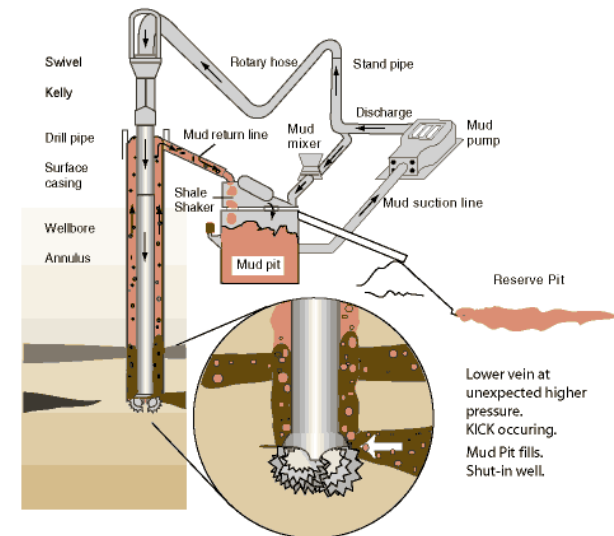


Particle Size Analysis of Drilling Fluids

- Introduction

- Drilling muds or fluids are complex aqueous or oil-based suspensions designed to fulfill a number of important functions during the oil extraction process.
- Main Functions
 - Provide hydrostatic pressure to prevent formation fluids from entering the well bore
 - Keep the drill bit cool and clean during drilling
 - Carry out drill cuttings
 - Suspending drill cuttings while drilling is paused and while drilling assembly is brought in and out of the hole
 - Avoid formation damage and limit corrosion



Typical Drilling Mud System

Why Drilling Fluid Particle Size Distribution is Important

- Mud performance controlled by manipulating the mud composition and the properties of the constituents through the addition of different additives.
- Particle size significantly affects the way in which the mud interacts with the surrounding geology.
- Particle size measurements play an important role in the formulation of high performance drilling muds.
- Particles smaller than the pore size of the surrounding geological formation will bridge rock pores during mud circulation, leading to the formation of a filter cake that prevents the egress of fluids from the well during drilling.
- This “filter cake” protects the surrounding rock from damage while simultaneously preventing fluid loss and achieving well stabilization.

Industry Techniques for Particle Size Analysis of Drilling Fluid

- Sieve Analysis
 - Sieve analysis has been used in particle analysis of drilling fluids for many years.
 - The problem with this technique:
 - Time (Sedimentation and Sieving are both slow and time consuming processes)
 - Particle Size (Particles too small for separation by sieving to be practical)
 - Error (Over-energetic sieving causes attrition of the particles and thus changes the calculated particle size distribution)

