APPLICATION NOTE

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Comparison of Suspended Solids Concentration (SSC) and Turbidity

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WHEN MEASUREMENTS MATTER

Comparison of Suspended Solids Concentration (SSC) and Turbidity

This application note discusses the relationship between Suspended Solids Concentration (SSC) measurements and turbidity measurements.

General Information

Excessive suspended sediment is the number-one cause of water quality violations in the U.S. Metal and insecticide contaminants are also leading causes of violations. Most of these contaminants are bound to suspended sediment. Turbidity can indicate the presence of sediment in surface waters and the chemical contaminates it carries. However, the relationship between NTUs and SSC can vary widely in utility.

It is often assumed that turbidity provides a direct measure of suspended sediment and that there is a formula or set of conversion factors with which SSC can be calculated from NTUs. This is simply not the case and no such formulas exist. Some also believe that turbidity standards behave the way sediments do in an OBS® sensor or turbidity meter. This is also not true in general because the size, near infrared (NIR) reflectivity, refractive index, and shape of sediment particles and turbidity standards (formazin and SVDB) differ from one another.

The most important of the factors is particle size, which can vary be a factor of 1000 in the environment. Figure 1 shows the size distributions of turbidity standards and suspended sediments in rivers and the ocean. When the sizes of sediment and standards overlap, there is good reason to believe the standards will mimic the light-scattering effects of sediment. While in other size ranges, the materials will not be optically similar.

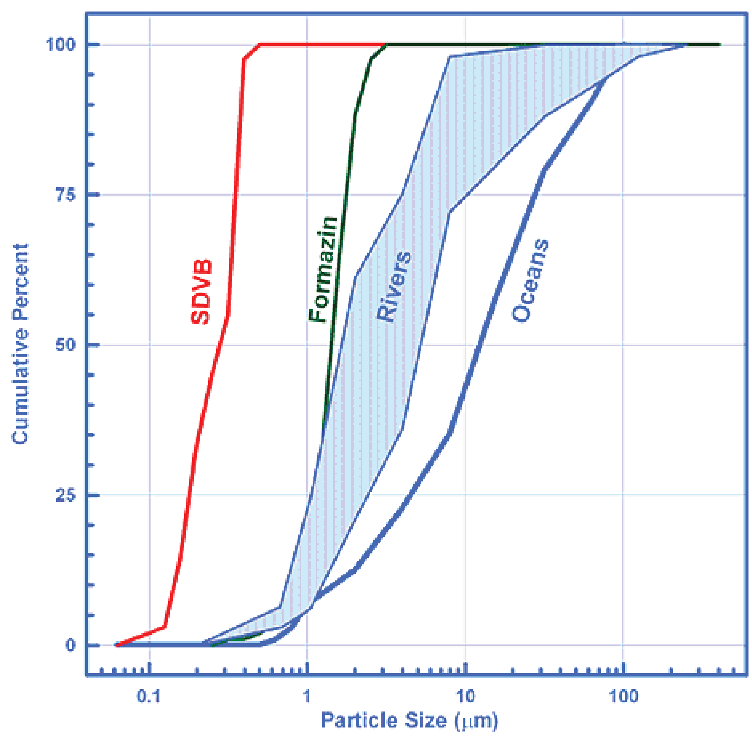

Figure 1. Graph shows how much variation there is in the size distributions of turbidity standards and suspended sediments in rivers and the ocean.

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Turbidity Standards Versus Actual Sediment Particles

Turbidity standards are fairly uniform in terms of size and refractive index; the particles of the SVDB standard also have uniform shape. However, actual sediment particles vary widely from place to place. Figure 2 provides Scanning Electron Microscopy (SEM) images of flocs from the Columbia and Colorado Rivers that illustrate the huge diversity of size and shape encountered in the environment.

