Application Report
Turbidity after Sand Filter

SIGRIST PROCESS-PHOTOMETER

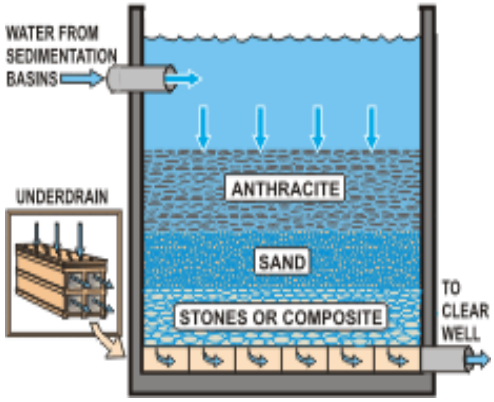
The World Health Organization (WHO) set the objective that the entire world population should have access to drinking water with a turbidity value no higher than 5 NTU. Currently only 35% of the worlds population can enjoy such water quality. One of the most important indicators of water quality is turbidity.
The water purification process consists of a number of process steps, which are structured in a typical water purification plant as follows: raw water intake – flocculation – sedimentation – fast filter – slow filter – disinfection. There is not only one type of process but many, depending on the amount, type and quality of the raw water, of national standards, legal requirements etc.

Different standards
Worldwide there are different standards for the measurement of turbidity in drinking water. The most important ones are:
Europe - ISO 7027 / EN 27027
Turbidity is determined via scattered light measurement. The light source is monochromatic at 880nm, the scattered light receiver measures at 90°. The instrument is calibrated with Formazine. The measured values are output in FNU (**F**ormazine **N**ephelometric **U**nits). A possible coloration of the water does not influence the measured values.
The USA - EPA 180.1
Turbidity is measured via scattered light measurement. The light source is white light (tungsten lamp with a colour temperature of 2200-3000°K), the scattered light receiver measures at 90° (range covered: 400-600nm). The instrument is calibrated with Formazine. The measured values are output as NTU (**N**ephelometric **T**urbidity **U**nits). Instruments based on this standard exhibit incorrect measurement in case of water coloration.
However, there are also many countries having their own standards (e.g. Japan) or none at all. Those measured values (if there are any at all) cannot be compared with the other standards.

Benefits
Filtration eliminates solids from water. It is the last stage of this kind in the water purification process before disinfection. Removing solids is important since they are often the carriers of organic and/or bacterial contamination (e.g. cryptosporidium).

By eliminating solids, the subsequent disinfection process becomes more effective, more efficient and safer. Turbidity measurement at the outlet of the filter is therefore available and necessary as quality control which is often required by the respective authorities and which has to be documented continuously.

Typical application
The following picture shows a typical slow sand filtration which is widely in use all over the world. Usually it is a multilayer sand filter with different types of sand and small stones.



Example of a multilayer sand filter

The water supplied passes through the sand as a result of the gravitational forces. The more tightly packed the sand, the slower the seeping. Sand filters can have a thickness of up to 1.5 m. At the bottom end of the sand layers, there are cavities in which the purified water collects. From there, the water is fed to reservoirs or directly to the next process step through pipes having considerable diameters.

Typical turbidity values: < 0.5 FNU, in some countries even < 0.0x FNU.

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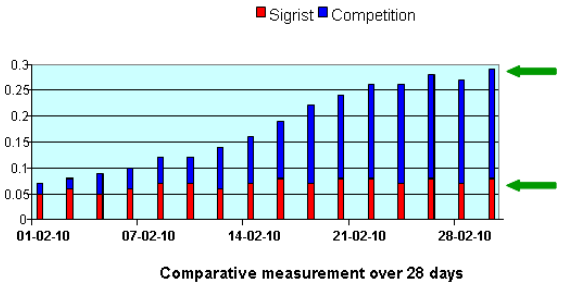
Practical measurements (example):



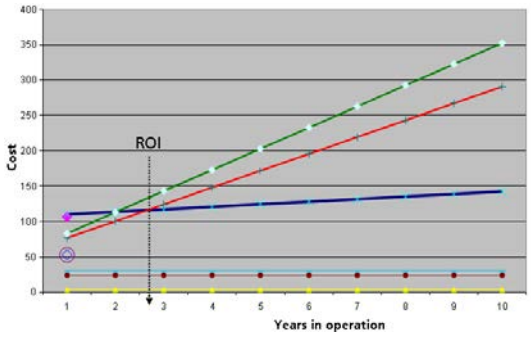
Comparative measurement over 28 days

The diagram above shows comparative measurements of a filtered water sample using a SIGRIST AquaScat alongside a competitor's instrument over a period of 28 days. The turbidity values from the AquaScat remained constantly around 0.05 FNU, whereas the comparative instrument showed continuously increasing values, which were a result of zero drift without correction. The AquaScat did not exhibit any drift, the automatic adjustment would correct possible variations and thus guarantee reliable values. In effect the comparative instrument was masking real values which were below the drifting baseline.

Total cost of ownership

Measuring turbidity at a critical point, such as filtration monitoring; only makes sense if the instrument is sufficiently sensitive to measure the slightest turbidity, and can reliably detect minor changes and has long-term stability. In addition, a measuring installation has to be designed such that it requires absolutely minimal maintenance or operator intervention.

The capital costs of acquisition of an AquaScat are significantly higher than those of the corresponding offers of the competition. However, if you consider the total lifetime costs of the instruments (i.e. not only the initial acquisition but also the costs of electricity, maintenance and repair, cleaning, calibration means and expenditure), the following comparison shows a clear advantage in favour of the AquaScat:



This example was calculated by a customer from England. The diagram shows at the bottom the annual operating costs of the AquaScat (yellow) and two evaluated comparative instruments (brown and light blue).

The upper lines show the total costs of the AquaScat (dark blue line) and the two evaluated comparative instruments (red and green lines).

This comparison impressively demonstrates that the higher investment costs of the AquaScat are compensated already 2½ year later by the advantageous operating costs and that the total costs over a period of 10 years amount to less than half of the costs of the other instruments.

Products

SIGRIST products and configurations:
- AquaScat WTM and checking unit *or*
- AquaScat WTM (A) *or*
- AquaScat P and checking unit
- Optional: flow measurement, level control, deaeration tube (for models WTM)

Parameter adjustments:
- Selection of a scale range
- Determination of the alarm values / limits

Advantages of the SIGRIST AquaScat
- Non-contact free-fall measurement technology and thus no contamination of the instrument (model WTM and WTM A). Optimized flow cell with self-cleaning effect (model P)
- High sensitivity and thus reliable detection of minor measurement changes, as low as 7mFNU
- Long-term stability of the measurement as a result of the negligible zero drift
- Recalibration of the instrument with secondary standards, no use of Formazine (optional: automatic adjustment)
- Low total cost of ownership
- Only water process turbidimeter with full auto-calibration check