A Clear View on Water Quality

By Marc Buttmann

For safer drinking water and more secure operation of industrial plants, close monitoring of water streams for impurities is required. This is ensured by the help of latest instruments like Optisens 1050.

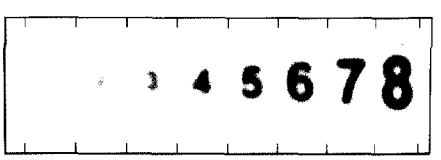
The purity of water is one of the key quality criteria in some of the most critical processes in our daily life. For example, energy generation requires the use of highly purified water for the generation of steam. In order to protect turbines and boilers in power plants, extensive efforts are taken in filtration steps to remove impurities like salts, hydrocarbons and minerals. Filter stations have to be monitored to ensure reliable operations and initiate removal steps in time.

In another example, potable water has to be treated to avoid harm to the human body. Particles that have not been removed during water treatment provide an ideal ground to grow bacteria in the water supply system. To identify these impurities, turbidity is widely used as a measurement. State of the art turbidity instruments are able to offer reliable monitoring with minimum service requirements. Traditionally, turbidity has been defined by use of test tables behind a sample. Depending on the turbidity the numbers on the test sample appear as a different clarity.

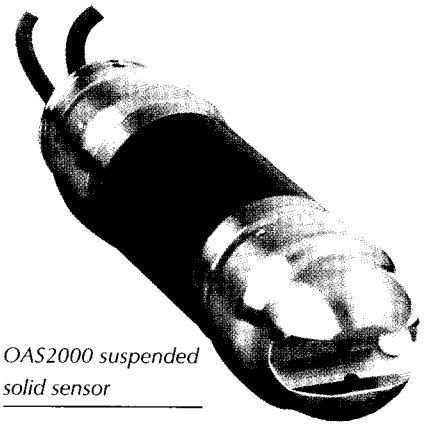
According to the US EPA (Environmental Protection Agency), turbidity is the cloudy appearance of water caused by the presence of suspended and colloidal matter. Technically, turbidity is an optical property of the water based on the amount of light reflected by suspended particles. Turbidity cannot be directly equated to suspended solids because white particles reflect more light than dark colored particles and many small particles will reflect more light than an equivalent large particle.

The ISO standard that is widely used in the European countries describes turbidity as reduction of transparency of a liquid caused by the presence of undissolved matter. Both standards compete against each other, even resulting in different methods to measure the sample. EPA requests for a white light measurement, and ISO demands the use of light in the IR range.

Turbidity is not a physical parameter but an optical effect. Therefore calibration can not be rooted back to the well known SI system (système international d'unités), but was standardised on agreed references. The turbidity standard, according to ISO7027, is based on a dilution of formazine ($C_2H_4N_2$) in pure water. FNU (Formazine Nephelometric Units) represents the engineering unit.



Test table for turbidity



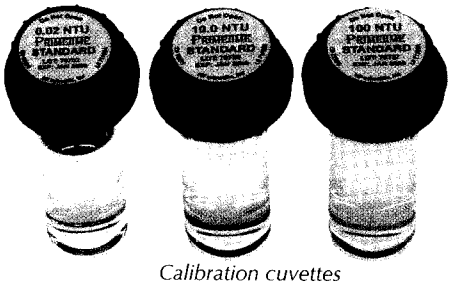
OAS2000 suspended solid sensor

Equally EPA standard 180.1 defines NTU (Nephelometric Turbidity Units) as engineering unit. Since formazine is a cancerogenic substance, alternatively SiO_2 particles are widely used to calibrate turbidity systems. A 1NTU or 1FNU turbidity standard can be produced by a 2.5mg/l dilution of SiO_2 in pure water. Pure water itself also contributes to turbidity due to absorption of light. The minimal turbidity of water is 0.016NTU or FNU.

