

Enhanced safety in polymer production

Leakage detection in the Ziegler-Natta Process

Benefits at a glance

- **Second process seal:** a special thermometer neck tube provides a second seal, preventing the toxic medium from penetrating the connection head.
- **Leakage signaling:** the failure of the thermowell is reported to the control system via a pressure switch.
- **Easy maintenance:** the thermometer assembly works with standard measuring inserts that can be regularly tested, calibrated or replaced.

Process conditions

- 50 to 150°C (122 to 302 °F)
- 1 to 50 bar (14.5038 to 725.189 psi)



In the chemical industry, the Ziegler-Natta process is fundamental to the production of a variety of plastic products, from packaging materials to automotive components. This process involves hazardous chemicals such as titanium tetrachloride and organo-aluminium compounds. For these highly exothermic polymerization reactions, precise temperature measurement is crucial to prevent runaway reactions and to ensure safety and efficiency of the process.

Furthermore it is essential to avoid an undetected leakage in the thermowell, as this would be an enormous risk to life and limb for the operating personnel if the instrument were to be opened for maintenance. iTHERM ModuLine TM131 with Dual Seal technology addresses these challenges by providing a second process barrier and signaling thermowell failures.

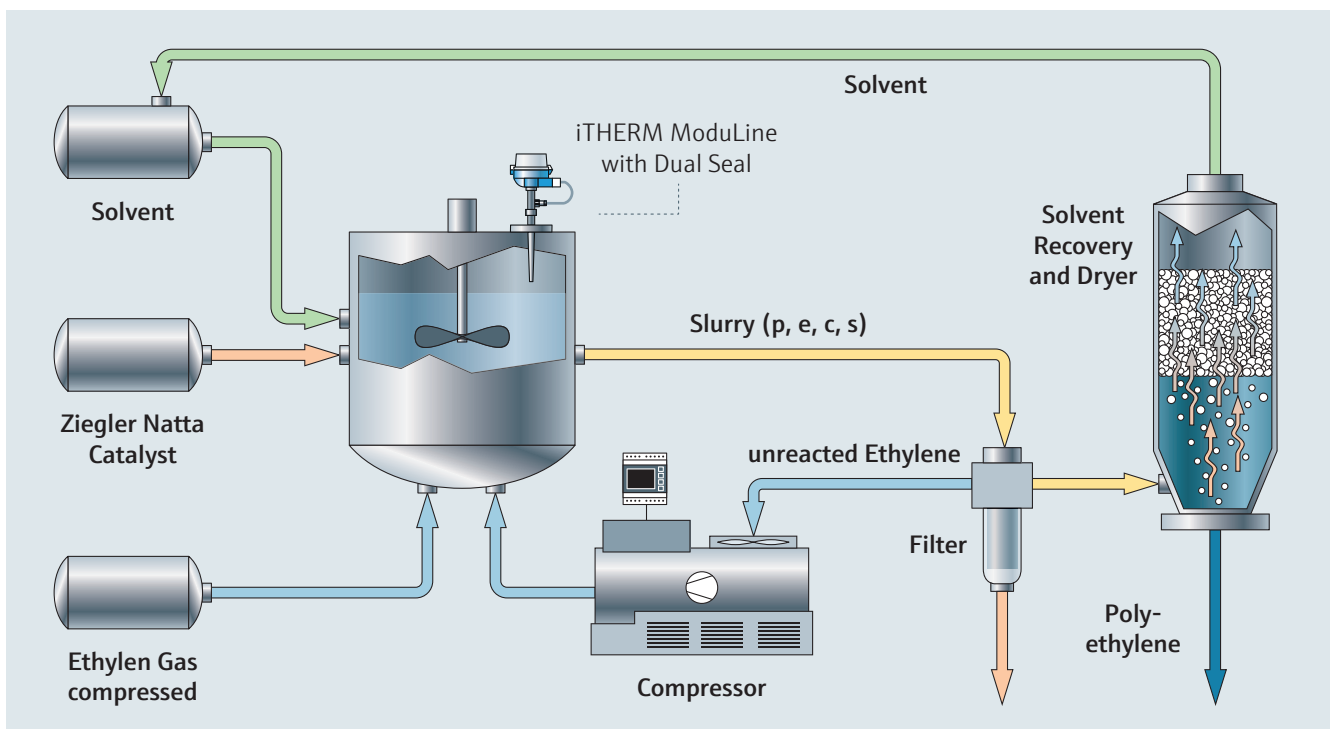
The challenge A proof test is essential for safety-critical temperature measuring points in accordance with SIL standards. This includes the test procedure for the temperature transmitter and the calibration of the thermometer measuring insert. However, the verification test does not include an inspection of the thermowell's integrity. If the thermowell fails, the medium may not escape immediately, as it initially enters the thermometer and, depending on the process pressure and installation position, rises into the connection head. As long as the measuring insert or transmitters remain intact, a valid measurement will continue to be output. Opening the connection head for the regular

proof test of SIL devices can allow substances to escape, posing an immediate danger to maintenance personnel.

