

## Seli developed low-cost modular turbidity sensors for process monitoring in the food and beverage industry.

In the beginning, the aim was to develop a turbidity sensor that should be less expensive to purchase and in operation than other sensors by the saving of maintenance.

The result from this is the sensor family STS.

The developed sensor is characterized by its compact design and by its high accuracy of measurement and repeatability in different processes. This is achieved on the one hand by the new monolithic structure of the optical sensor assembly group and on the other hand by the good electronic amplifier module. Only through the use of modern processors and electronic components was it possible to realize a sensor in this compact version. The specific requirements for the temperature stability of the selected components are fully met by the "STS".

### What happens at screening liquids?

Light shines through liquids. When light is passed, a portion of it can be lost, it is absorbed. 100% transmission means that no light is lost, 0% transmission means, however, that no light reaches the detector.

### What is turbidity measurement – where is it used?

The turbidity measurement is often used in the beverage, food and dairy industry as well as in the chemical and pharmaceutical industry, to monitor continuous process results or to indicate changes certainly (e.g. solids concentrations, yeast concentrations, phase separation, filter breakage-monitoring).

The turbidity of a liquid is a subjective impression. The cloudiness is caused by small particles in the liquid which

have a different refractive index from the carrier, or by absorption. There are various methods to measure the turbidity, for example, the transmitted light method (180° method) or the scattered light or nephelometric method. Other methods are the reflection measurement or the ratio method.

All typical measurement procedures function as follows: from the transmitting light a bundled beam of light is transmitted through the liquid. This beam is scattered on particles and recorded by the scattered light detectors.

At the same time the transmitted light is measured. The quotient of scattered light and transmitted light is the turbidity value.

The above methods are not comparable and depend strongly on the particle size.

### What is the STS capable of – what is different?

The STS measures transmitted light (180° method) in the near infrared wavelength range at 880nm according to ISO 7027 and denotes it as 0...100% signal in its integrated display. In this way cross-colour effects can be completely avoided. Offering optical path lengths of 5mm to 20mm the STS is appropriate both for medium and small turbidity / absorptions.

The next step in the development will be designed for high turbidity.

Most manufacturers use incandescent lamps as a light source. This involves several problems and all components used therein have tolerances to one another which affect specifically hot/cold changes (e.g. cleaning methods such as

### The range of STS is at:

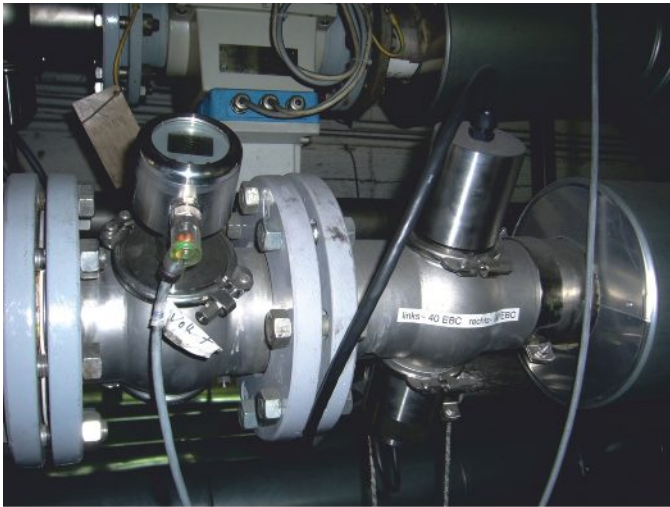
OPL 5mm	0...500 EBC	0...2000 FAU	5,0 g/l	~0,4 % TS
OPL 10mm	0...250 EBC	0...1000 FAU	2,5 g/l	~0,2 % TS
OPL 20mm	0...100 EBC	0... 400 FAU	1,0 g/l	~0,1 % TS

OPL - optical path length

FAU - Formazine Attenuation Units

TS - Dry Substance

Based on Formazine: 1 FAU = 0,25 EBC = 2,05mg/l = 9,00000205%TS



CIP/SIP) extremely and strongly the repeatability. In order that this lamp brings reproducible values, a very constant current source is required. In addition, the right wave range has to be filtered out and the light beam has to be focused by use of various lenses. Furthermore, the detector often reacts on surrounding light influences.

For the "STS" we use a high quality industrial-suited LED transmission source and therefore require neither a highly complex constant current source nor filter elements or lenses! All components are combined in a monolithic component and hence are subject to a constant tolerance even in the case of changing temperatures.

Here the design is absolutely without a gap, with surface roughness of less than 0,4 mm.

The sapphire-window is installed flush-mounted in a specially developed process and does not require the usual polymeric seal. There are no gaps or edges and we achieve a completely hygienic design. The "clogging" of the windows is here effectively prevented.

An advantage of the "STS" is that the concentration measurement is independent of the colour. Also, we achieved a very compact design with integrated electronics and display for parameter setting. The resistant sapphire-window is fully CIP/SIP-compatible and the sealing system is

absolutely polymer-free. By using an LED light source a stable and durable signal is guaranteed, which is almost maintenance-free. Despite its compact dimensions, a digital and analogue output is integrated.

The system guarantees:

- secure phase separation (if turbidity is present)
- faster product change
- filter monitoring
- easy parameterization
- process observation and documentation via PC

**A renowned German brewery also made absolutely positive experiences.**

About now more than one year we observed the turbidity meters provided by seli in three different cases of application. The measured data are continuously recorded on a BDE-system and can be evaluated even historically with a resolution of 10s.

The measurement locations are:

- Turbidity in the wort after lauter tun ; STS 01 OPL 20mm
- Turbidity in the yeast sales management to switching after phase change during start-up and cool down ; STS 01 OPL 10mm

- Turbidity measurement after the yeast dosing to control at start-up whether yeast is metered; STS 01 OLP 10mm

In summary, it can be stated that, in all three cases of application, the measurement tasks were resolved very well and that maintenance works on the systems were not needed during the whole test phase.

The measurement at the lauter tun shows a very good parallelism, in comparison with EBC turbidity measurements built and recorded parallel, and can also be used as a process control variable. This is illustrated in a data sample of the running production in the plant. The measurements in the yeast applications provide unique switching signals with which proper phase separation is possible.