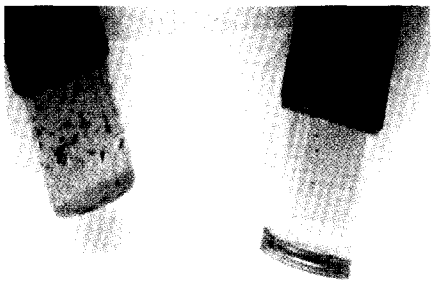
The particle size, colour and specific weight have direct influence on the relationship between the weight per volume dilution and the turbidity effect. This effect is based on the reflection of light by the particles within the sample. Particles reflect light in all directions, generally depending on the particle size compared to the light wave length. As a special phenomenon, the 90° reflected light is widely independent of the particle size and therefore represents the concentration. With the use of Infrared Light according to ISO 7027, particles larger than 1µm will be safely detected.

Another application of turbidity measurement is the optical measurement of solids concentration. As described, many substances reflect or absorb light energy and therefore can be quantified by attenuation of light. Typical applications are the concentration measurement of yeast in the beer brewing process or the measurement of sludge concentration in waste water treatment process. Optical measurement of the solids concentration is specifically recommended where the specific weight of the particles is similar to water and therefore the sludge concentration has little effect on the mass. In any case the optical system has to be calibrated to the individual sludge to consider the specific optical properties of the particles.

Calibration is usually performed by correlating a measurement result to a laboratory measurement. In laboratories the concentration is determined by drying a sample and weighing the solid residues. Alternatively a sample can be prepared using a know quantity of dry matter. Dilutions of 30% and 10% of this stock liquid allow for a 3-point calibration of the system. Limitations of these measurements



Calibration cuvettes

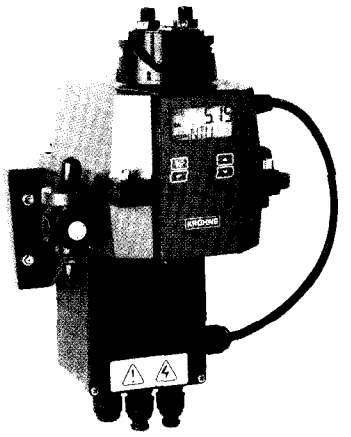


Effect of ultra sonic cleaning in treated waste water application

arise in real applications due to mineral scaling of biological coating of the optical system. This will lead to false readings due to additional absorption of light energy. A regular calibration of these systems is therefore mandatory. With KROHNE's new OPTISENS 1050 system this recalibration is simplified. The measurement cuvette can easily be replaced by sealed calibration cuvettes that contain factory produced standard solutions.

This enables a complete check and recalibration of the system within thee easy steps using calibration standards of 0.02NTU, 10NTU and 100NTU. There is no need to feed liquid standards into the system or perform separate laboratory measurements.

In addition, an ultrasonic cleaning system keeps the measuring cuvette clean from deposits and prolongs the service interval. This even allows installations in most challenging applications like treated waste water that still contains significant biological activity. With the OPTISENS 2000 suspended solids sensor, an integrated spray nozzle keeps the optical system free from deposits. Pressurised air of water can be applied and is being automatically controlled by the converter.



OPTISENS 1050 turbidity system

Automatic cleaning of OPTISENS OAS2000 sensor

In conclusion, the OPTISENS family of turbidity and suspended solids sensors enable the user to closely monitor water streams for impurities reliably with low service and maintenance demands. This contributes to safer drinking water and more secure operation of industrial plants while using water and steam as a utility.

In sludge applications it allows for concentration measurement with low service requirements due to integral automatic cleaning of deposits and coatings.

About the Author

Marc Buttmann is Management Consultant to Krohne Water Solutions, a manufacturer of Analytical Instrumentation for the water and waste water industry to complement the global offering of Krohne in flow, level and temperature instrumentation. Marc has over 15 years experience in the instrumentation business and in the global water market.

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