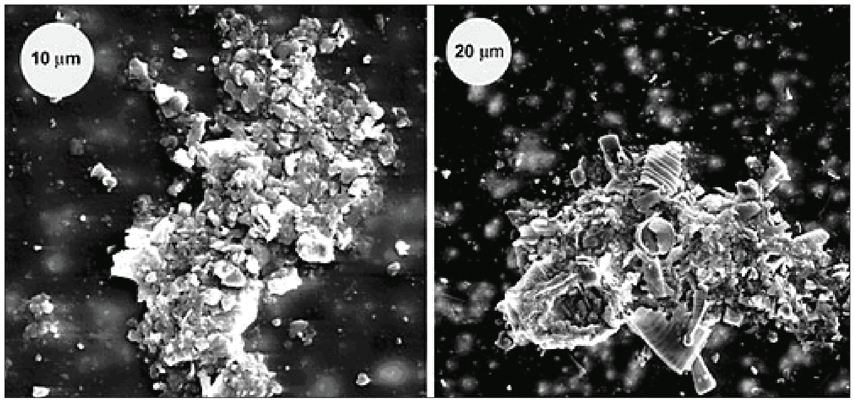

Photo courtesy of GFS Chemicals.

Figure 2. SEM images shows the huge diversity of particle size and shape encountered in real life.

Calibration of OBS Sensors

When using OBS sensors to measure SSC, it is unnecessary to first calibrate them with formazin or SVDB and then establish a relationship between NTU values and SSC as many OBS users continue to do. If your primary objective is to measure SSC, do the calibration with sediment and avoid the errors introduced by making two numerical conversions—one from the OBS signal to NTU values and a second one from NTU values to SSC. If you calibrate directly from the OBS signal to SSC, you achieve an improved standard error in SSC conversions.

Correlating SSC and Turbidity

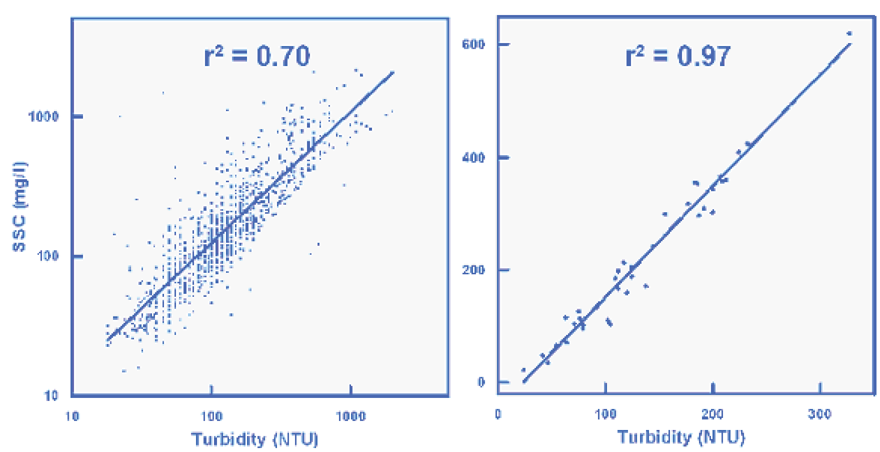

Figure 3. The graph on the left provides measurements of runoff from a freeway, which indicates a bad correlation between SSC and turbidity. The graph on the right provides measurements from San Francisco Bay that indicates a good correlation between SSC and turbidity.

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However, situations may occur in which you will have a record of turbidity (in NTUs) and will want to correlate it with concurrent measurements of SSC in water samples. There are environments where this works well and there are others where it is not satisfactory.

For example, a large number of turbidity and SSC measurements from a freeway's runoff is shown on the left hand graph in Figure 3. While the general relationship is useful for establishing time trends in SSC of highway runoff in the monitored location, the NTU-SSC relationship cannot provide an accurate way to estimate it.

At a second location in San Francisco Bay, however, the SSC is highly correlated with the NTU values obtained from an OBS sensor (see right-hand graph in Figure 3). At this monitoring location, the NTU-SSC relation will provide for the accurate estimation of SSC from OBS turbidity measurements.

References

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