Boost heat exchanger efficiency and safety

with accurate non-invasive temperature measurement

Benefits at a glance

- Improved efficiency
- Improved energy recovering rates
- Improved safety
- Easy installation
- Reduced maintenance
- Reliable performance

Process conditions

Ethylene

- Cooled down by secondary TLE from 400/450 °C to 250/320 °C (752/842 °F to 482/608 °F)
- Pressure: 1,7 bar (24 psi)

Water

- Temperature: 180 °C (356 °F)
- Pressure: 120 bar (1740 psi)

Super-heated high-pressure steam

- Temperature: 325 °C (617 °F)
- Pressure: 121 bar (1754.96 psi)

Pipe sizes: from 38.10 to 101.60 mm (1.5 to 4 inches)

A Transfer Line Exchanger (TLE) is a vital component in the chemical industry, particularly in quenching units where ethylene is rapidly cooled to stabilize gas composition and maximize product yield. In this process, heat is transferred from the hot ethylene gas to a cooling medium, typically water, to efficiently achieve the desired temperature reduction. Maintaining pure steam quality, including humidity control and the absence of water droplets, is important for efficient energy recovery from the TLE to ensure the required turbine performance for downstream power generation.

Accurate temperature measurement in the heat exchanger is critical for process efficiency, monitoring the thermal behavior of the heat exchanger itself, product quality and safety, and environmental concerns. It prevents overheating or undercooling, reduces energy consumption, and meets industry standards and regulatory requirements.

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The challenge One of the main challenges is monitoring **multiple measuring points across different pipes** of different sizes. Each of these pipes requires accurate temperature monitoring at both the inlet and outlet to ensure efficient heat transfer and stabilize the gas composition and quality of the produced steam. Measuring the temperature difference (Delta T) between the inlet and outlet is critical to assessing the heat exchanger's efficiency. Continuous monitoring ensures the heat exchanger operates within desired parameters and detects deviations promptly.

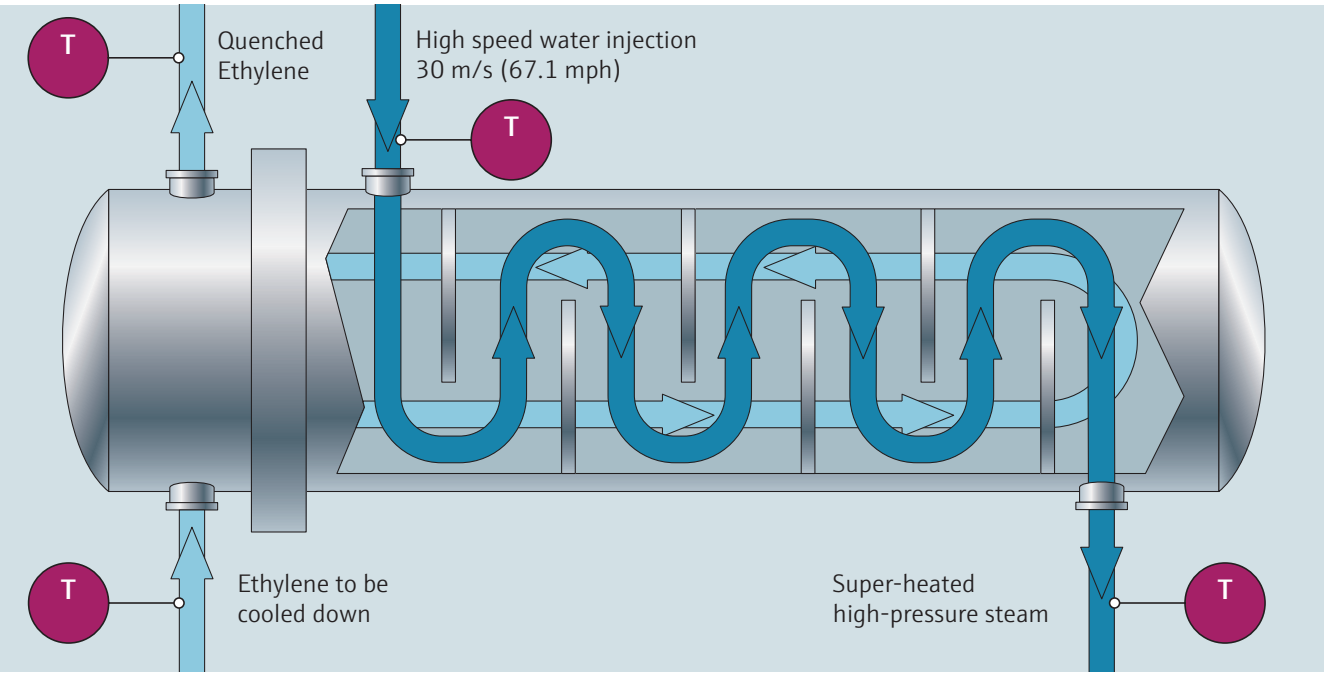
The pipes are subject to **vibration,** which affects the stability and accuracy of temperature sensors. In addition, **high flow rates** can induce fluid turbulence, compromising temperature measurement accuracy and creating challenges for invasive measurements with thermowells. Another objective is to prevent an ethylene leakage, especially when using thermowells. Leakage can pose a fire hazard, compromise personnel safety, and affect the efficiency and integrity of the production process.