Industry Techniques for Particle Size Analysis of Drilling Fluid

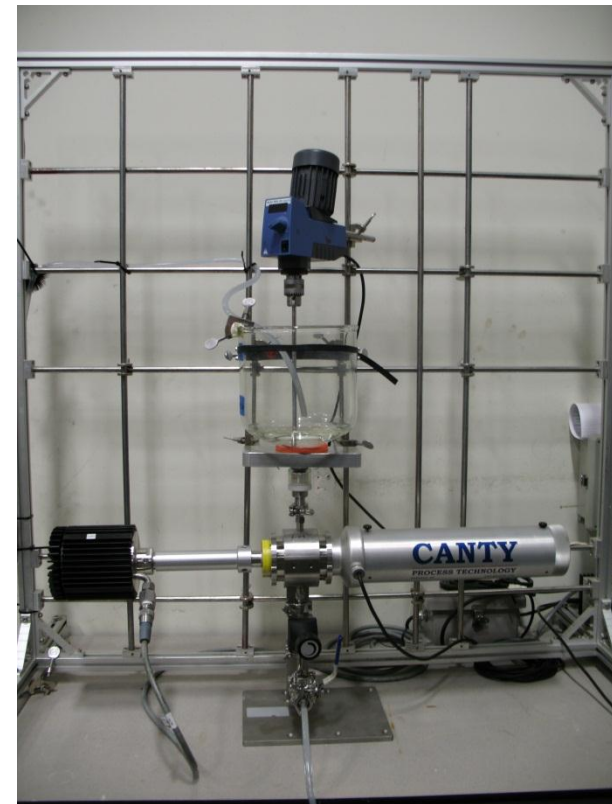
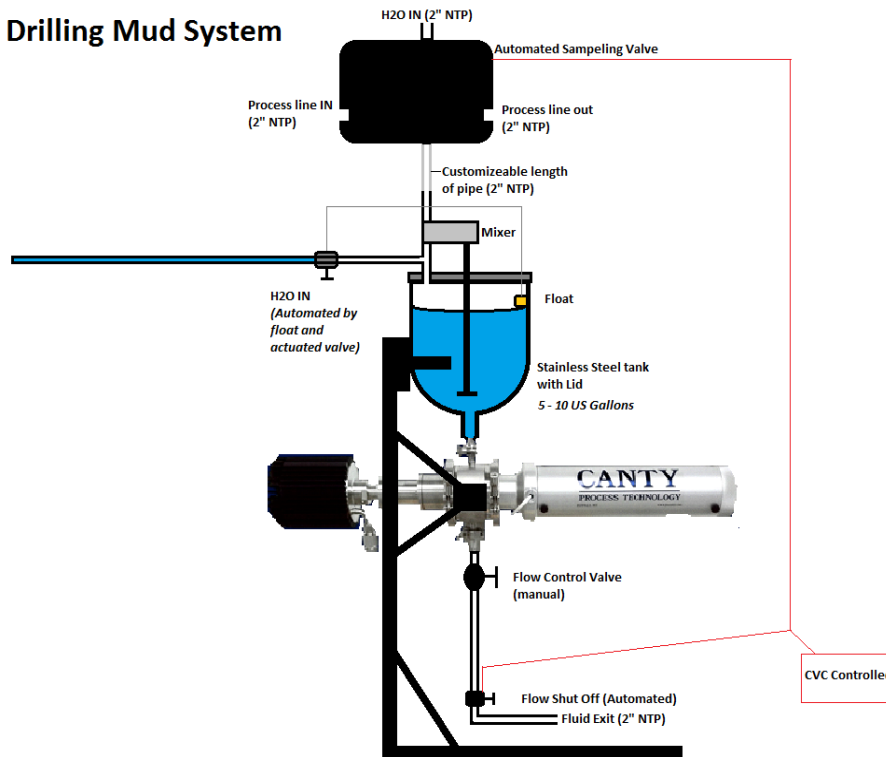
- Laser Diffraction
 - Laser diffraction is increasingly being used in the analysis of drilling fluids because of its quickness and ease of use, but there are many problems associated with it.
 - The problem with this technique:
 - Non-spherical objects (large discrepancy between laser measurements)
 - Laser 1 Dimensional (equivalent sphere) and not recommended for large aspect ratio. Tend not to correlate to each other or when suspension fluid change
 - Distortion of Measurements (existence of “ghost” particles caused by sharp edges on the objects which produce high angle diffraction. These “ghosts” diffractions are interpreted by the laser diffraction instrument to be small particles.
 - Acicular particles (image analysis shows much larger particle sizes compared to laser diffraction because laser diffraction undercounts events generated by larger dimensions (major chord)).
 - Laser diffraction intrinsically biased towards the smaller edge of spectrum.

Canty Advantage

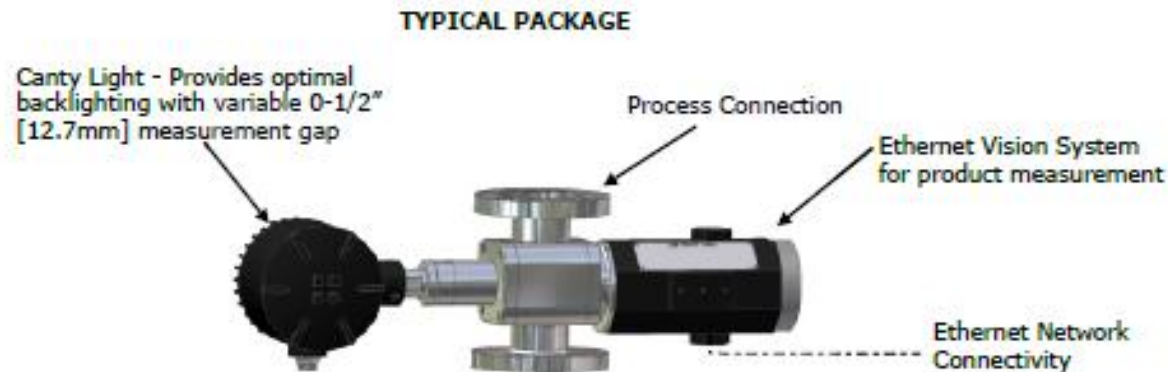
- Canty Drilling Mud System
 - Canty's Drilling Mud particle Analysis system has many distinct advantages or Laser Diffraction systems.
 - Real time 2D particle analysis.
 - Visual verification both of set-up and measurement run, allows for particle shape to be identified.
 - Direct measure of particle area – a two dimensional measurement.
 - Direct measurement of particle perimeter – a two dimensional measurement.
 - Direct measure of major axis and minor axis – a two dimensional measurement.
 - Able to thin measurement data using minimum particle size, maximum particle size, and particle aspect ratio.
 - Direct measurement of particle color.

