In-Line color control: Continuous monitoring of product color with Wedgewood analyzer

To measure and control the liquid color in a manufacturing process samples are often used. These samples are then analyzed in the laboratory. This is a time consuming process and like any offline quality control the laboratory data is not instant. Correcting the process based upon samples makes room for production spill.

The solution is: Continuous monitoring of product color with a Wedgewood in-line color monitor.

What is color?

Color is the visual perceptual property corresponding in humans to the categories called red, yellow, blue, black, etc. Color derives from the spectrum of light (distribution of light energy versus wavelength) interacting in the eye with the spectral sensitivities of the light receptors. Color categories and physical specifications of color are also associated with objects, materials, light sources, etc., based on their physical properties such as light absorption, reflection, or emission spectra.

Typically, only features of the composition of light that are detectable by humans (wavelength spectrum from 400 nm to 700 nm, roughly) are included, thereby objectively relating the psychological phenomenon of color to its physical specification.

Because perception of color stems from the varying sensitivity of different types of cone cells in the retina to different parts of the spectrum, colors may be defined and quantified by the degree to which they stimulate these cells. These physical or physiological quantifications of color, however, do not fully explain the psychophysical perception of color appearance.

Drinking water color

Why measure drinking water color? Drinking water color measurements has become more and more important around the world, due to customer expectations, national and local regulations like the USA EPA, The Canadian Federal-Provincial-Territorial Committee on Drinking Water and European Union. Below is a copy of the national regulations from USA and EU.

US regulations:
The U.S. Environmental Protection Agency (EPA) has established National Primary Drinking Water Regulations that set mandatory water quality standards for drinking water contaminants. These are enforceable standards called “maximum contaminant levels” or “MCLs”, which are established to protect the public against consumption of drinking water contaminants that present a risk to human health. An MCL is the maximum allowable amount of a contaminant in drinking water which is delivered to the consumer. The EPA calls for a maximum level of 15 color units for the drinking water.

EU regulations:
The European Union drew up the Council Directive 98/83/EC on the quality of water intended for human consumption, adopted by the Council on 3 November 1998. This was drawn up by reviewing the parametric values of the old Drinking Water Directive of 1980, and strengthening them where necessary in accordance with the latest available scientific knowledge (WHO guidelines and Scientific Committee on Toxicology and Ecotoxicology). This new directive provides a sound basis for both the consumers throughout the EU and the suppliers of drinking water. The EU standard only calls for acceptable to consumers and no abnormal change. Individual countries within the EU might have local standards for drinking water color requirements.

The Wedgewood solution

The Wedgewood Analyzer with the right combination of light source, optical filters, photo detectors, and flow cell path lengths, will monitor color of a process stream with readout in color scales over different ranges. Typical measurement wavelength ranges would be from approx. 390 nm up to but not limited to 465 nm.

The Wedgewood analyzer‘s major advantage is that the sensors are designed for true in-line process use and that the transmitter will allow the color scale to be readout linear or nearly linear in color.

The most commonly used standard water color scale is the APHA/Hazen scale (Figure 1)

The Wedgewood design with two wavelengths also enables the measurement system to compensate for suspended solids that normally will affect the absorbance measurement.

A thumb rule is given that the suspended solids should not cause more than 1/3 of the total absorbance in order for the system to be able to make automated compensation. If higher turbidity is present in the raw water stream an in- line customer supplied filter can be installed prior to the sensor. In humid or condensing environments the sensor can be fitted with an air purge option to prevent disturbances caused by window fogging.

Due to the long path length (250 mm) the Wedgewood system will detect and measure very low changes in water color. A typical laboratory analyzer will use a path length of 50 mm. The Wedgewood analyzer will be approx. 5 times more sensitive compared to the laboratory instrument.

The Wedgewood water color monitors can be used on both the raw and the final treated water.

Raw water measurement:
The raw water color measurement can be used to measure the quality of the raw water source and used to predict changes to the first process steps in treatment plant. The raw water source can be affected by heavy rain, water run off from snow and ice melting depending upon the water source. Any changes in the raw water might call for an increased coagulant treatment and the color monitor can be used to control the coagulant treatment process. A major change in the raw water color might also indicate pollution of the raw water source, maybe a spill from a nearby industrial production plant or other contamination.

Final water measurement:
The final water color measurement can be used to measure and verify the quality of

the final water according to the regulations specified either by national or local agencies. The measured color data can be used as proof of quality and can be reported to local or national agencies.