Until now, the only countermeasure was a regular prophylactic inspection of the thermowell, which required its removal and inspection. This process involves the risk of opening the process, necessitating a complete system shutdown and flushing with e.g. nitrogen before qualified personnel, equipped with breathing apparatus, can proceed. Despite these precautions, residual quantities of liquids or gases may still escape, potentially requiring an evacuation of the plant.



Thermowell leakage



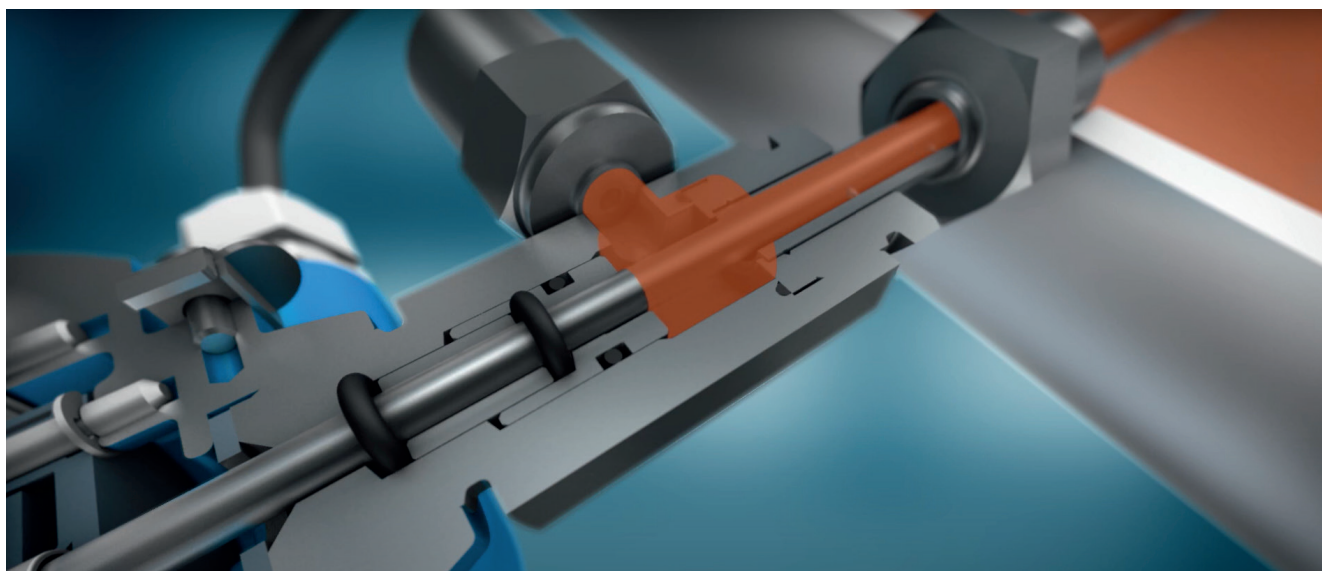
Ziegler-Natta process

Our solution iTHERM ModuLine TM131 with Dual Seal technology provides a second process barrier (Dual Seal) to eliminate the risk of leakage at critical measuring points while the thermometer retains the advantage of using a spring-loaded, standardized, and replaceable measuring insert. **The Dual Seal functionality is located in the thermometer neck tube between the process connection and the connection head.** As soon as the pressure inside the neck tube increases, a pressure switch detects loss of thermowell integrity. The internal pressure compresses the sealing package, hermetically sealing this section. In the event of a leak in the thermowell, O-rings ensure that the medium cannot flow into the connection head in the event of a thermowell break.

The connection head contains the iTEMP TMT82 2-channel temperature transmitter. While the temperature signal (usually Pt100) remains unchanged on the first channel, the second channel is configured as a

thermocouple whose two conductors end at the pressure switch. As long as the switch is closed (thermowell is intact), this measurement provides the operating temperature of the transmitter. Triggering the pressure switch generates a signal on the second channel, which can be transmitted to the control system via diagnostic information.

This allows thermowell breakage to be detected without interrupting the temperature measurement signal, ensuring that the process can be safely shut down before major damage occurs. In the event of a normal reaction, the mixture is pressed out of the reactor afterwards, using a compressor. The pressure required for transportation would be sufficient to trigger the pressure switch and compress the sealing package. This ensures continuous protection by the O-rings and a repeat test of the thermowell integrity with each batch process, ruling out the possibility of starting another batch with a faulty thermowell.



Functional sketch of Dual Seal technology

Result iTHERM ModuLine TM131 with Dual Seal technology not only provides a second process barrier, but also signals when a fault is present, ensuring the safety of the operating personnel. In the case of a thermowell failure, the plant operator receives the thermowell integrity alarm along with a valid temperature signal. As a result, a controlled emergency and plant shut down can be initiated, so no people will be harmed. The risk of media leaking through the thermometer is thus limited to the absolute technological minimum.



iTHERM ModuLine
TM131 with Dual
Seal technology



iTHERM ModuLine TM131 modular thermometer with iTEMP TMT82 temperature transmitter

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