Canty Laboratory Drilling Fluid System

Drilling Mud System



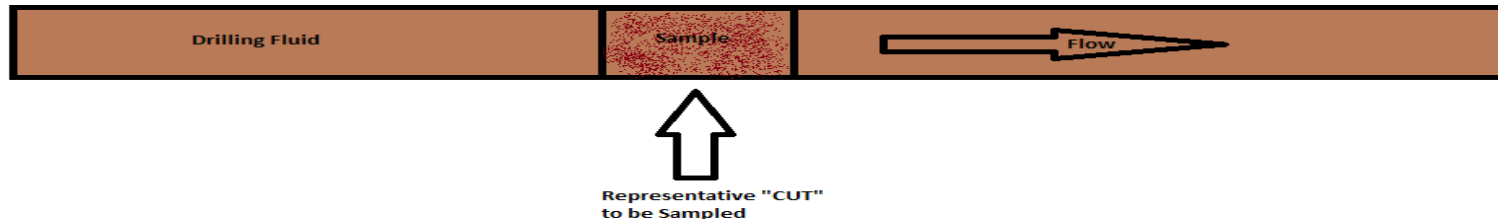
Canty In-Line Drilling Fluid System



- The Canty In-Line Drilling Fluid System allows for the analysis of drilling fluids by a direct in-line process connection.

Canty Cross-Cut Sampling Valve

- Cross-Cut Sampling Valve System
 - Canty's cross-cut sampling valve system allows for quick consistent and repeatable sampling of a drilling fluid process line.
 - The valve system directly samples a cut of fluid from the center of a process line.
 - That full "cut" is then diluted in water and directly run through the analysis equipment.
 - This method allows for direct testing of a representative "cut" of drilling fluid.



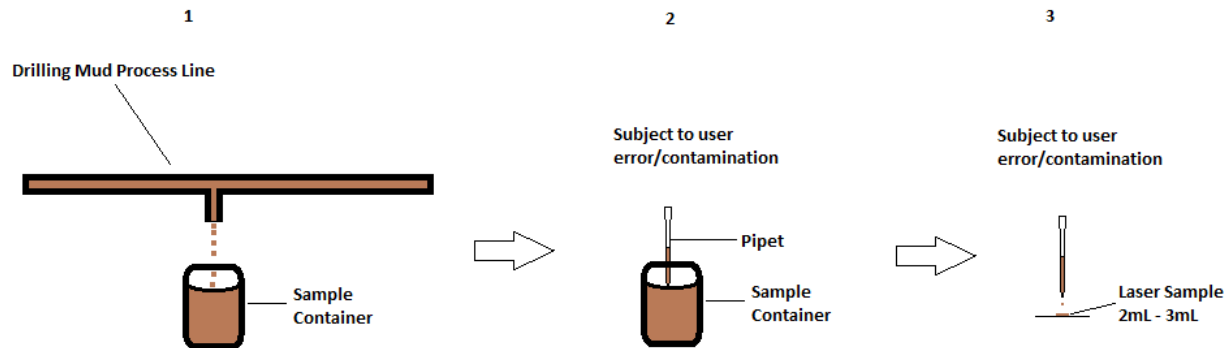
Laser Sampling Problems

Laser diffraction typically only uses a sample size of around 1mL to 2mL. The problem with this is the steps necessary to break down a sample small enough for laser diffraction from the original sample gathered at the process line. Some possible issues are:

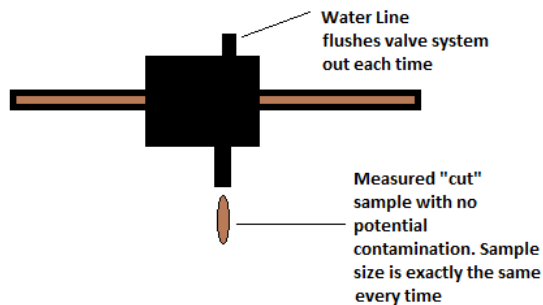
- Does the sample container harbor particles not wanted within the sample?
- By the time the sample is drawn have particles began to settle out of solution?
- Is there a large difference in particle density between a sample drawn from the top of the container to the bottom?
- Is a few mL sufficient for proper particle analysis?
- **With the Canty Cross-Cut Sampling Valve none of these potential sampling issues come into play.**

Sample Extraction Comparison

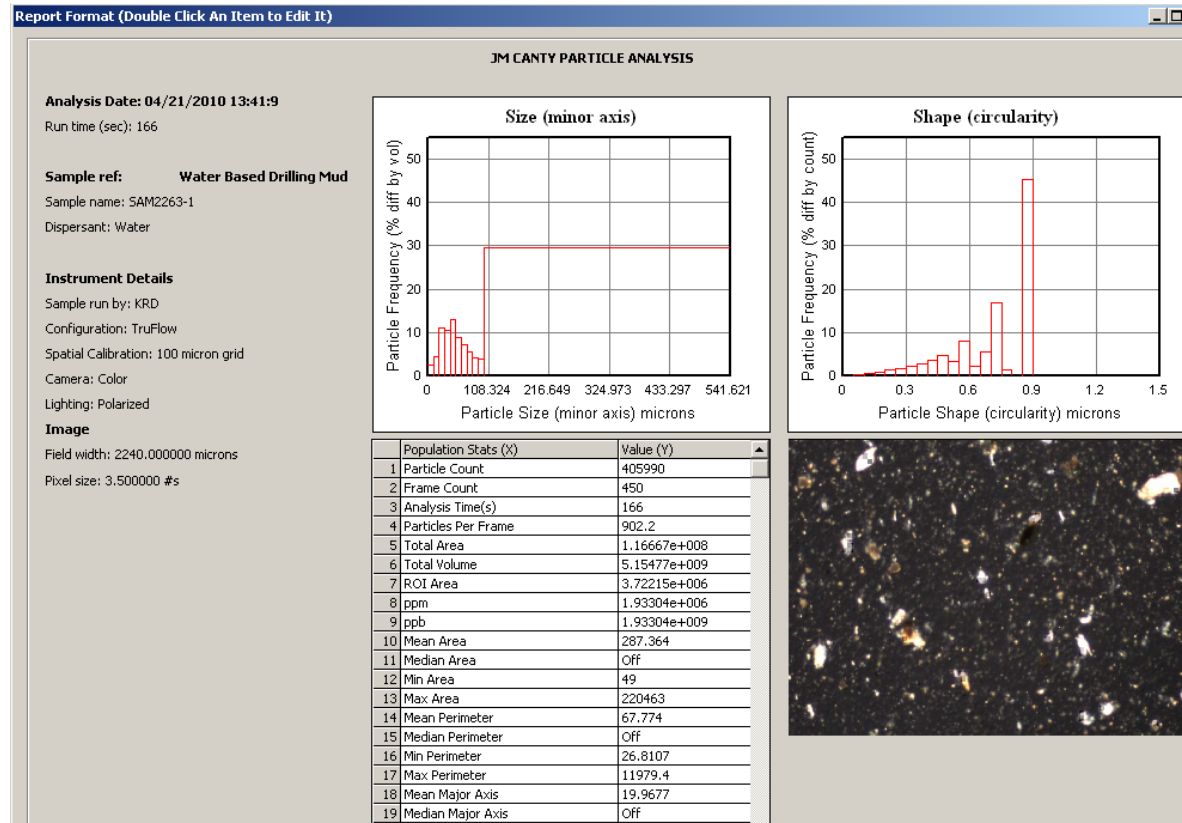
Laser Sample Extraction



Canty Cross-Cut Sampling Valve System

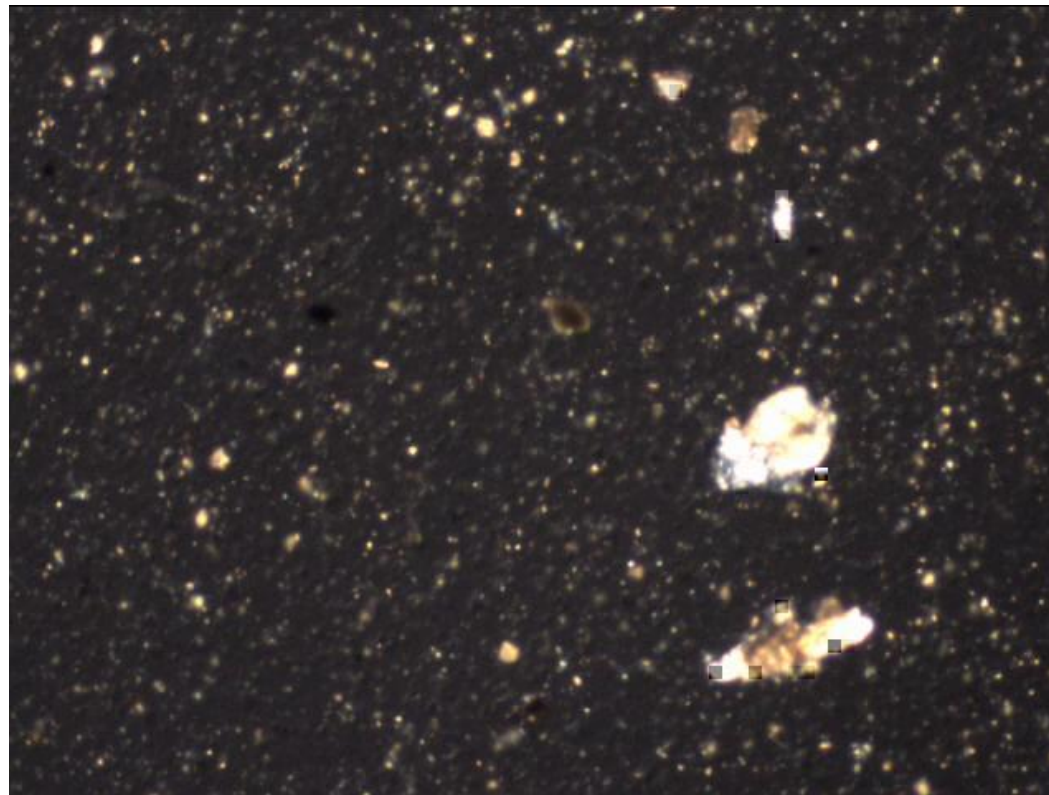


Drilling Mud Testing



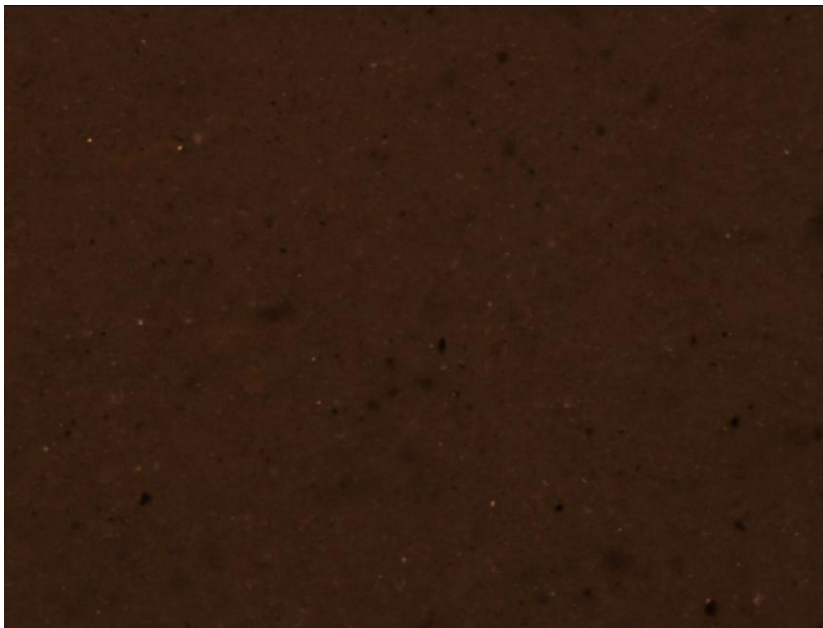
Drilling mud spiked with Barite + Mica + Gseal + LCF + Carb + Poly
(Cross-polarized lighting used to optimize difference in particles types)

