

# Automatization of Synthesis Processes

Process control in the chemical industry is indispensable. Large chemical companies use measuring instruments for safe and cost-saving handling in synthesis processes. This increases efficiency and output while maintaining product quality. At the same time, expensive and time-consuming laboratory tests can be reduced. How exactly does the ColorPlus Ex from Sigrist monitor a chemical synthesis?

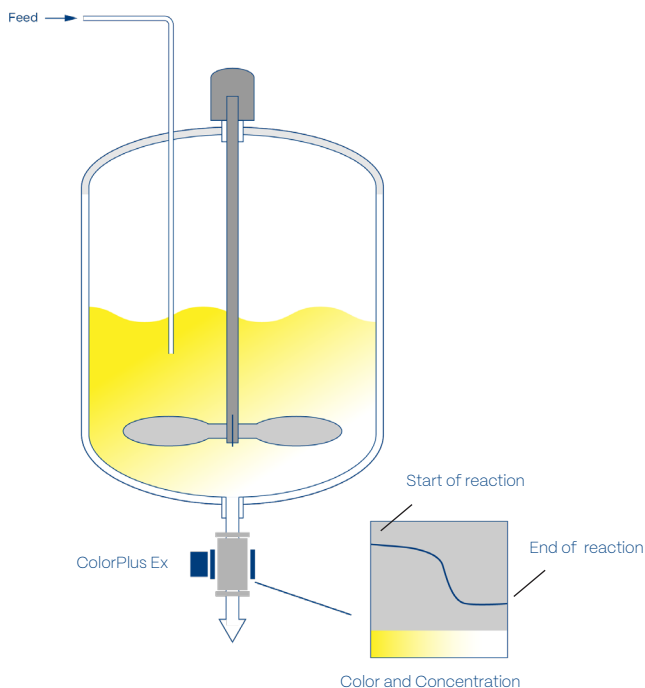


Diagram of a chemical synthesis. When the reaction is complete, the Hazen value is 0, i.e. the mixture is colorless. The ColorPlus Ex measures the decolorization to determine the completion of the reaction.

The reaction mixture is colored during the course of the reaction. The decolorization is measured to determine the completion of the reaction. The on-line process monitoring and control ensures reproducibility in the process. The measurement is carried out quickly and continuously in the process line, thus saving the costs of laboratory tests.

## Typical Application

The measurement of Hazen is used, for example, in the synthesis of propene acid (trivial name: acrylic acid, CAS number: 79-10-7). The colorless product is produced from the two-step oxidation of propene. An explosive mixture with oxygen occurs from concentrations of 3.8 vol%. The use of Ex-certified measuring devices is therefore an absolute must.

In the first stage, propenal (trivial name: acrolein) is produced, which has a slightly yellowish color. In the second stage, the propenal is converted by a molybdenum-vanadium catalyst at high temperatures.

The Hazen color number is suitable for determining yellowish colorations. The diagram shows schematically how it works. When the reaction is complete, the Hazen value is 0, this means that the mixture is colorless. An increased value indicates that starting material is still present.



The Color Plus Ex

### The Solution

The ColorPlus Ex is available with a customer specific measuring cells. A version with flameproof encapsulation is offered for installations in areas requiring explosion.

### The Customer Benefit

**Initial situation at the customer:**

Production volume of 1.5 million tons at a market price for acrylic acid of CHF 1.5 – 2.5 /kg:

Sigris device	Customer benefit	
ColorPlus Ex	Increase in yield	Sales increase CHF/year
Exact measurement of end of reaction	1%	At least 60'000 CHF/year

### Technical Details

- Measuring device can be fitted with up to three LEDs (fitted according to exact customer requirements)
- Flexible selection of optical path lengths between 3 and 150 mm. This allows very small values (up to 10 mE) to be measured without any problems.
- Designed for process conditions up to 195°C and 20 bar
- Flexible measuring cells available. They can be connected to any process lines.

### Further practical measuring tasks

The ColorPlus Ex is also used worldwide in the synthesis of maleic anhydride, phthalic anhydride or methacrylic acid.

It is used in oil refineries around the world. There, after the distillation of crude oil, the quality of the products (petrol, diesel, naphtha) is determined using color numbers such as Saybolt or ASTM. This is where the Sigris photometer device scores with its high accuracy and reliability.

### Fun fact

**Color numbers are quality characteristics that are used in various industries. They are always based on a concentration of one or more products that absorb in a similar spectral range. The color number or visible substance color corresponds to the complementary color. What does that mean? Hazen is a measure of the yellow coloration of a solution. The corresponding complementary color is blue. As mentioned above, wavelengths in the range 350 – 450 nm are used, i.e. „blue“ light source.**

