

# Creating the perfect *blend*

*Mixing is the most common, the most important and probably the most researched activity in the process industries, which is why developments should be actively monitored, writes Andrew Smith.*

**T**he most common process carried out in the food, chemical and pharmaceutical industries is also the one which can have the most dramatic effect on productivity, product quality and energy use. Selecting the most appropriate mixing technology for specific applications is therefore crucial.

Mixing is also a discipline worth keeping tabs on. Fluid dynamics is particularly aptly termed since ongoing research in both academic and industrial circles constantly increases our understanding of how liquids, emulsions and suspensions behave in different circumstances.

Increased demand for bespoke processors is also driving developments. Fierce competition on supermarket, sweet shop and drug store shelves means constant product innovation, often with new and sophisticated formulae which may have properties requiring customised solutions. Many a mixer manufacturer will be prepared, at a cost, to help out, and eventually the lessons learnt from the exercise will filter through to that company's proprietary equipment.

As such, there is steady flow of new products

and technologies introduced to the market and the payback for updating the mixing process can be considerable – in terms of both efficiency and quality – if a more appropriate product or technology is introduced.

A new **mixing processor** is not, therefore, only to be considered when a new line is to be installed or an existing machine has come to the end of its useful life. Perhaps more than any other part of the processing function, mixing should be subjected to a cost-benefit ratio analysis at regular intervals to determine whether the pay-back time for updating the process would justify the capital spend.

However, there are a number of criteria which must be considered when determining the right product for the job, the complexity of which will vary depending on whether the machine is a replacement or intended for a new product line.

#### **Batch or in-line process**

The primary consideration will be the basic configuration: does the task require a batch process or in-line set-up? Not surprisingly, higher added value products produced in lower volumes tend to be batch mixed, while for larger volumes an in-line configuration may be more appropriate, but the ultimate choice will depend on individual circumstances.

Choice will also, of course, be affected by the nature of the products being mixed. For example, simple dispersion and blending of liquids of a similar viscosity is generally best effected by low shear operations, while for those of different viscosities, or where there is solid suspension, a high shear action may be required.

In order to arrive at the correct solution it is essential that the process required is fully understood and that all physical characteristics

of the products to be mixed – such as viscosity, rheology, temperature and particle geometry – are known and available to potential suppliers.

Increased understanding of fluid dynamics, work on the computation of flow patterns in vessels and the use of computer aided design and manufacture (CAD/CAM) has greatly aided mixer design. Matching the mixer to the task has therefore become a more certain procedure, so long as the physics of the machine and materials to be blended are understood.

#### **Need for trials remains**

The result is more rapid progress in the decision making process and an increased likelihood of scale-up success. Unfortunately, it does not mean the need for trials is eliminated: theory aids choice and design, practice proves it. For this reason suppliers with test facilities or loan machines are recommended for all but simple mixing tasks and especially for new applications.

New from Silverson Machines is the VSP batch mixer which has been specifically designed to incorporate free-flowing powders into liquids by feeding them through a hopper or vacuum wand directly into the mixer's rotor/stator workhead. The company says this provides a highly efficient and hygienic method of powder/liquid mixing using an in-tank mixer.

High speed rotation of the rotor within the workhead creates a powerful suction, says Silverson, which draws powder from the hopper, through the eductor tube and into the centre of the mixing zone. The powder is therefore introduced to the liquid under intense high shear which instantly mixes the materials before they are projected into the body of the mix.

The company claims there is virtually no opportunity for agglomeration of the particles

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and problems such as rafting, dusting and 'scumline' on the vessel walls are said to be practically eliminated. Powder flow is controlled by a manual butterfly valve which minimises aeration. Indeed, small volumes of light, dusty powders can be absorbed straight from the original containers using a vacuum wand in place of the hopper.

### Meat processing mixer

An unconventional approach has been adopted by Weiler Beehive for its meat processing mixer which it says provides a rapid, high quality mix at a lower lifetime cost than conventional blenders.

Rather than relying on the speed of the paddles to obtain a proper mix, Weiler depends on the design and configuration of its overlapping, counter-rotating paddle system which it says provides an efficient mix, quickly – typically 3-4 minutes – at a paddle speed of just 13rpm. This compares to standard speeds of 25-45rpm for other blenders, which the company says can overwork meat products and reduce quality.

A positive feed of mixed product to the discharge is achieved by a full-length unload screw and using counter-rotation of the paddles for the complete mix cycle. Polished surfaces on the vessel, paddle and screw are said to reduce 'fating out' and help prevent product sticking.

