APPLICATION NOTE

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Basics of OBS® and Turbidity Sensors

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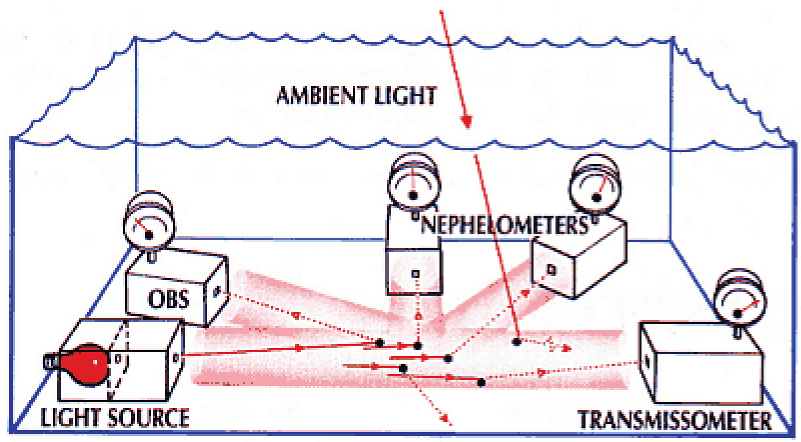
WHEN MEASUREMENTS MATTER

Basics of OBS®and Turbidity Sensors

This application note provides general information about sediment sensors, light sources and detectors, optical designs, applications, and turbidity standards.

Optical Sensors

Optical sensors are designed in many ways to detect light scattering and attenuation in order to measure sediment and turbidity in water samples. Some of them are shown in Figure 1, but despite their diversity, they all work in the same basic way. A water sample, the red-shaded region, is illuminated by a light source, shown by the red light bulb, and one or more photo detectors convert the light radiated from the sample to photo current. The amount of photo current depends mainly on the area of the illuminated particles but also on particle size, shape and reflectivity. Since the area of the illuminated particles is directly proportional to the suspended solids concentration, SSC, measurements of light scattering provide a way to estimate SSC. Certain conditions (size, color, disaggregation effects), explained in related application notes, must be met to do this accurately. Light absorption by the sample will also affect the photo detectors and the indicated turbidity of the water. While laboratory turbidity meters can have several photodetectors, submersible sensors usually have only one. This is because it is difficult to design submersible sensors with multiple detectors. OBS sensors detect light scattered over a range of angles that depends on the model and particle concentration in the sample. The OBS-3 detects light scattered between 140° and 160° and the OBS-5+ between 88° and 170°.



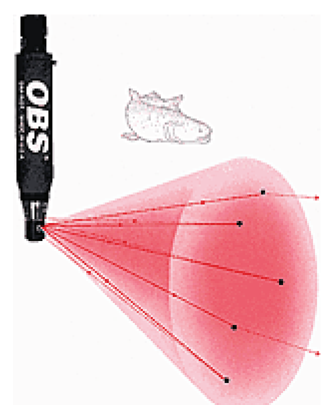


Figure 1. The sketch on the left shows how various devices detect a light source created by a red light bulb. The sketch on the right illustrates the angle in which the OBS-3 detects the scattered light.

Clear waters in alpine streams and springs, transmit nearly all light in its initial direction with very little scattering. Most other surface waters contain suspended matter that scatters more light from a beam than is absorbed. Turbidity standards made by suspending formazin particles and styrene divinylbenzene (SDVB) spheres in water cause optical sensors to produce a signal in proportion to the turbidity value of the standards (see application note on Turbidity Calibrations).

Conversions of Detector Signals

Conversions of detector signals to engineering values, such as mg l^{-1} or NTUs is done by a sensor signal processor or by an operator using Excel. A sensor must be calibrated with sediment or turbidity standards before it can make such conversions. Sediment calibration is the process by which OBS signals are related by a mathematical formula to standard SSC values for suspensions of sediment from the measurement site. OBS sensors can be calibrated with any natural sediment or man-made particles, such as wastes from oil shale, coal, glass, and ceramic production. While several issues demand caution (see the *Sediment Calibration of OBS Sensors* application note), a meter calibrated in this way can be used to estimate rapidly and continuously the SSC in lakes, rivers, reservoirs, settling ponds and process tanks.

Suspended Solids Concentration (SSC)

SSC is a physical quantity with units mass per unit volume (mg l^{-1}, kgm^{-3}). So knowing its value at a particular time and location enables calculations of such things as sediment loads of streams, background SSC levels for managing waterside construction, dredging, and logging to minimize adverse impact, and operations complying with NPDES permits. Calibration for turbidity measurements establishes a numerical relationship between OBS signals and corresponding standard NTU values. The resulting mathematical formula is used for assigning NTU values to water samples from OBS signals. Unlike SSC, turbidity values are relative units that have no direct physical significance.

References

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