Analyzers for the drinking water process:
The modular design of the sensor enables the Wedgewood sensors to be tailored to operate at specific pressure, temperature and measurement ranges.
For measurements in the drinking water process plants Wedgewood offers two standard solutions:

1. Raw water measurement:
Model OCM44P/OUSAF21
range: 0-500 APHA/Hazen

2. Final water measurement:
Model OCM44P/OUSAF21
range: 0-20 APHA/Hazen

Other measurement ranges are available upon request.

To prevent fouling of the optical windows caused by inorganic precipitants or biofilm, regularly cleaning of the sensor is recommended. The cleaning of the sensor can be automated by installing 3 way valves on the in and outlet of the sensor. The valves can then be used periodic to disconnect the sensor from the measurement stream to be flushed with a cleaning solution that removes the inorganic/biofilm from the windows.

Another feature is the unique EasyCal™ that allows the user to verify operation of the color analyzer without introducing liquids standards in the sensor. The operation of the EasyCal™ can be fully automated so no human intervention is needed.

The Wedgewood drinking water color analyzers has been applied and proven in several drinking water color applications around the world, with references in countries like Norway, USA and Canada.

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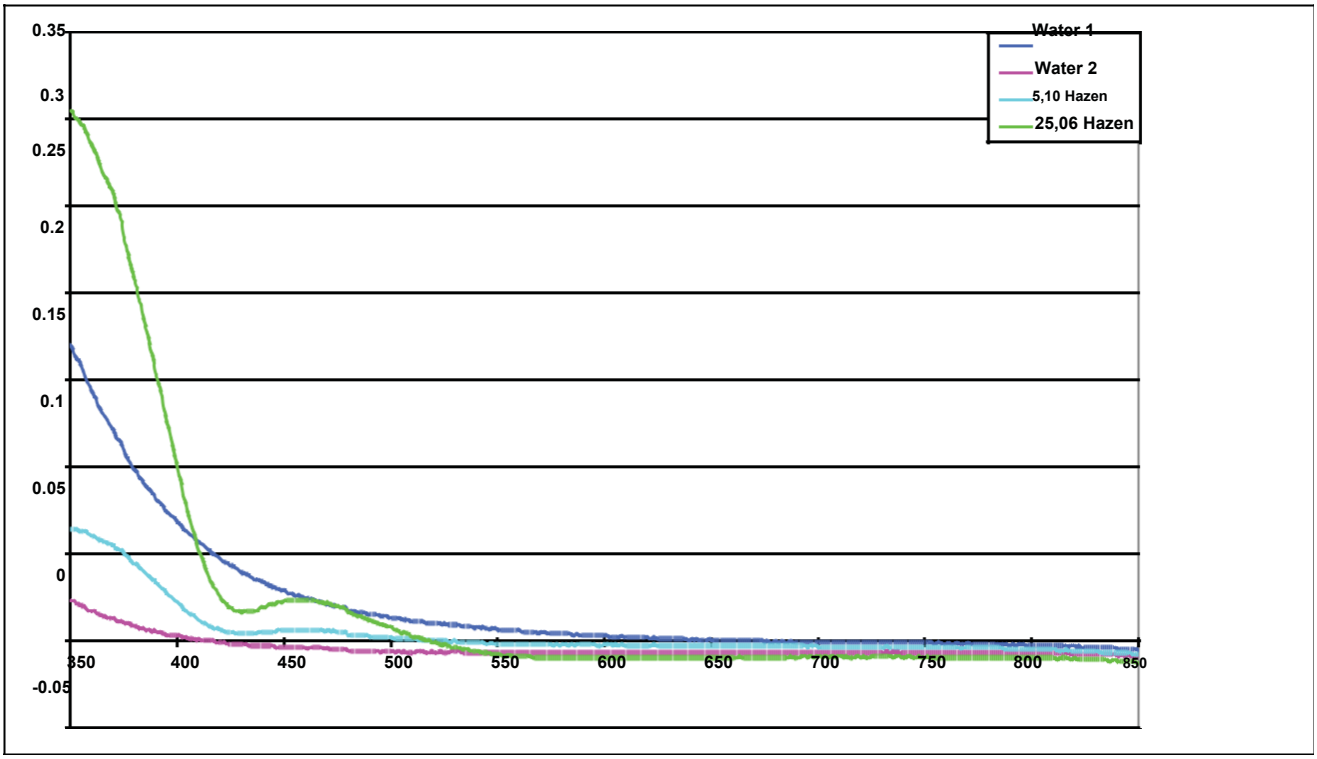

Figure 1: AHPH/Hazen standard compared with drinking water