Method Improvement on Particle Size Distribution Analysis of Mature Fine Tailings by Laser Diffraction

Zohrab Ahmadi, Adnan Younis, Vicente Fiorini Stefani, and Amir Iqbal

Argile Analytica Inc.

Abstract

Subsampling of the oilsands and mature fine tailings (MFTs) specimens are usually performed on solid powder using either static or rotary riffles for laser diffraction particle size distribution (LD-PSD) analysis[1]. The required mass of a subsample for the laser diffraction analysis is dependent on the volume of the instrument's recirculator as well as the quantity of fines and clay size particles of the subsample being analyzed. The low volume of the recirculator and high content of clay size particles dictate less quantity of the subsample for the analysis. However, the riffles lose the capability to produce appropriate repeatability as a result of lowered justified representation of the quantity of the sample. In addition, obtaining extremely low quantities of subsample is laborious and time-intensive. This problem is more pronounced for MFTs where the fraction of clays is substantially higher compared to oilsand samples. Our in-house study on several types of MFTs revealed that the precision of findings on cumulative volumes of particles < 44 microns can be greatly improved by subsampling a larger portion of the slurry MFTs using a Lightnin impeller to homogenize the slurry at optimized conditions. The relative standard deviation percentage (%RSD) was reduced between 2-6 times for several different MFT samples, thereby demonstrating the advantage of slurry over solid subsampling for MFTs

