

# Application Note

## HYGROPHIL F 5673

Process Trace Moisture Analyzer for  
Syndiotactic Polystyrene Production



## APPLICATION NOTE

### Syndiotactic Polyesterene – The Superior Thermoplastic

Syndiotactic Polyesterene (SPS) can be described as a superior engineered thermoplastic which was first synthesized in 1985 by Idemitsu Kosan Co. Ltd. (Tokyo, Japan). The semicrystalline polymer stands out with a wide range of features. It offers a great heat resistance and chemical stability against several acids and alkalis and is ideal for

automotive electrical parts and high-speed communication devices because of its electrical properties. It can be easily processed by molding with only minimal shrinkage. SPS is inexpensive, tough, lightweight and at the same time environmental friendly because it is easy to recycle.

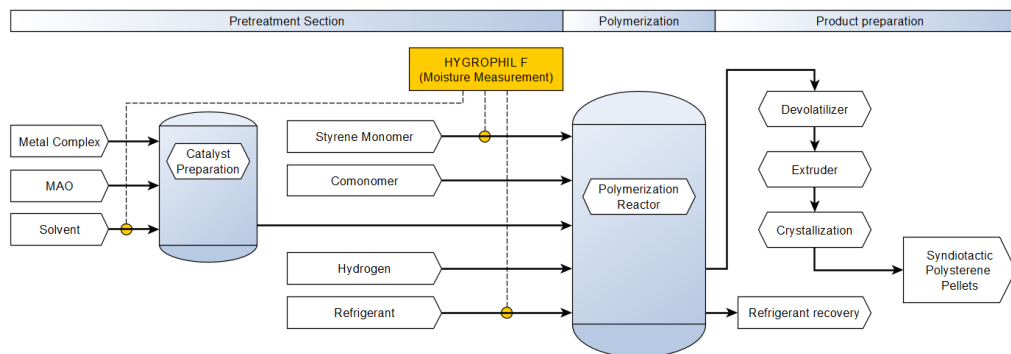


Figure 1: Simplified production process for syndiotactic polystyrene

The styrene monomer and comonomer solvent preparation is essential to the process because even small amounts of impurities like oxygen and polar components may reduce the performance or even deactivate the reaction with the catalyst.

In the pre-treatment section, the catalyst is prepared by reaction of a transition metal complex and methylaluminoxane (MAO) in an aromatic solvent. The transition metal complex is crucial because of its influence to reaction rate and the degree of syndiotacticity. (Syndiotacticity describes the position of the phenyl groups which are positioned on

alternating sides along the hydrocarbon backbone.)

The polymerization reactor consists of the reactor tank, agitator and an evaporative refrigeration system to control the temperature. Styrene monomer, catalyst and hydrogen are fed to the reactor where the polymerization reaction takes place.

In the product preparation section unreacted monomers and residual solvents are removed in dryer arrangements to devolatilize the SPS. Product stabilizers are added in the extruder and finally crystallized and prepared to pellets.

### Even traces of moisture reduce the performance and product quality

Due to the unwanted influences of polar components, the moisture measurement in the raw materials is essential to maintain process efficiency, high product quality and reduced corrosion of the plant.

Usually the Styrene monomer and the solvent for catalyst production are removed from impurities by molecular sieves. Moisture measurement at the outlet of the sieves helps to control the regeneration intervals for energy savings but mainly to ensure that moisture is removed at all

times. The allowed moisture level in this application is usually below 5 ppmw which asks for a reliable inline trace moisture analyzer.

The BARTEC BENKE Hygrophil F is a multi channel trace moisture analyzer with an extremely robust but accurate moisture sensor suitable for inline installation. The standard calibration down to a moisture of 0.05 ppmw is usually validated by an independent and accredited laboratory.

## APPLICATION NOTE

### The HYGROPHIL F is designed for the needs of the oil, gas and chemical 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 dew point temperature as well as other units such as water vapour pressure, parts per million, mg/m<sup>3</sup> and further more. 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.

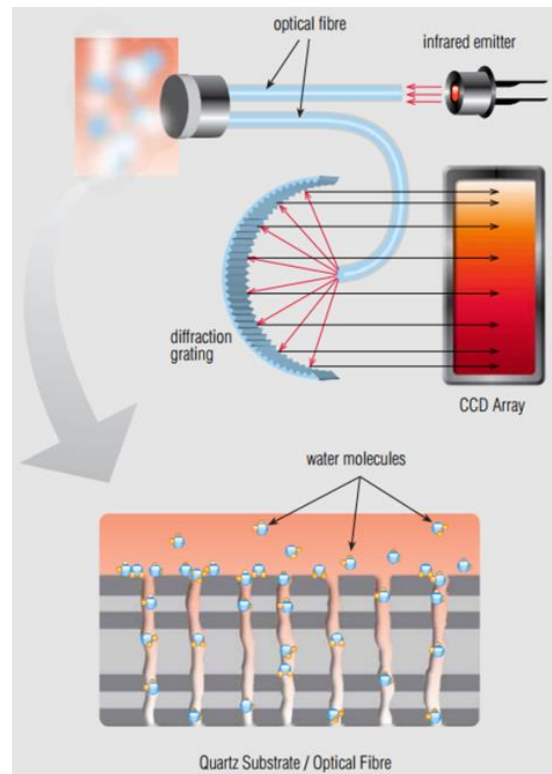


Figure 2: Schematic of the Measurement Principle

### 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 on request
- 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)