PetroCAM®

A Digital Imaging Particle Analyzer for Produced Water

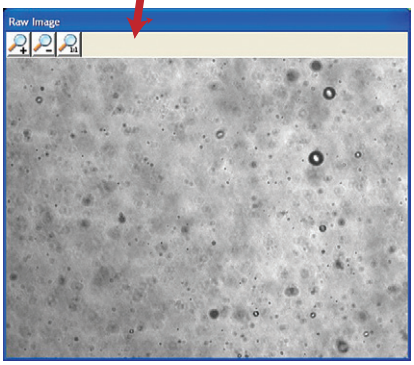
Combining superior optical engineering with state-of-the-art imaging analysis software, the rugged PetroCAM® accurately analyzes the size and concentration of oil droplets and solid particles in fluids. Having the ability to discriminate oil from solids and solids from one another using particle shape, PetroCAM is well-suited for the monitoring of produced water. The lightweight portable system is connected to a laptop for control and analysis, easing field analysis. PetroCAM instantly displays particle size and shape distributions, and also calculates concentrations for oil in water and other particulate matter contained in fluids. The images enable automated measurements and allow for quantitative and qualitative review of the particle images for greater process understanding, as well as an archival record of the actual particles used to create the measurements.

A Real-Time Visualization System for the Petroleum Industry

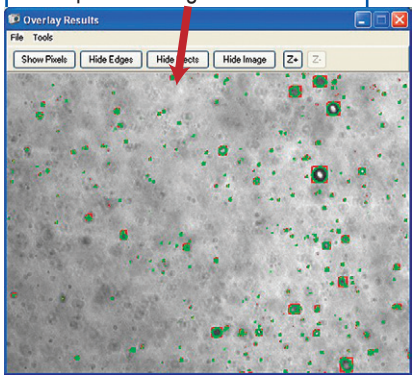
The diagram below shows how the PetroCAM works. The system saves an image of each particle detected along with up to 26 different measurements for each particle. The many shape attributes captured enable the VisualSpreadsheet© pattern recognition software to easily distinguish oil droplets from other particles.

How it works:

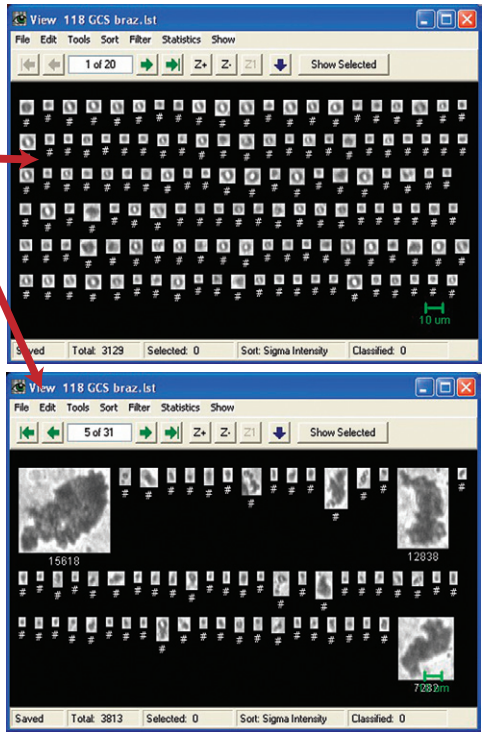
1.) Raw Image as seen by camera view of flow cell. Sample is moving through the flow cell from top to bottom under pressure at a rapid rate. Particles are “frozen” by using a strobed light source.



2.) Image after processing. Green depicts outline of particle as determined by binary thresholding. Red square defines bounding box for saved particle images.

