# SAW sensors are all torque for mini mixer development

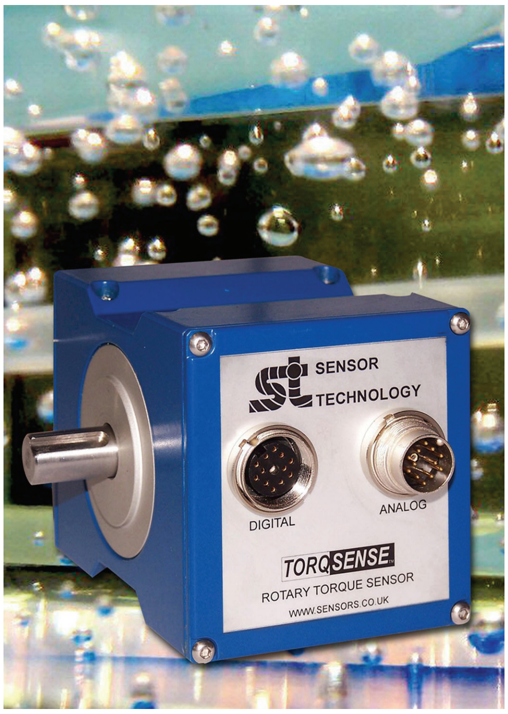
A torque sensor is helping to analyse the mixing properties of a recipe in a development project being carried out at the University of Bradford

Research and development being carried out at the University of Bradford to develop a miniature mixer (5-25g batch) that incorporates a set of integral instruments to monitor the properties of materials as they are being mixed. The instruments work in real-time during the mixing process and output is captured to a PC for subsequent analysis. Software is also being written to enable analysis to be performed simultaneously with the mixing and perhaps even be used to interactively control the mixer itself.

One of the key parameters for measurement is the torque of the mixing element, as this will become constant once mixing is complete. This parameter is being measured by a TorqSense noncontact sensor from Sensor Technology, which offers the development team the advantage of not requiring slip rings, making the mixer easier to build and rebuild between trials, and is more robust in operation.

## Mini mixer development

The mini mixer development and validation is the result of a three-year EPSRC sponsored programme of research. The results are expected to have a big impact on formulation of viscous mixes and scale-up of extruders. Traditionally, recipes for formulating specific coloured plastics for consumer products, for example, are developed in 25 to 50kg batches, mixed in an industrial scale twin screw compounder. Several batches may be required before the recipe is finalised, so the cost and time involved can be considerable. The development of a smaller mixer is clearly advantageous.




TorqSense torque sensors use two tiny ceramic piezoelectric frequency resonating combs, otherwise called Surface Acoustic Wave (SAW) devices, that are fixed onto the shaft of the torque sensor to measure applied torque. As the torque changes the combs vary their spacing and consequently the resonant frequency of the SAWs changes proportionally to the torque applied in the rotating shaft. The combs are, in effect, frequency-dependent strain gauges that measure changes in resonant frequency of the shaft. A wireless radio frequency (RF) coupling is used to interrogate the SAWs and transfer the data signal to a pick-up head.

The same RF coupling is used to supply power to the SAW devices and because the gauges are based on piezo technology they need less than 1mW of power. This arrangement removes the difficulty of fitting slip rings and maintains the measurement quality throughout an extended test run.

TorqSense sensors were chosen for use in this project because they saved considerable time and effort during the dismantling and rebuilding exercises typical of a development project.

*More information on SAW technology is available from the Sensors section of the Automation pages at www.connectingindustry.com*

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## SAW technology in brief...

A SAW transducer consists of two interdigital arrays of thin metal electrodes deposited on a polished piezoelectric substrate. The electrodes that comprise these arrays alternate polarities so that an RF signal of the proper frequency applied across them causes the surface of the crystal to expand and contract, generating the surface wave. Because the surface wave or acoustic velocity is $10^{-5}$ of the speed of light, an acoustic wavelength is smaller than its electromagnetic counterpart. This results in the SAWs ability to incorporate a large amount of signal processing or delay in a very small volume.