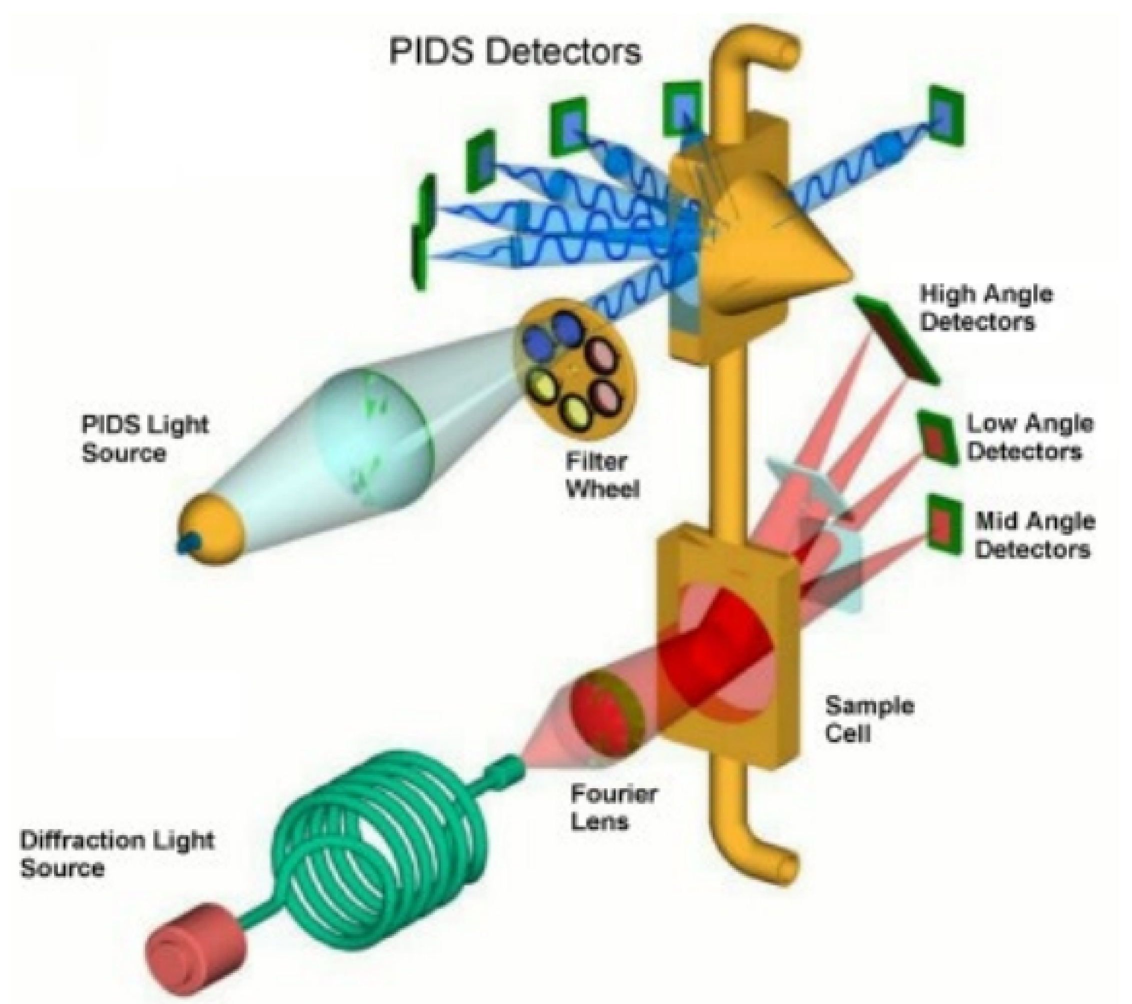


Figure1: A block diagram of the LS 13 320 optical system. In the sample cell suspended particles scatter the incident light in characteristic patterns according to their size.

Methodology

Initially, the MFT Samples were cleaned to remove bitumen and water from the solids as the bitumen will interfere with the particle size determination. The optical bench configuration is normally equipped with a visual indicator for the proper range of a solid sample. When the obscuration is between the 8-12%, the reading is considered reliable. Below or above this range different analytical errors occur and hence reading is erroneous.

