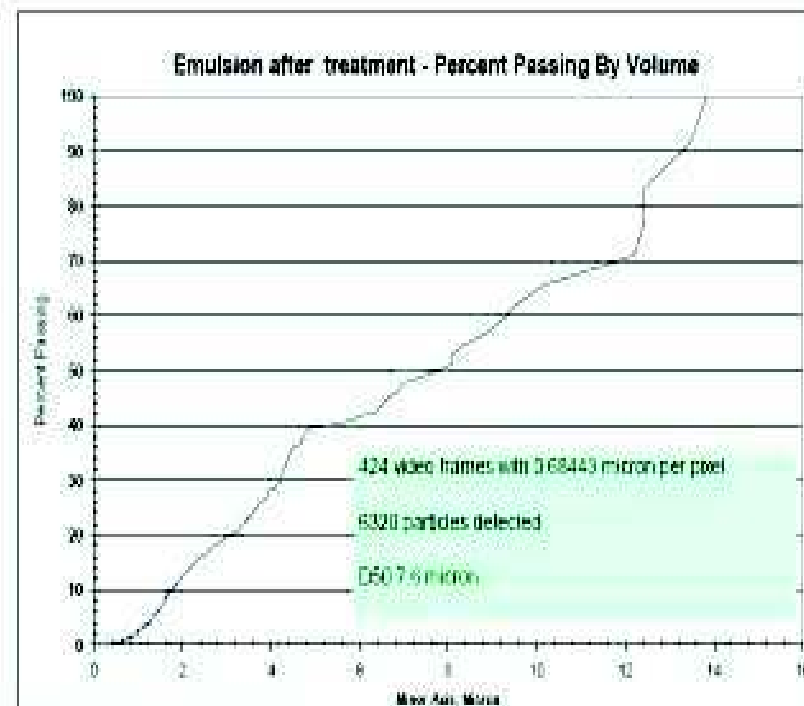
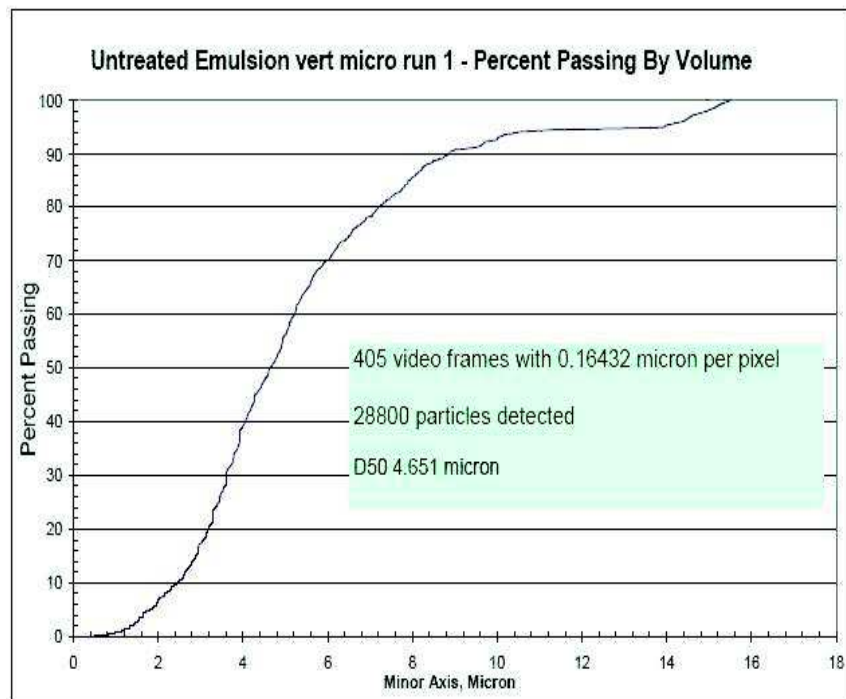
After chemical treatment  
the water droplets show  
significant tendency to  
coalesce.





# Software Analysis

- Following Graphs show droplet size in pre and post treated crude. Shift in the post treated graph toward larger droplet size indicates the coalescing of the droplets into larger formations.