Robust thermowells, designed to withstand vibration and high flow rates, can severely disturb the flow, reduce measurement accuracy, and inadvertently extract valuable heat from the process, slightly affecting the thermal dynamics and temperature measurement. The right choice of a thermometer for this application, whether invasive or non-invasive, depends on various factors such as flow rate and pipe size. Non-invasive options are a viable alternative and offer several advantages over invasive methods.

Our solution **iTHERM SurfaceLine TM611** offers all the advantages of non-invasive temperature measurement, while still providing the highest accuracy and fast response time. By eliminating the need for a thermowell in the pipe, it avoids fluid disturbances, ensuring a homogeneous flow and increasing the efficiency of the heat exchanger. It also eliminates the need for wake frequency calculations and periodic inspections associated with thermowells. The thermometer can be easily and flexibly attached to the outside of the pipe using stainless steel screw clamps.This eliminates any risk of leakage and associated harm for plant, personnel, and environment.

The complete assembly of iTHERM SurfaceLine TM611 has been tested in accordance with the marine approval requirements (DNV approval), with vibration being a major part of these tests. The device has also been tested according to IEC 60068-2: broadband noise, shock test and rough handling.

For TM611 to achieve the highest possible measurement accuracy and best response time, it is important that the pipe diameter is accurately reflected by the instrument's thermal coupling element. Likewise, a suitable insulation should be applied to protect the sensor against the ambient conditions. The thermometer is completed by the iTEMP TMT86 temperature head transmitter, a PROFINET transmitter with two universal sensor inputs with Ethernet-APL. It allows digital communication down to the field level, and reliable operation with sensor monitoring and device hardware fault recognition.



Heat exchanger design

Benefits at a glance

- **Improved efficiency:**
  Accurate temperature monitoring ensures efficient heat transfer and stable gas composition.
- **Improved energy recovering rates:**
  No contact with high-pressure steam streams, ensuring steady heat transport and no heat loss.
- **Improved safety:**
  Non-invasive design minimizes the risk of leakage.
- **Easy installation:**
  Quick attachment to pipes reduces installation time.
- **Reduced maintenance:**
  No need for frequent inspections or wake frequency calculations.
- **Reliable performance:**
  Non-invasive thermometer for vibration and harsh conditions.

Result The non-invasive thermometer iTHERM SurfaceLine TM611 successfully meets the challenges of temperature monitoring in a heat exchanger. By measuring temperature accurately and fast, the performance and efficiency of the heat exchanger can be optimized, resulting in improved product quality and operational reliability.

iTEMP TMT86

iTHERM SurfaceLine TM611

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