Drilling Mud Testing

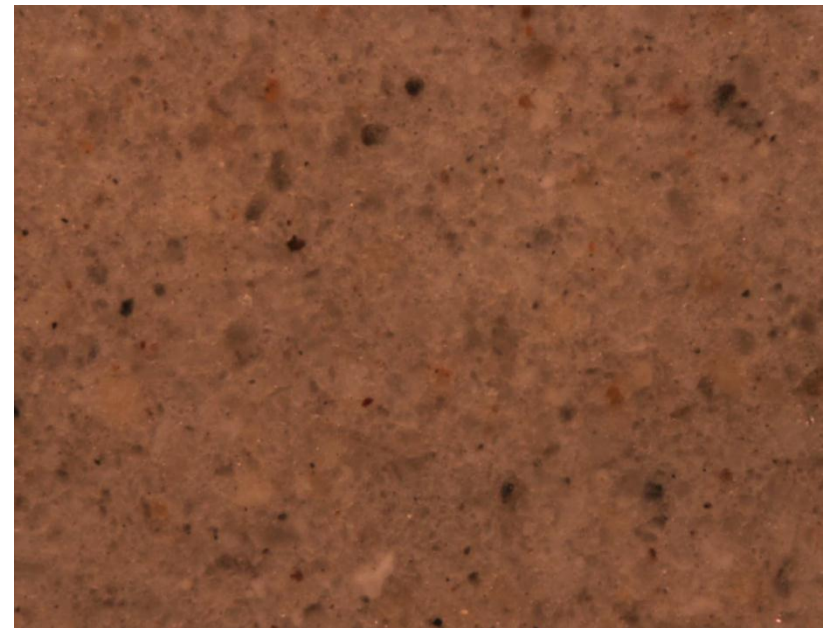


640 x 480 color image oil based drilling mud
(Cross-polarized lighting used to optimize difference in particles types)

Drilling Mud Testing

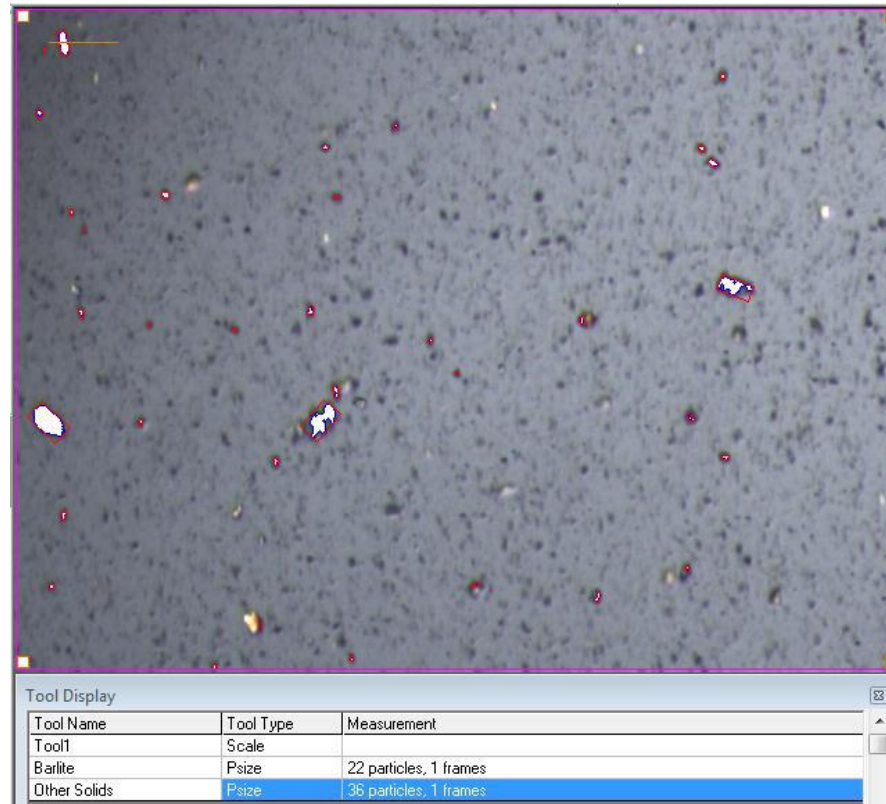


Water based mud



Water based mud spiked with – carb
Notice increase in “white” particles

Canty Software Analysis



Canty Vision Software Package Individually analyzes particles
(water based drilling mud / polarized lighting)

Conclusion

- Canty's Drilling Fluid Particle Analyzer is a system capable of high precision drilling fluid analysis. Our analyzers offers many unique advantages over laser diffraction technology.
- With the ability for high resolution color analysis the Canty Drilling Mud System can be a unique tool for drilling fluid engineers to aide in the microscopic examination of drill cuttings.