

Calibrating the LISST Series Instruments

SEQUOIA SCIENTIFIC, INC.

◆ APPLICATION NOTE L009

The LISST series of instruments measure particle size distribution, i.e. the volume fraction contained in each of 32 size bins. Additionally, the instruments deliver the calibrated volume concentration as well, i.e. μ of particle volume per unit volume of water (e.g. μ l or ppm). This note concerns the procedure that is employed for calibration of these instruments.

The operating principles of the small-angle scattering method is described in Application Note L001, and in greater detail, in Agrawal and Pottsmith (Marine Geology, v168, 2000, pp 89-114). Essentially, the optical scattering by an ensemble of particles is sensed simultaneously at 32 angles. This information is *inverted* to construct the size distribution.

The Calibration procedure involves:

- ◆ Measurement of scattering for a known concentration of particles in water;
- ◆ Inversion of the data to obtain the uncalibrated size distribution;
- ◆ Summation of the uncalibrated size distribution to obtain total *uncalibrated* concentration;
- ◆ Estimation of the calibration constant from a ratio of the *uncalibrated* total volume concentration to the *known* concentration in the preparation of the suspension.

This method provides a 'black-box' calibration constant. Since the method determines the total particle volume concentration from the measured, detailed size distribution, the calibration constant remains the same for all sizes in the measurement range.

A user of the instrument can carry out this procedure by operating the instrument using the LISST, standard particles, and the auxiliary Mixing Chamber - both available from Sequoia as options. The essential steps are:

- ◆ Obtain a background scatter file using filtered, water (note: allow no bubbles);
- ◆ Prepare a suspension of sample particles with a weighed amount of particles added to filtered water, then obtain 100 samples (*scans*) of scattering data;
- ◆ Process the particle datafile in Sequoia's LISST data processing program while temporarily setting the *Calibration Constant* in analysis software to 1. The result of this processing will be a size distribution file. The final step is to:
- ◆ Sum the size distribution for each scan. A stable average of the total volume concentration is obtained if the test is done with about 50-80% optical transmission, and 100 scans of data are stored. This *uncalibrated* mean total concentration when divided by the known input *volume* concentration (in μ l) yields the calibration constant. Replace this value for 1 as inserted earlier in LISST analysis software.

The tests can be carried out with microspheres of latex or PVC¹ for the simple reason that the underlying physics assumes spherical particles as scatterers. When using this calibration constant for estimating concentrations of non-spherical particles, differences should be expected since the method produces the concentration of *equivalent* spheres. If it is known that a specific broad particle type as in riverine sediments characterizes the environment where the measurement is to be made, the calibration should be carried out with a sample of river water. This will take into account the non-sphericity of those specific particles.

As a final caution, particle density should not be overlooked when employing this procedure. Please contact us for particles and their properties.

¹ Standard particles are available from Sequoia

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