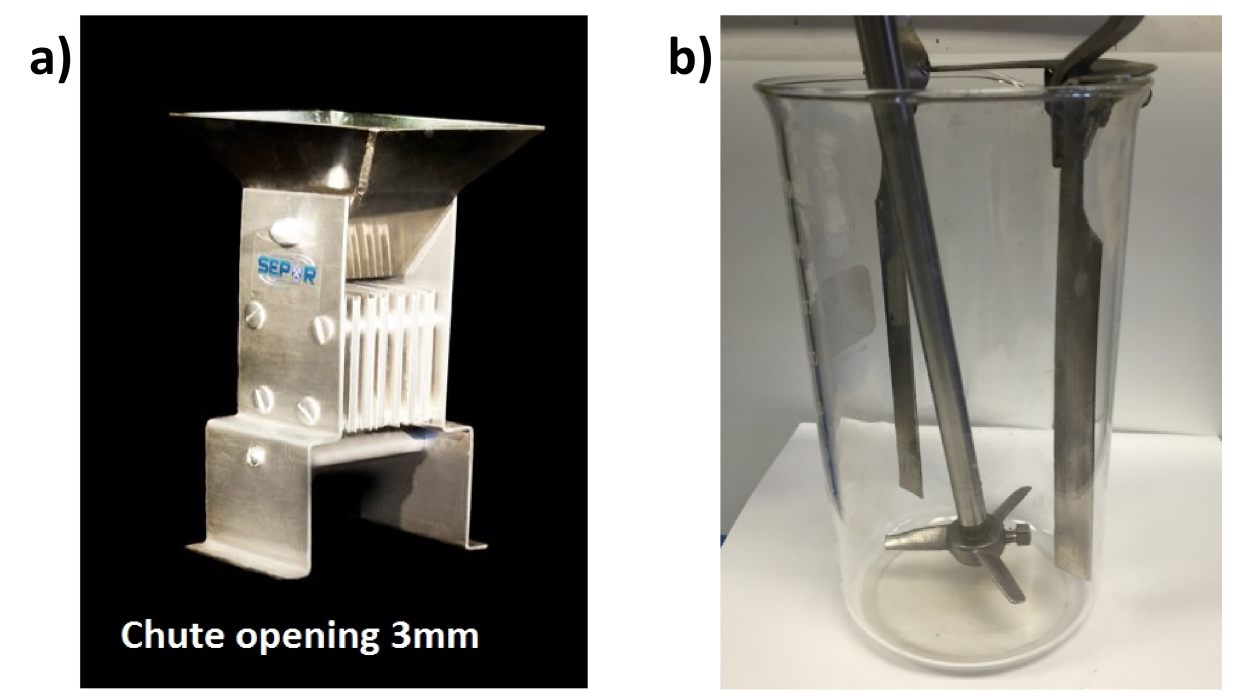
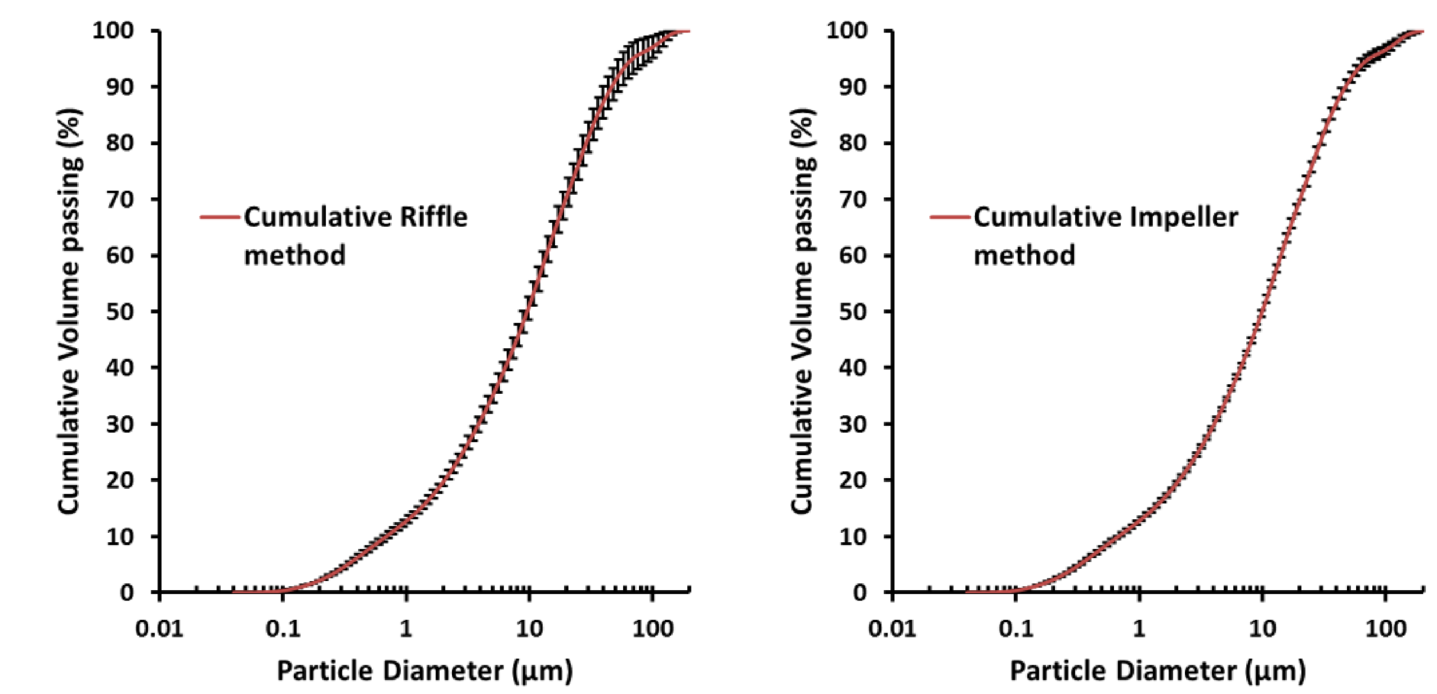


Figure 2: It is critical to select the proper amount of sample within the recommended range. For this comparison and statistical study, a calibrated static riffle divider (a) was used to divide 10 separate subsample's mass (0.08-0.11 g) for each representative MFT specimen. A larger mass portion of each MFT (1.0-1.2 g) was also subsampled for the slurry subsampling method (b). The slurry samples (~ 3L) were subjected to the same procedure, the subsampling was performed by a syringe with a long needle positioned at the impeller level after the boiling process was complete.