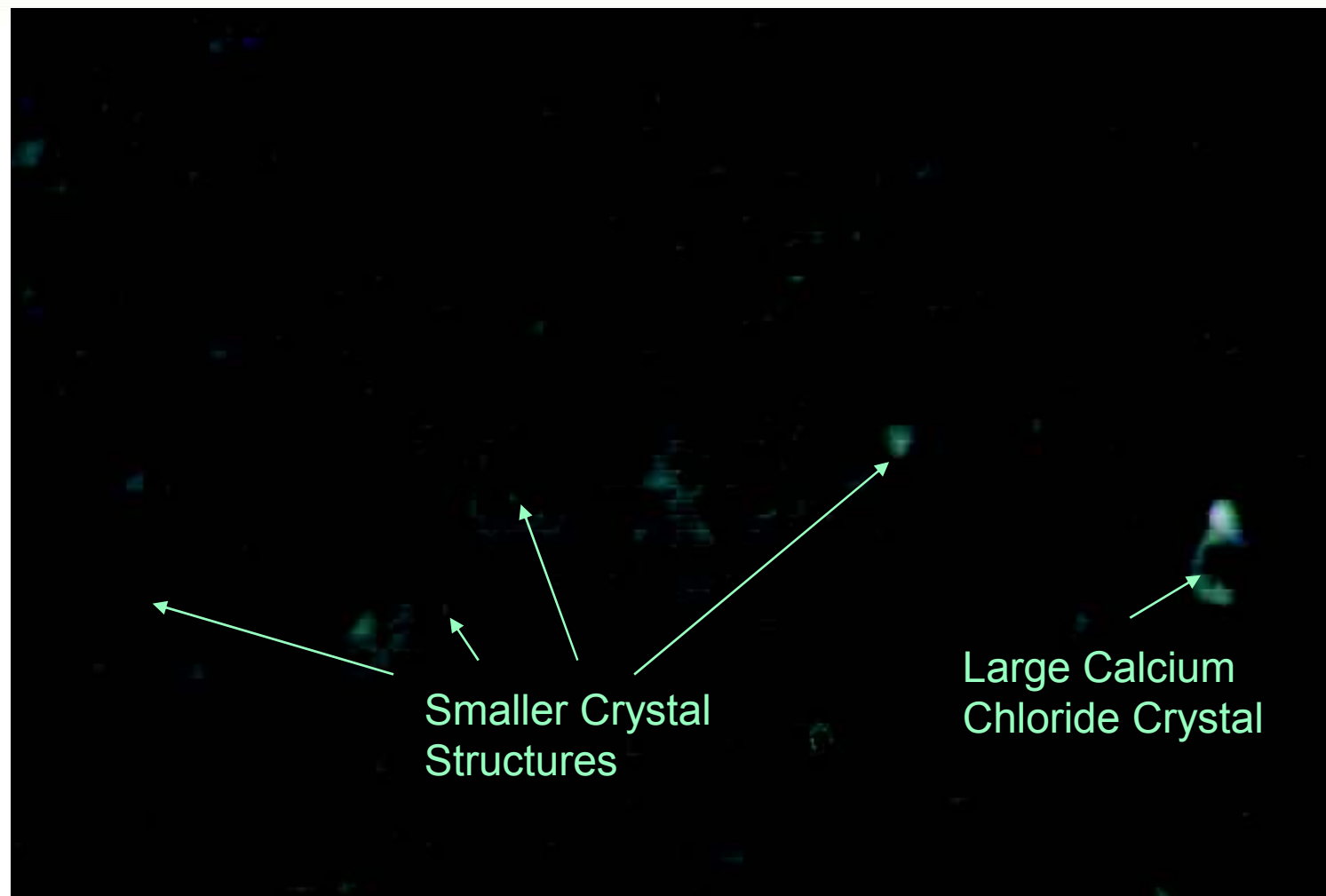


# Crude Oil & Refined Product Analysis

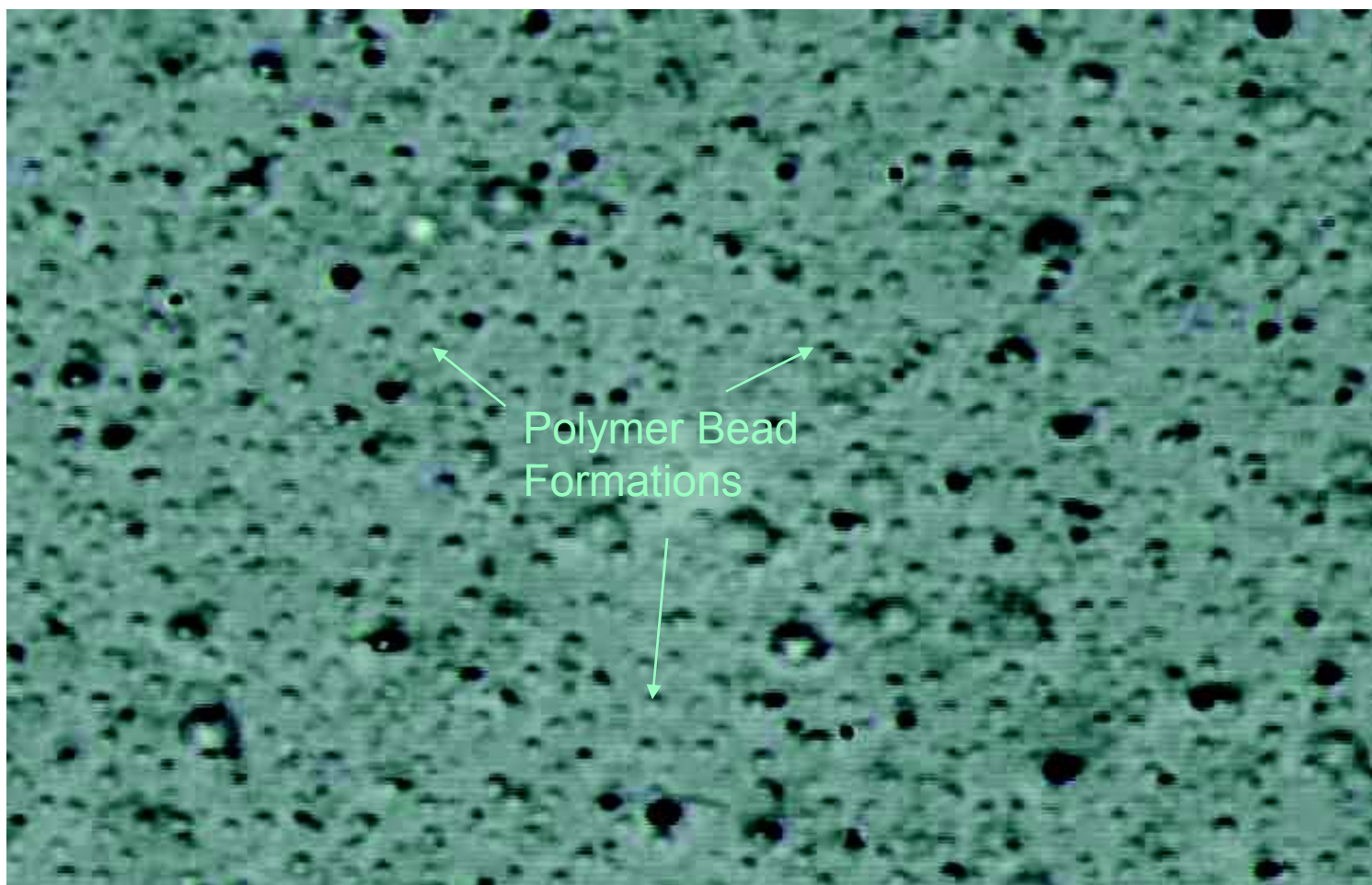
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- Crude oil, while predominately carbon and hydrogen, from the well head contains varying salts, metals, water and minerals.
- Refining produces plastic monomers that are further refined to specific compositions.
- Vision into the product, as shown in the images that follow, reveal information about product make up and formation.

