Torque monitoring makes sense

Plant monitoring and control is particularly vital in the continuous process industries, where any failures can have dire consequences on production. With most machines driven through a rotating shaft, torque monitoring can identify problems before they become critical, says **Tony Ingham** of Sensor Technology

In many process plants there is often thousands of simple sensors and switches out on the plant floor, collecting data and feeding it back to the SCADA software in the control room. These sensors are tracking every little change in the plant's operating parameters, indicative of either the state the materials being worked or of the state of the machinery itself. For instance, an increase in torque on a mixer drive may suggest that a mixture has thickened up as expected, or alternatively that a seal or bearing is failing – either way this is vital information.

Some parameters in a process can be measured directly and simply – temperature for example. Others are more difficult to measure, so an often-used technique is to measure a related parameter (typically one related to the plant or machinery rather than the process material) and interpolate from this.

Many types of process plant, such as mixers, pumps and conveyors, are motor driven, and measuring the motor output characteristics will often provide process information. For instance, the torque of a motor could suggest the quantity, speed or viscosity of the process material being worked.

Torque measurement has an important role to play, because in measuring plant performance, you get to see how the machinery is holding up. Knowing what to look for will provide an early warning of breakdowns, allowing pre-emptive maintenance to be scheduled. This can be critical for continuous processes where downtime can be very costly.

This all sounds very useful, and actually measuring torque is now quite simple. For example, TorqSense provides a digital, non-contact means for taking the readings. In use, a couple of 'pads' are fixed to the shaft of the sensor and a digital TorqSense electronics module unit mounted close by. The module monitors torque, and feeds it as a data signal to the SCADA control system.

The 'pads' contain tiny piezoelectric acoustic wave combs. The spacing of these combs are designed to open or close under the torque being applied to the drive shaft. The greater the applied torque, the more the distortion.

The digital TorqSense unit then emits a low powered radio frequency signal towards the combs, which are reflected back to the TorqSense unit. The reflected signal returns as a changed frequency, the change being proportional to the distortion of the combs, and thus to the applied torque on the drive shaft. The physical phenomenon which deforms the combs is called Surface Acoustic Wave (SAW).

Torque measurement in action

Real time process control for food manufacture involves characterising the flow and mixability of highly non-Newtonian fluids. TorqSense transducers can monitor the constantly changing flow characteristics of materials including tomato ketchup, chocolate, pasta sauce and chicken tikka massala as they are mixed.

Many manufactured foods are presented in a sauce, what physicists describe as a neo-liquid, but to date real time control has been virtually impossible due to the non-uniform nature of the food, which may contain particulates, fibres, vegetables, meat, nuts, raisins, biscuits etc.

To achieve real time control the TorqSense has to be able to detect the changes with sufficient sensitivity, yet be robust enough for general industrial abuse. In addition, it must not compromise hygiene standards and regimes. TorqSense has been found to meet these requirements and is being used by a number of food processors.

TorqSense transducers can monitor the constantly changing flow characteristics of food materials

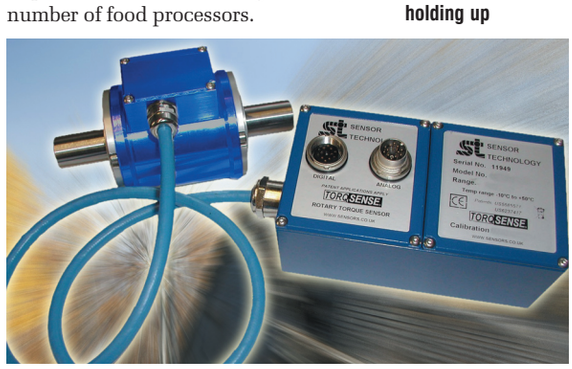
Often the key requirement is to mix sufficiently to achieve a uniform dish, but not to waste time and energy by over-mixing. This can be done by monitoring the applied torque on the mixer's shaft, as it will move to a steady state (within the characteristics of the given recipe) once fluid uniformity is achieved.

In a separate example, a TorqSense is helping analyse recipe mixing properties in a project that could cut development costs in the food and plastics industry and help nanotechnology advances in pharmaceuticals.

Research and development is 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.

One of the key parameters to be measured is the torque of the mixing element, as this will become constant once mixing is complete. This is measured by a TorqSense non-contact sensor, which offers the advantage of not requiring complex and delicate slip rings, making the mixer easier to build (and rebuild between trials) and is more robust in operation.

Traditionally, formulating recipes in the plastics industry may require several batches before the recipe is finalised. Therefore, the development of smaller mixers is advantageous, but the laboratory device must be able to duplicate mixing in the larger scale and also guide the design and operation of large machines. This research programme has achieved this, and the fact that the technology will transfer to other soft solid sectors means it is likely to recoup development costs quickly.



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