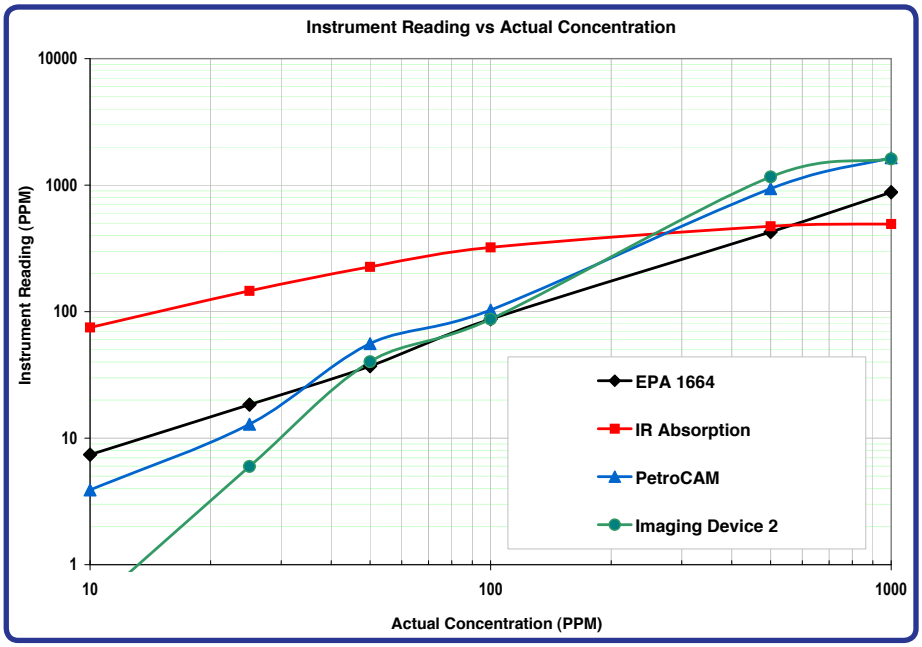


3.) Particle images separated by VisualSpreadsheet software based upon shape: Top right window shows oil droplets, Bottom right window shows “other particulates” (sand, etc.)



A new, "direct" measurement technique for oil in water:

Measurement techniques for quantifying oil in water can be divided in two distinct types: "direct" measurements and "indirect" measurements. A "direct" technique actually measures the oil contained in a sample, whereas "indirect" techniques use a measurement that can be shown to *correlate* to actual oil in water content. Two of the most common measurement techniques, IR absorption and UV fluorescence, are indirect techniques.



In recent years, encouraging new methods for "direct" measurement of oil in water have been increasingly used, especially particle analysis techniques. These systems directly observe and quantify oil particles (undissolved oil). Unfortunately, most "particle counters" are based upon techniques which require an assumption that all particles are spherical in shape. Because of this assumption, these systems are incapable of distinguishing between oil droplets and other particulate matter such as sand.

Imaging particle analyzers, however, overcome this issue because they are able to measure *shape* parameters such as length, width, circularity and roughness. Since oil droplets always image as spherical particles, these shape parameters can be used to separate these other particulates from the oil droplets.

An experiment was conducted to compare the performance of four different oil in water analysis methods on samples of known oil in water concentration *. In order to provide repeatable results, a detailed Standard Operating Procedure (SOP) was developed for mixing up batches of oil in water samples to known concentrations of 10, 25, 50, 100, 500 and 1000 PPM.

The results (see above) clearly show that the PetroCAM most closely tracks the EPA 1664 method results, which are used in the US as the "yardstick" for oil in water measurements. A second set of samples mixed also contained known amounts of sand in them. The results from this second set of samples also showed that the PetroCAM most closely tracked the EPA method. The samples with sand represent a much more "real world" example in that produced water typically has large quantities of other particulates. Only an imaging device such as PetroCAM has the ability to distinguish these particles from oil droplets, therefore correctly measuring the oil content.

* Source:
Brown, L., Ide, M. and Wolfe, P. 2009. Measuring Oil in Water, A Sanity Check. *Proceedings of Offshore Technology Conference: May 2009*

Features Include

- ◊ Pressures up to 2000 psi
- ◊ 24/7 On-line Monitoring
- ◊ Identification and Analysis of Particles and Droplets
- ◊ Stainless Steel Enclosure
- ◊ Intuitive VisualSpreadsheet© Analysis Software
- ◊ Laptop PC Controllable
- ◊ Size Distribution Display
- ◊ Concentration Calculations
- ◊ Multiple Solids Identified
- ◊ Automatic Particle Classification
- ◊ Lightweight and Portable
- ◊ Rugged and Dependable Operation

FLUID IMAGING TECHNOLOGIES FlowCAM

Particle Analysis with Vision