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ionix ADVANCED TECHNOLOGIES

Ultrasonic monitoring of molten salt for energy

Real-time, on-stream, determination of molten salt thermophysical properties for energy

Overview

A solution was sought by a renewable energy plant operator to monitor the thermophysical properties of molten sodium-potassium nitrate "solar salt" at temperatures exceeding 360 °C / 680 °F. Solar salt is a common eutectic mixture used for thermal energy storage or heat transfer in concentrated solar plants due to its wide temperature range and low cost compared to thermal oils. However, it is important to control the thermophysical properties of the salt to maintain the optimum efficiency throughout the changing parameters of daily energy generation.

It is well established that the thermophysical properties of molten salts, such as heat capacity, correlate well with sound velocity, and can be an effective measurement technique for real-time monitoring.

The Challenge

A number of challenges are presented around the deployment of an ultrasonic measurement system for molten salts

- The transducer needed to be in contact - partially submerged - with the molten salt through the continuous operating temperature range of 240 to 565 °C.
- The material of construction is required to be resistant to the corrosion effects of solar salt.
- High sensitivity and signal to noise is required to gain accurate characterization of the thermal properties.

The Solution

- 3.25 MHz HotSense sensors, constructed of stainless steel were coated with a corrosion resistant layer to provide a stable and reliable corrosion barrier once submerged.
- The transducers, capable of continuous operation at 600 °C, were put in to contact the molten salt, such that the integrated delay line was partially submerged for effective coupling, directed toward a known reflector target in the fluid.

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- Initially, all sensors were connected to commercially available ultrasonic gauges to collect A-scan data from the reflector and determine velocity.

Execution

- Installation was completed by operators with on-site supervision of Ionix experts.
- High precision measurements (+/- 0.1 µs) of time-of-flight to known reflector distances were recorded using the commercial UT velocimeter gauges enabling precise velocity determination.
- The integrated delay line offered a known reference point for accurate timing.
- Existing lookup tables were initially implemented to determine the heat capacity for the measured velocity, to be expanded into a digital solution.

Key deliverables

- High frequency, high quality data from inaccessible locations allows plant operators to optimise their processes to **increase productivity, efficiency and profitability**.
- Frequent, consistent and high-quality solar salt velocity data collection now enables operators to **optimise their process parameters to generate consistent outputs.**
- **Plant and personnel safety is increased** by removing the requirement for staff to access hazardous environments using remote data collection methods.