

Application Report

Colour (Hazen) of Raw Water

The water available at the intake of a water treatment plant can originate from different sources: ground water, rivers, lakes, wells. Accordingly, this water can be contaminated in different ways. Solid matter, dissolved organic carbons, humic acids, germs, micro pollutants or traces of iron or manganese can occur in any combination. Especially in the case of surface water, colourings ranging from browns to yellows, green or even red might be present.



Pict. 1: Moorland water with a high load of humic acids



Pict. 2: Slurry in surface water

Yellow colours are mainly a result of humic acids in the soil and, depending on the season and the amount of rainfall; they are also a result of fertilization related to farming activities.

Benefits

The detection of colour in water (yellow cast) is a simple absorption measurement. This allows an immediate decision if the water has to be rejected or which kind of treatment steps is necessary.

Typical application

The water is conducted into the water treatment plant in a canal or a pipe. Using a pump or with hydrostatic pressure, a sample is fed to the measuring instrument.

Depending on the origin of the water, the season or the weather conditions, this sample contains more or less solids (turbidity). This can be from less than 1 FNU to several 100 FNU. The sample therefore has to be Pre-filtered in most cases. SIGRIST has such a filter unit in their portfolio, consisting of a coarse filter of 1 μm and a fine filter of 0.5 μm .

In addition to the solids and the organic load (also called UV254, DOC or UV-absorption) yellow colourings (colour) can occur. This colour is measured by absorption. For this, a light source

in the range of 365-455 nm is used. The unit is stated as Hazen or Pt-Co (Platinum-Cobalt).

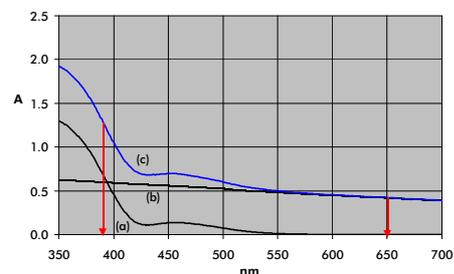
Colour values which are typical in raw water can be up to a few Hazen, but they can also be several hundred Hazen. At the end of the water treatment – depending on the respective country – a maximum of approx. 15 Hazen are normally permitted.

Technically, the SIGRIST ColorPlus with a 100mm PVC measuring cell (alternatively 50 mm PVC) can measure from a few Hazen to several thousand Hazen depending on the wavelength used. In the application described here, however, mostly very low values are of interest. The instrument is capable of measuring values which cannot be detected by the naked eye.



Pict. 3: ColorPlus Bypass with a 100 mm PVC measuring cell

Apparent colour vs. true colour



Pict. 4: Absorption spectrum of Pt-Co

Despite filtration of the sample, solids are left in the water and falsify the measurement. The particles scatter light which ultimately does not arrive at the receiver, and thus an absorption is indicated which is too high (or Hazen values which are too high). In this connection “apparent colour” is also spoken of.

The diagram in picture 4 shows three curves. The following formula applies: $c = a + b$, with c = apparent colour, b = influence of the solids (turbidity), a = true colour

In order to measure the true colour, it is therefore necessary to completely eliminate solids or to compensate their influence with a 2nd light source.

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Limits of the compensation:

At each moment of the compensation the following applies: at the most, $\frac{1}{3}$ of the absorption value may be caused by the solids in the sample. In order to define an instrument, the "typical" turbidity and colour also has to be known in addition to the maximum values. It might well be that the sample is filtered and a turbidity compensation is nevertheless employed, depending on the requirements to the measuring accuracy.

Comparison in-line measurement <> laboratory

It is often the case that, after the installation of an in-line instrument, its values are compared with the laboratory measurements. Curve a) in picture 4 shows the absorption spectrum of the calibrating liquid Pt-Co. It is obvious that the wavelength used has a considerable influence. The values can only correspond if both in-line and laboratory measurements are carried out at the same wavelength. That has to be clarified before an order is made.

Cost-benefit analysis

This measurement supplies the water treatment company with a cost-advantageous online monitoring for raw water. If an alarm is set off, the respective water can be treated or channelled into the reject depending on the soiling.

The in-line measurement results in process reliability.

In addition, the instrument can be combined with an UV254 measurement thus reducing costs.



Pict. 5: ColorPlus bypass in raw water with sample filtration

Products

SIGRIST product and configurations for this application:

- Basic instrument 1 VIS bypass: ColorPlus 2
- Configuration LED ColorPlus, e.g. 365 nm (country-specific!)
- PVC measuring cell 100 mm VIS for ColorPlus with cover (for high colour concentrations: measuring cell 50 mm)
- SICON control unit
- Option: Hazen calibration for ColorPlus – with or without certificate
- Option: filter unit FEW3 with filter cartridges

Parameter settings

- Adjust water flow
- Determine limits for pre-alarm and alarm with the customer

Alternative methods, competitors

- On the market are multi-parameter instruments and spectro-analysers which may have colour as a parameter
- Laboratory measurements

Advantages of the SIGRIST ColorPlus bypass » Customer benefits

- Internal compensation of window soiling
 - » permanently precise measuring values
- Little maintenance effort: The instrument causes an alarm as soon as the measuring cell needs to be cleaned
 - » no fixed maintenance cycle is necessary
- Simple cleaning of the measuring cell, monitoring of device exclusively with distilled water and control unit
 - » no chemicals are necessary
- Very high sensitivity
 - » low detection limits
- Influence of turbidity can be compensated with a 2nd wavelength of 700 nm (alternative to filtration but only in case of very slight turbidity)
 - » values measured are more precise
- Optionally, the measurement of organic load (also called UV254, DOC or UV absorption) can be integrated at low costs
 - » one instrument – two measurements