# Crude Oil with Chloride Crystals



# Styrene Formation



# Vision in Reforming Furnaces

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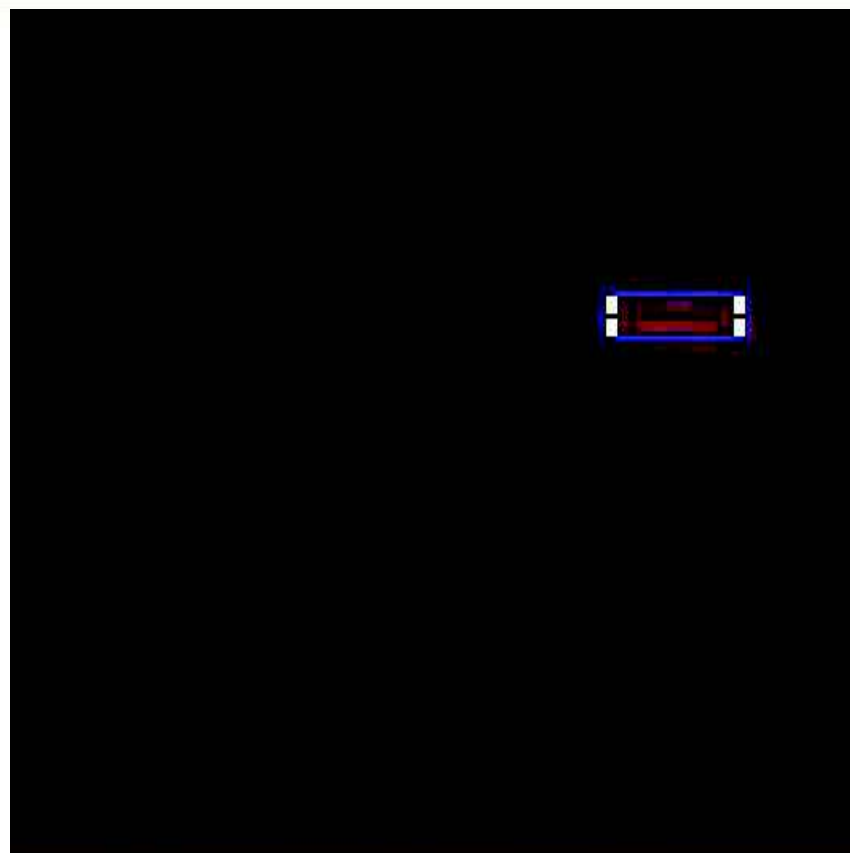
- Monitor Tube Temperature Profiles
- Monitor Flame for Temperature and Size
- Tube temperatures can become imbalanced over time due to several factors including burner malfunction, feedstock variations, catalyst changes etc... These types of changes can lead to critical thermal stresses in the tubes and ultimate failure.

# Thermal Analysis

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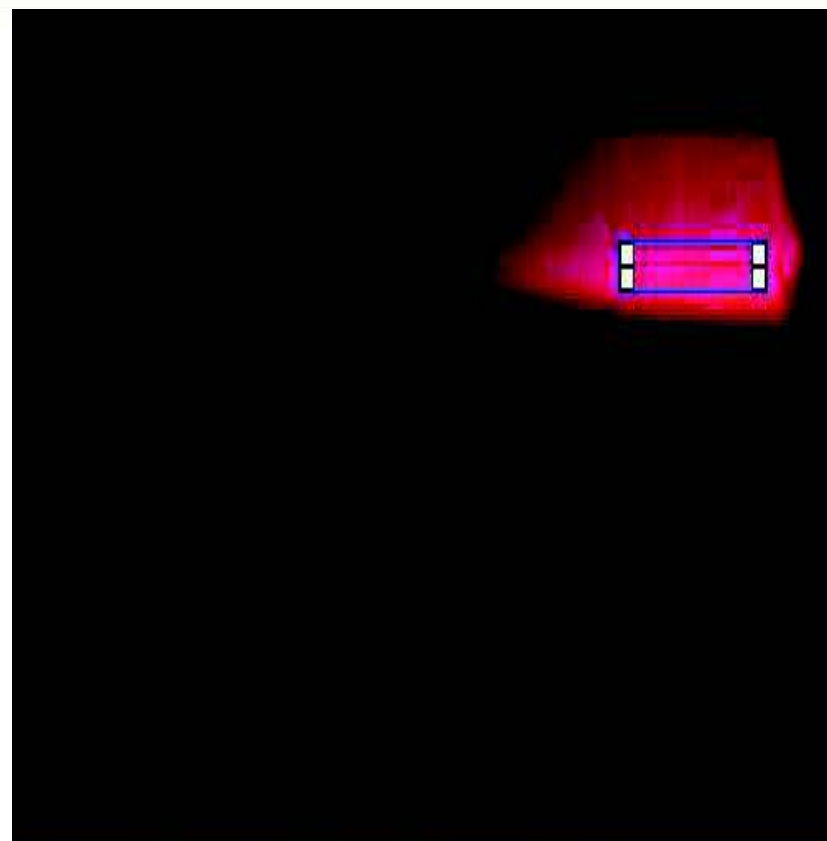
- Applicable in the visual range of temperature.
- Higher incident intensities on the CCD equate to higher temperatures.
- Systems can analyze the full extent of the tube in the field of view for temperature profile.
- Software enables tracking of temperature excursions from norms across field of view. This can indicate the onset of process irregularities before they become critical.

# Thermal Demonstration



Display

Name	Tool Type	Measurement
ie 1	Intensity	y = 74.859=846.863 grayscale, u=10.415, v=48.078, r=129.481, g=



Display

Name	Tool Type	Measurement
e 1	Intensity	y = 127.475=950.000 grayscale, u=19.763, v=87.301, r=226.67