

## Precision mixing contains costs

A pre-pilot mixing plant is using wireless TorqSense transducers for ultra-accurate viscosity measurement of high-value compounds. The plant is used to prepare small batches of compounds from shampoo and detergent to cosmetics, therapeutic and medical preparations. Some of the ingredients in the compounds are very expensive, so product developers are loath to make large batches early in the formulation process.

Instead, they start with 850 millilitre samples for the early stages of each project, then once the recipe is well-proven, move on to pilot-scale work where the samples are measured in thousands of litres. The final stage is, of course, full-scale production where volumes may be truly enormous.

The TorqSense transducers were supplied by Sensor Technology of Banbury, whose Mark Ingham explains the design of the pre-pilot plant: "It can take three hours or more to make a single sample, each produced with precision accuracy – and development programmes need a great many samples. Clearly this cannot be done manually. Automating the basic mixing process is in principle straightforward; for this the plant has four workstations based on paddle mixers, each of which is monitored by a TorqSense."

TorqSense constantly assesses the level of torque in a driven shaft. Often, this is used to measure the power being provided by the drive motor. However, in this case it is the opposite – TorqSense is used to calculate the drag being exerted on the paddle and shaft by the liquid being mixed.

"The mixing process changes the viscosity of the liquid, which is what causes the drag," says Mark. "In the first instance the TorqSenses are looking for the viscosity to stabilise to a steady value that won't change any further no matter how much more mixing is done."

"Then they measure that very accurately. The viscosity is what gives the final commercial product its sense of quality: a low viscosity and the product feels

watery, cheap and ineffective; overly high viscosity and it is unpleasant and greasy.

"There is an optimum point where the product feels luxurious and high quality, which is what needs to be identified for each formulation. In the past this was done manually, so was completely subjective and unquantifiable: TorqSense has changed this to a precise and scientific procedure."

TorqSense is a wireless sensor, which is not physically connected to the mixer shaft by slip rings. Instead, it monitors the torque via radio waves. A shaft deforms very slightly when it rotates, the amount of deformation being proportional to the torque. TorqSense measures the

deformation so that it can calculate torque. To do this two tiny piezo-electric combs are

glued to the surface of the shaft at right angles to one another; shaft deformation will expand one comb and compress the other.

The radio frequency signal emitted by the TorqSense is reflected back by the combs, with its frequency changed in proportion to the combs' deformation.

"The procedure to set up the TorqSense is very simple, says Mark. "Solution's using other technologies would probably take several hours to set up. With a regime of up to 30 tests per day, TorqSense is the only real solution for this plant."

Other TorqSense attributes that have been made full use of are its enormous overload capacity, which enables it to cope with robust and demanding test cycles, and its digital output. The output is fed straight into a computer program that compares viscosity measurements with the ingredient ratios and calculates changes to the recipes for optimised results. Mark sums up: "This plant is in effect a totally automated laboratory that can develop perfect formulations in a closed loop calculation. It has changed pre-pilot tests from time-consuming trial and error to precision materials science."

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functionalities. Some are pure mixing models, some perform both mixing and removal of visible bubbles and some can both mix and degas to a high level under an integral vacuum — and removing micro-bubbles down to 100 microns diameter. Opting for a machine with more functionalities than you need will increase upfront costs.

Assessing both the volume and frequency of the mixing process are important in determining firstly which mixer to invest in and which consumables you will need. A machine capable of mixing larger volumes will be more expensive, so it may be more cost effective to mix materials in smaller batch sizes. For example, if you are mixing 500g of material, splitting it into five batches that fit into a smaller machine might offer better ROI.

Weighing up all the indirect costs from the process, labour and quality factors against the cost of the mixer can help to determine the payback period and the ROI of the equipment. Like all mixing processes, a THINKY Mixer will require some ongoing expenditure in mixing containers. There is a trade-off of disposable versus reusable containers, remembering to factor in cleaning time for the latter.

For critical processes, the risk of cross contamination may mean you are required to use single use containers. The ultimate solution would be to mix in the final packaging container, which is a feasible option if required.

Mixer choice will depend on volume and features, that is to say integral vacuum. A good supplier will have the ability to address your mixing challenge by doing laboratory evaluations and demonstrations with you. Their previous experience will help you develop the best combination of mixing parameters for an optimal outcome.

The return on investment calculations will include time savings (both in mixing and in process preparation and clean-up), and mixed quality including consistency and bubble-free.

Sometimes, the combination of mix ratios, viscosities, liquids, pastes and solids cannot be mixed successfully any other way.

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## Technical innovation for mixing and agitation

Nord Drivesystems has developed a powerful combination for use in mixing and agitation processes: The MAXXDRIVE industrial gear units with the new SAFOMI-IEC adapter is specifically developed for mixers to improve operational reliability and reduce the need for the replacement of wearing parts. In combination with the NORDAC FLEX SK 200E frequency inverter for the power range up to 22kW, a flexible unit with low maintenance is offered.

MAXXDRIVE industrial gear units, an integral part of the Nord portfolio for ten years, offer high output torques from 15 to 282kNm and ensure smooth operation even under demanding conditions. The FEM-optimised and

compact design enables operation under ultimate external loads. For agitation applications, a combination with the SAFOMI IEC adapter is recommended, in which an oil expansion chamber is directly integrated.

SAFOMI is available for MAXXDRIVE parallel gear units in the sizes 7 to 11 covers maximum output torques from 25 to 75kNm. SAFOMI impresses with its compact and simple design and integrated oil equalization volume, which means that there is no need for oil tanks and hoses or the shaft sealing ring between the gear unit and the IEC cylinder, which is prone to leakage and wear. Using the SAFOMI-IEC adapter instead of the standard IEC adapter on the agitator drive increases operational reliability and

lowers maintenance costs. Not only is the oil level and thus the required oil volume lower, but thanks to fewer attached components the installation space is also reduced.

For the further reduction of wearing parts and attached components, Nord recommends a combination of MAXXDRIVE industrial gear unit, SAFOMI-IEC adapter, a drive motor and NORDAC FLEX SK 200E. The frequency inverter can be flexibly installed and features a high output range as well as a wide choice of optional functions and accessories. It can be directly mounted on the motor without control cabinet.

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