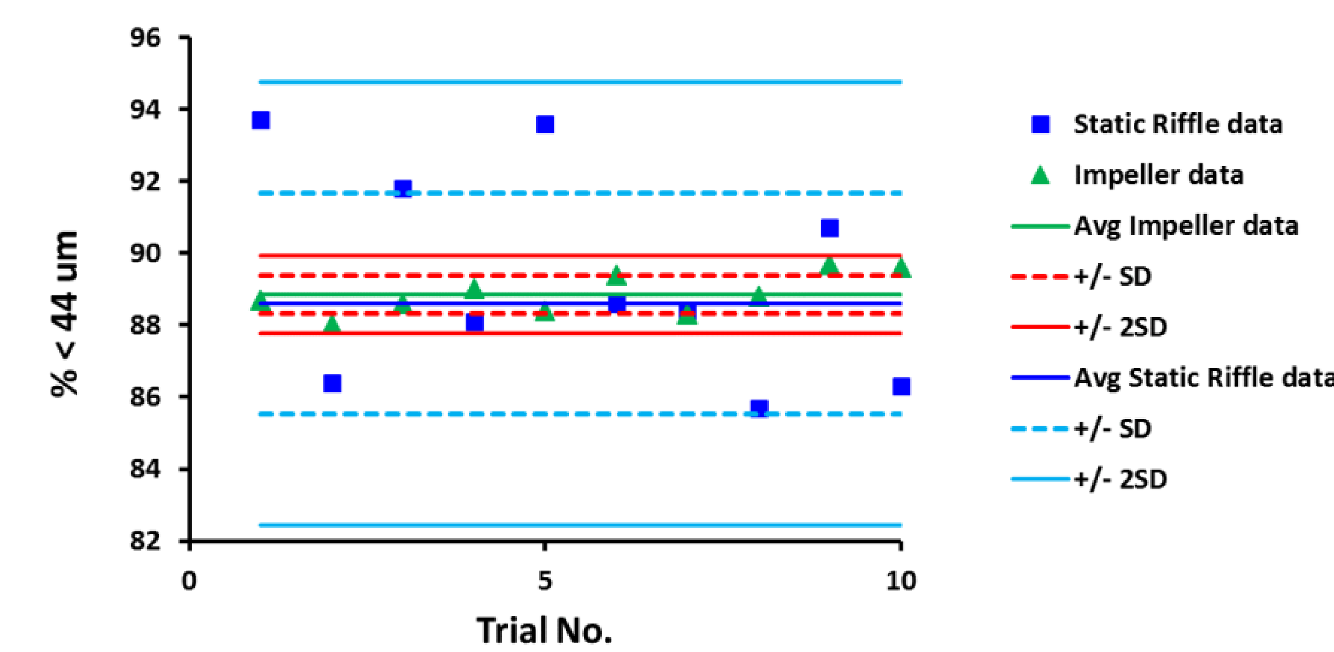
Results

In general, the precision of an analytical technique will always be limited by the precision inherent in each step involved when working towards the goal of precise findings. Our findings show that the standard deviation can be greatly reduced by an impeller method of subsampling from a slurry sample instead of a conventional method of riffling of solid samples. This method is more effective when the MFT specimens become less homogenous and hence have greater probability that the static riffle will fail to provide repeatability.

Results



Graph 1. Right and left show the cumulative volume percentages of impeller and riffle methods respectively. Findings demonstrate the error of subsampling is much larger in the riffle method than impeller method.



Graph 2. The actual data entries of 10 analyses for each method in addition to the average, average±SD and average±2SD are shown above. Both series were overlaid for a better visualization of the precision difference.

References

'Unified Fines Method for minus 44 micron material and for Particle Size Distribution' http://www.cosia.ca/initiatives/project-research, accessed Dec 13th **2016.**

Experimental insights into laser diffraction particle sizing of fine-grained sediments for use in palaeoceanography, Sedimentology 56, 2192, **2009.**

High-resolution particle size analysis of naturally occurring very fine-grained sediment through laser diffractometry, Journal of Sedimentary Research, 74, 5, 736, **2004.**