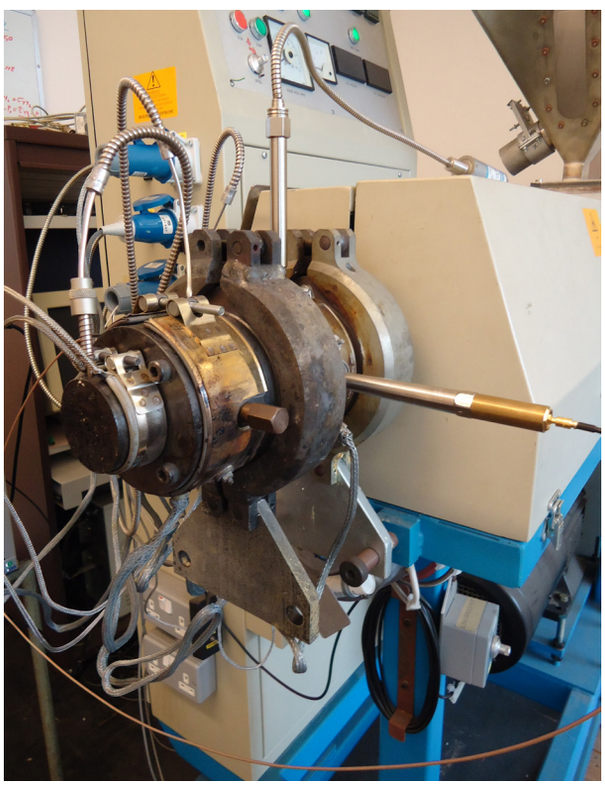
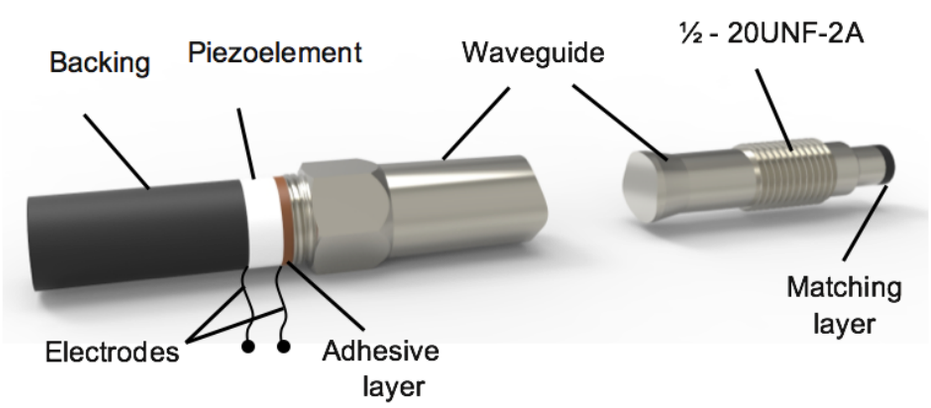
Development of a Low Cost In-line Polymer Inspection System to Improve the Use of Recycled Materials in Plastics Processing Industry / POLYSENSE

the objective of the project

Development of compact, non-invasive, real-time sensor based on an ultrasonic piezoelectric transducer for the in-line measurement of density and viscosity of the polymers while circulating in a molten state inside the machine allowing the prediction of the polymer behaviour and the feedback to the process control.



Project of ultrasonic waveguide with transducer



Single screw extruder with waveguides

Ultrasound Institute of Kaunas University of Technology
http://ultrasound.ktu.edu

ultrasound institute

1. Proposed and developed a novel ultrasonic method for density measurement in different liquids in extreme conditions. The density measurement algorithm, invariant for the temperatures changes, was created.

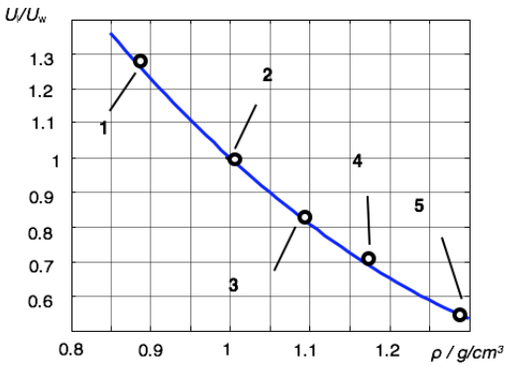
2. For measurements in extreme conditions ultrasonic transducers with solid waveguides possessing a low thermal conductivity were proposed. The optimization of the waveguide geometry was performed which enabled to reduce the level of trailing waves.

3. The complex analysis of the measurement uncertainty has shown that the relative expanded measurement uncertainty of the ultrasound wave velocity in polymer melt is uc=0,66%, the relative expanded uncertainty of the polymer melt density isuc=1,07%.

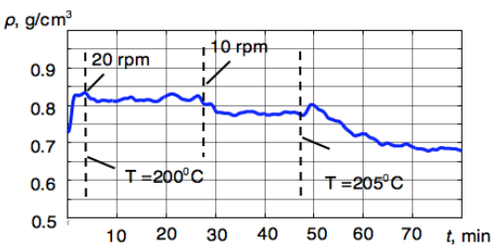
4. Developed ultrasonic waveguide sensor for measurement of viscosity of highly viscous fluids. The measurement principle is based on application of guided shear-horizontal SH0 mode of the Lamb waves propagating in an aluminium planar waveguide immersed in a viscous liquid. Attenuation of the guided wave depends on viscosity of the surrounding liquid and is used for viscosity estimation.

5. The experiments carried out using the proposed viscosity sensor have demonstrated that it is possible to measure viscosities of various liquids in the range from 20 Pa•s up to 27,000 Pa•s. As the waveguide is made of metal (aluminium) and the sensitive part of it does not contain any moving parts and electronic units it is quite robust to surrounding conditions and can be used in relatively wide ranges of temperatures and pressures.

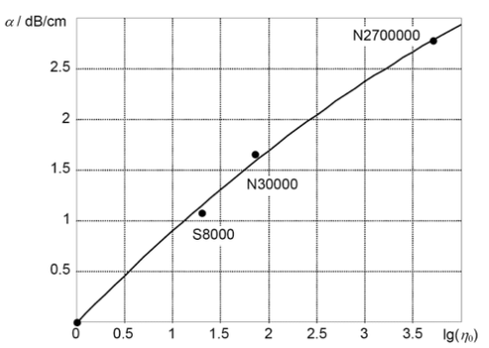
3D finite element modelling of displacement distribution in viscosity measurement waveguide



Dependence of the normalized amplitude U in the reflected signal on the density of loading liquid (1 -ethyl alcohol, 2 –distilled water, 3 -20% sugar/water, 4 -40% sugar/water, 5 -60% sugar/water)



Variations of the density of the virgin PP melt for different temperatures and pressure (rpm –revolutions per minute)



Attenuation coefficient α of the SH0 wave in the aluminium wave-guide versus dynamic viscosity

project homepage

http://www.polysense.eu/