Non-invasive ultrasound investigation of composition and temperature of fluid mixtures

Reference No: B70063

CHALLENGE

It has been shown that the **propagation velocity of sound waves** in a fluid is very **sensitive to the fluid composition.** Making them an excellent tool for the non-invasive monitoring of chemical reactions. However, the propagation velocity is **also strongly influenced by the fluid temperature.** Thus, any change in temperature – either through the process itself being non-isothermal or through external influences – can **severely reduce measurement precision.** The miniaturized design of surface acoustic sensors, their high thermal stability, and possibility of wireless integration make them very promising devices for automated process monitoring. Specifically, in the context of industrial automation, on-line monitoring becomes absolutely crucial in order to implement real-time corrective measures.

INNOVATION

The inventors suggest a method and device, based on **Lamb-wave propagation.** Exploiting this approach, the piezoelectric sensor elements can be mounted on the outside of fluid filled conduits made from any structural material, i.e. glass, plastics, and metal. The excited Lamb-waves exhibit partial radiation loss into the fluid and the remaining energy propagates along container wall. Measuring both components of the wave – the part that traveled through the fluid and the part that traveled through the wall - the **temperature and composition of the fluid can be determined independently**[1].

COMMERCIAL OPPORTUNITIES

This is of particular importance if the mixing of two components results in a temperature change, e.g. when alcohol or urea are dissolved in water, or when monitoring a fermentation process. In those cases, the **determination of the composition from transit time,** without a **simultaneous temperature measurement,** would be misleading. Another field of application is the monitoring of mixtures of cryogenic gases, in particular noble gases, used to fill double-pane windows. Relevant industries include:

- Automotive
- Food processing
- Chemical processing

DEVELOPMENT STATUS

Prototype tested.

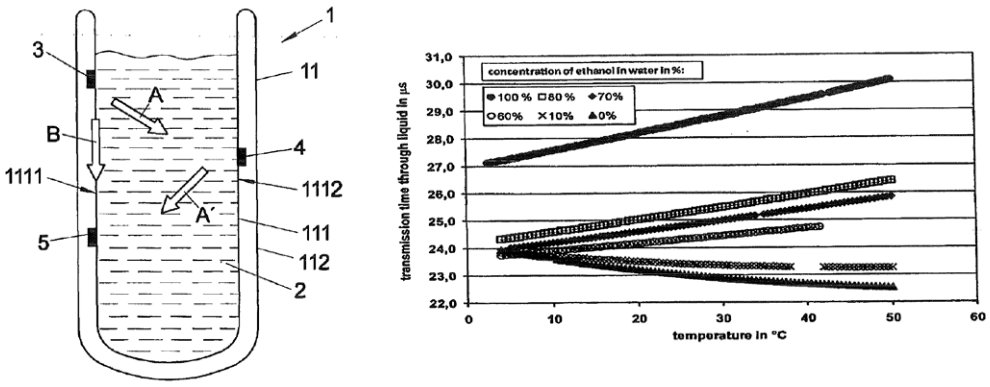

Figure: (Left) Showing the suggested device and method[2]. A Lamb-wave (B) emitted by the source (3) propagates along the wall and gets detected by a sensor (5). Radiation losses (A) propagate into the medium and get detected on the opposite side of the container by another sensor (4). (Right) Measurements demonstrating the interdependence of composition and temperature.

REFERENCES:

1. D. Friedrich et al., Sens. Lett. 9,714-716 (2011); doi:10.1166/sl.2011.1599
2. EP2343548B1

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