

Application Note

HYGROPHIL F 5673

Process Trace Moisture Analyzer for
1-Hexanol Production by Ziegler Alfol Synthesis



APPLICATION NOTE

The reaction of organoaluminum compounds found by Karl Ziegler in the 1950s opened a way to produce primary, straight-chained and even-numbered Alcohols from an Ethylene source.

The Ziegler Alfol synthesis used for the production of high purity 1-Hexanol from petrochemicals is a four stage process:

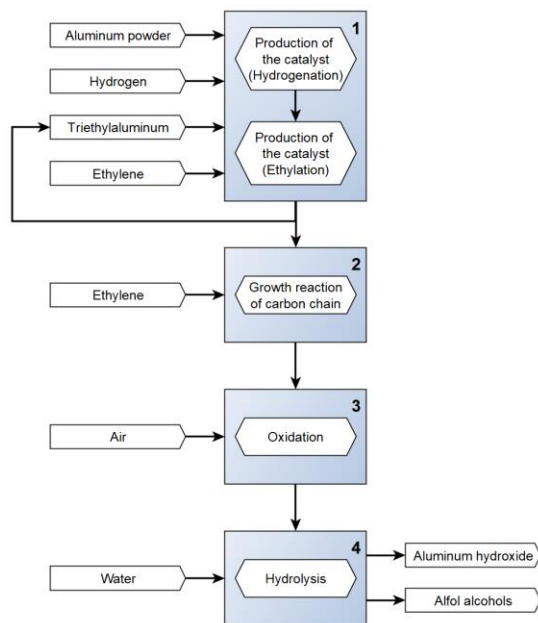


Figure 1: The Alfol Synthesis Process

In the first step the catalyst Triethylaluminum is produced. Very fine aluminum powder and Triethylaluminum are hydrogenated to Diethylaluminum hydride in the presence of Hydrogen.

Next, Ethylene is used for the conversion into Triethylaluminum at approximately 100 °C and 2.5 MPa.

In the second process step, a flow reactor is used for the strong exothermic reaction where the carbon chain-growth takes place. The temperature of the insertion reaction is about 120 °C and ethylene pressure is typically 10 to 14 MPa.

The Trialkylaluminum compounds are oxidized in the third step with air to alkoxides. It is important to use very dry air for this exothermic reaction to minimize the formation of byproducts like Aldehydes, acids, esters or ethers.

In the last process step, the aluminum alkoxides are saponified with water to alcohol and pure aluminum hydroxide. The alcohol selectivity is typically ranging from 85 to 91 %.

The mixture of water and Alfol alcohols are phase separated to remove the water. The organic phase is then fractionated by distillation to reach a 1-Hexanol purity of greater 98.5 %.

The water content in the final product is typically stated with less than 1000 ppm (wt.).

Reliable moisture measurement for process optimization and quality control

A reliable inline moisture measurement helps to ensure that the product is complying with the specification. Especially when the process parameters are changed and optimized for energy savings or yield optimization.

Compared to other measurement technologies the HYGROPHIL F does not require extensive sample conditioning and recovery

systems. The installation of the moisture sensor with the sensor retraction armature offers a measurement directly in the process line.

The BARTEC BENKE's trace moisture sensors are trimmed to superior robustness.



Figure 2: Sensor installed in sensor retraction tool

APPLICATION NOTE

The HYGROPHIL F is designed for the needs of the petrochemical industry.

The core element of the moisture sensor is an optical thin film element made of silicon dioxide and zirconium dioxide. The microporous stack of alternating high and low refracting optical layers is forming a Fabry-Pérot Interferometer with a distinctive and reliably detectable reflection minimum in the spectral range around 820 nm.

Selective to water, molecules can diffuse into the porous Fabry-Pérot element, which then performs a shift of the reflection minimum in proportion to the actual water vapour pressure. The spectral shift is detected and evaluated with a compact high-resolution polychromator, which is located in the evaluation unit together with the light emitting diode. The interconnecting fiber optic cable can be up to 800 m long because of the detection of an optical minimum instead of an intensity change.

The evaluation unit processes and calculates the present moisture content as well as other units such as water vapour pressure.

Several analog outputs, MODBUS, PROFIBUS RTU and via TCP/IP as well as relay contacts are equipped as standard for interconnection to the control system.

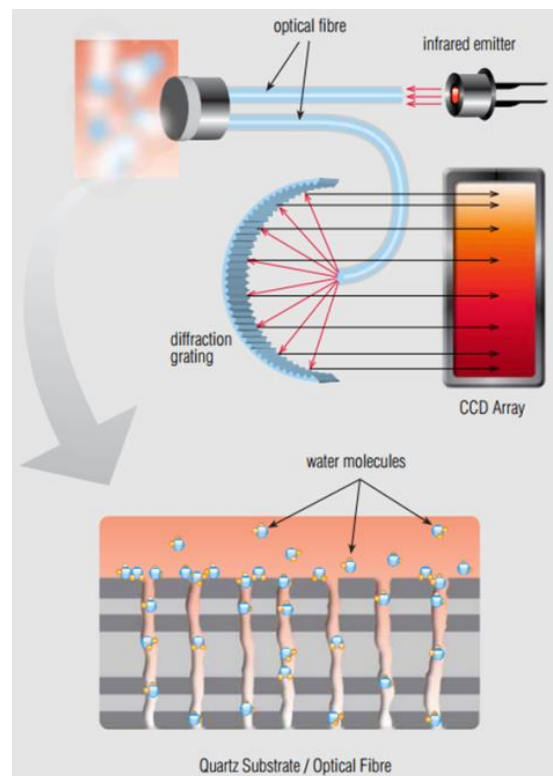


Figure 3: Schematic of the Measurement Principle

Thousands of installations worldwide prove the advantages of this measurement principle:

- Robust sensor construction for outstanding long-term stability
- Sensor validation at process conditions by accredited and independent laboratory available
- Easy sensor cleaning and almost no maintenance required
- In-line installation with sensor retraction armature possible (fast response and emission-free)
- Flexible on-line solutions with customized sample conditioning systems
- Certified for safe operation in hazardous area (ATEX, IECEx, CSA, TR CU)