

Application Note

HYGROPHIL F 5673

Process Trace Moisture Analyzer for
1-Butene Comonomer Drying with Molecular Sieve



APPLICATION NOTE

Traces of moisture can degrade your Polypropylene quality and poison your catalyst

Polypropylene is one of the most versatile and important thermoplastics. Compared to Polyethylene, it is even stronger, stiffer and harder. Supplemented with additives, many properties like ultraviolet and chemicals resistance, thermal stability and flame resistance can be enhanced and used for bottles, toys, casings, furnitures, fabrics, and many more. Polypropylene can be produced by three different processes that includes a Ziegler-Natta catalyst. The suspension (“Slurry”) process, the bulk polymerization process and gas phase process with solid catalyst.

The density as well as thermal behaviors (crystallization, melting and degradation) of the final product can be controlled and improved by involving a comonomer like 1-Butene to the polymerization process.

Moisture must be rigorously excluded because even traces of water may result in deactivation of the catalyst. Even if the solubility of water in 1-Butene is very small (Figure 1), dehydration is mandatory.

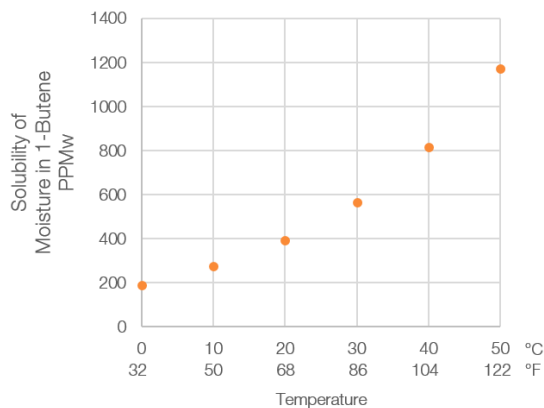


Figure 1: Solubility of Moisture in 1-Butene

Depending on the plant size, the dehydration unit for the 1-Butene comonomer is equipped of several molecular sieve vessels. The example (Figure 2) shows a two bed unit for dehydration below 5 ppm_w.

Once the 1-Butene passed the first vessel, the moisture is analyzer to detect moisture break-through in case that the molecular sieve is

exhausted or damaged. After the second molecular sieve the moisture is again measured in the outlet stream of the dehydration unit. Molecular sieves require a periodical (several days) regeneration with hot gas.

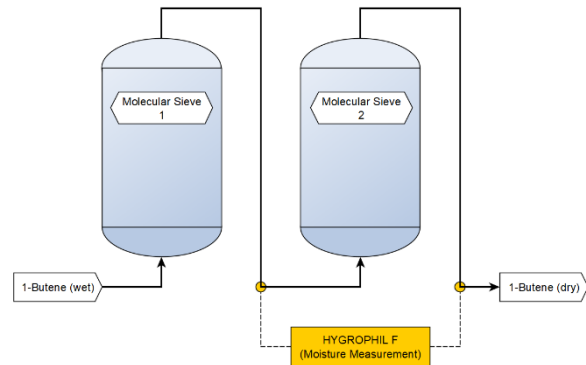


Figure 2: Schematic of a simplified molecular sieve dehydration unit

Typical Process Conditions:

Composition: pure 1-Butene
 Temperature: 10 to 30 °C
 (50 to 86 °F)
 Pressure: 600 to 1200 kPa_g
 87 to 174 psig
 Moisture: greater than 25 ppm_w (feed)
 less than 5 ppm_w (outlet)

A reliable trace moisture analyzer is essential for safe and efficient operation:

- Early detection of moisture break-through
- Ensurance that the moisture at the outlet is below 5 ppm_w to protect that catalyst
- Define the regeneration intervals for process optimization and energy saving

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

Inline or at-line installations are possible with sensor retraction armature or sample conditioning systems.

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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/m³ 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.

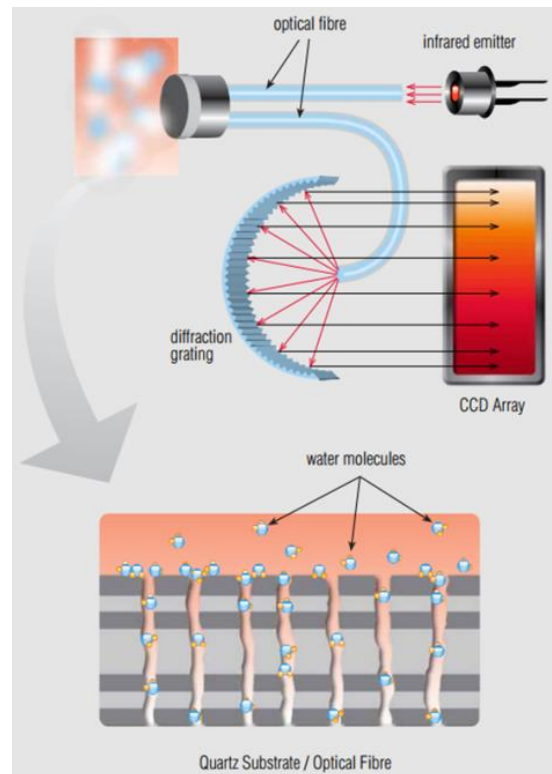


Figure 3: Schematic of the Measurement Principle

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 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)