

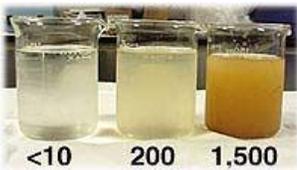
Turbidity

Monitoring with the LiquID™ Station

Defining Turbidity

Turbidity is an indicator of the visual “haziness” of a sample stream and is defined as a measure of the amount of light scattered by particulate matter suspended in the sample (examples pictured below).

Historically turbidity is defined as a measure of attenuated or scattered light (e.g. EPA Method 180.1) determined in the visual or near-infrared spectrum and reported as either nephelometric turbidity units (NTU), Formazin turbidity units (FTU), Formazin nephelometric units (FNU) or simply turbidity units (TU). In practice turbidity is quantified by relating it back to a known standard.



Turbidity in NTU.
USGS, Chattahoochee River

However, despite these common practices it remains difficult to relate turbidity measurements between instruments and from one sample stream to another because the intensity of scattered light is dependent on particle size, density, refractive index, the true color of the sample stream, bubbles, sample cell variations and optical fouling of the optical cell all of which will impact different

instruments in varying ways depending on the wavelength(s) of incident light used in the measurement.

LiquID's advanced approach to Turbidity

The LiquID station uses patented multi-spectral technology for monitoring turbidity which produces a more accurate quantification of sample stream clarity than possible with NTU-type devices. Three key features of the LiquID Station are responsible for this extraordinary accuracy:

1. **HIGH SENSITIVITY**
LiquID uses a high-quality photon counter combined with telescoping algorithms that ensure high performance in low (< 1 ATU) and high (>100 ATU) turbidity environments.
2. **MULTISPECTRAL FLEXIBILITY**
LiquID stations employ patented HMA logic (Hybrid Multi-spectral Analysis) developed just for this system that makes use of both transmission and scattering techniques to produce a more accurate view of the overall effect of different types of particles on the dispersion of light than possible with other devices that use one type of measurement.

About LiquID™

The LiquID Station from ZAPS Technologies (pictured below) is an innovative, optical instrument for continuous water quality monitoring. The automated online instrument analyzes a continuous flow-through stream from a pressurized water sample line using multi-spectral light and software algorithms, and uses no reagents nor produces any waste other than the original sample (which is returned or wasted as appropriate). With this method LiquID is capable of monitoring a wide range of water quality parameters in a number of different industry applications, including those relevant to municipal water and wastewater treatment, water reuse systems and industrial process control.



3. MULTIPLE WAVELENGTHS

Most turbidity devices collect information at a single wavelength. LiquID on the other hand measures attenuation over a large part of the particle-size distribution from colloidal material to aggregates and presents this information as highly accurate Attenuation Units (ATU).

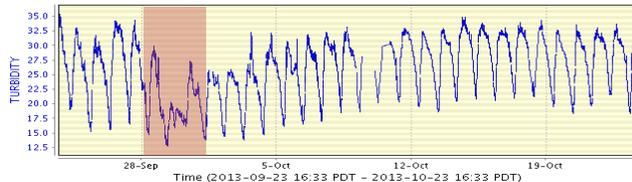
Summary

The LiquID's advanced approach translates into accurately characterized Turbidity measurements across a wide range of sample stream locations and conditions. The two graphs below represent turbidity measurements over a month period from physical locations within 20 miles of each other. Notice in the highlighted sections how the rain event on 29 Sept. increased turbidity in the mountain stream but showed up as dilution in primary sewage inside a nearby combined sewage-storm water treatment plant.

FROM MOUNTAIN STREAM



TO PRIMARY SEWAGE



In summary, LiquID's advanced approach produces turbidity that takes all size fractions into account and does not focus on one type of particle like standard turbidity meters. By accounting for the full range of particle size and composition LiquID is able to provide a comprehensive view of the net effect of particulate matter on the clarity of the sample stream. The combination of better measurement (patented) and innovative design (patented) gives LiquID the flexibility to continuously monitor turbidity in virtually any environment with no calibration and minimal hands-on maintenance.

Additional References

1. "Turbidity -- Units of Measurement." <http://or.water.usgs.gov/grapher/fnu.html>. US Geological Survey, Oregon Water Science Center, 03 Jan. 2013. Web. 25 Oct. 2013.
2. Campbell, D., and Spinrad, R., "The Relationship between Light Attenuation and Particle Characteristics in a Turbid Estuary." *Estuarine, Coastal and Shelf Science* 25.1 (1987): 53-65. Print.
3. Zaneveld, J.R.V., Spinrad, R. W., and Bartz, R., "Optical properties of turbidity standards." *Ocean Optics VI, Proc. SPIE 208* (1979): 159-168. Print.

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