Because of the low rpm and the use of just one 11kW motor to drive both paddles, Weiler says the mixer requires fewer spare parts, lasts longer and uses less energy than conventional systems, a fact that it has proved in "several cost of ownership assessments".

Meanwhile Winkworth Machinery has extended its range of extruder discharge Z blade mixers with what it says are cost-effective, lighter duty models for the food, pharmaceutical, ceramic and other process industries.

Explaining the move, sales director Paul Winkworth says: "Our range of tilt, bottom outlet and extruder Z blade mixers have long been associated with processing the toughest and most viscous doughs and pastes. Many lighter products, however, still require the efficient kneading, mixing and folding action unique to the Z blade mixer, but do not require the heavy duty design and build quality associated with really tough mixes. Hence we have introduced the new, price competitive, lighter duty extruder mixer."

The company says lighter mixing applications have specific and very different requirements, including compactness, quiet running and an



**Lighter duty:** Winkworth has extended its range of Z blade mixers with a lighter duty extruder mixer

hygienic, easy to clean and maintain design. To achieve this, Winkworth says it has included a number of new features.

Independent drives for each blade and extruder screw now negate the need for gears and enable a more variable mixing action, while the redesigned gland area with a new gland housing is said to facilitate cleaning and rapid re-packing of the glands when required.

### Enhanced safety

Internally, the trough, blades and screw are polished and one end-plate is welded to assist cleaning. The extruder nozzle can also be simply removed for cleaning or changing. Finally, safety is enhanced by fitting the key operator switches on the lid to eliminate wiring on the mixer.

In a move the other way, Winkworth has extended its range of XF paste feeders with the addition of a heavy duty XF Compound Feeder which is of heavier construction and incorporates a new positive feed into the discharging screw.

The company says this enables it to handle more difficult, heavier pastes, such as dough moulding compounds and pastes that have poor flow qualities. It also allows higher throughputs, typically up to 50-100kg a minute depending on the product and profile of the extrudate.

Apart from improving productivity, the feeder



**Processors from France:** CDH blenders are available with a range of attachments

– which is designed to transform a large mass of paste into a continuous round or rectangular profile – is also said to have a number of other advantages for plant automation, including acting as an interface between batch and continuous operation. It also enables positive feed into other process equipment such as pumps, which can suffer if supply is not constant, and is said



**Adding powders to liquid:** *Silverson VSP mixer provides high shear below the surface*

to be able to improve product appearance.

Optional features include removable rollers and screw to assist cleaning, hoppers to suit a number of batch sizes, chopping devices to cut the extruded product into lengths and different shapes and sizes of extrusion.

Winkworth says that in response to customer demand it has also introduced the option of an angled agitator for its process vessels. Traditionally, agitators sit vertically on top of the process vessel, but because clients in the food industry have requested a mixing action which also lifts and drops, it has developed the new option for vessels from 65 to 1000 litres. Quick release clamps on the vessel lids also now provide improved access for cleaning.

Given the gastronomic reputation of France,

it is perhaps of no surprise that the country also has a name for manufacturing food processing equipment and several key players have UK representation.

The Contimix continuous food mixer system manufactured by the French processing specialist, Simon, is now available in the UK through Record Pelkman. Based on a double screw principle, the CIP capable Contimix system is primarily designed for automated production of pasty products without overworking the dough, and is said to be “exceptionally flexible” as it is manufactured around a modular design.

### Up to 3 tonnes an hour

The length of the system can be altered and there is a choice of mixing screw diameters from 63 to 340mm, allowing production rates of 200kg to 3 tonnes an hour to be catered for. A single 2 metre long module with a 170mm screw diameter would, for example, serve a line requiring 1.5 tonnes of biscuit dough an hour. Adding mixing units allows incorporation of ingredients at different stages.

The double screw technology is said to provide “fine tuning” of the mixing process with each mixer having two stainless steel screws that can be set to have fixed or progressive pitch, either equal or offset. The jacketed design allows the mix to be heated or cooled, while optional extras include vacuum transfer and steam injection.

PLC controlled, the machines can use volumetric, weight or flow metering for ingredients dosing and product handling. As well as stand-alone mixers, Record Pelkman can supply complete systems including dosing, regulating and controlling equipment.

The company says it has conducted tests with various “UK-style” mixes ranging from cake icing through soft biscuit dough to Christmas cake batter and in each case the Contimix produced dough of the required consistency and homogeneity without damaging delicate ingredients such as fruit.

### Flexible continuous mixer

Also available through Record is Simon’s latest MXT continuous mixer which, it says, has enormous flexibility, being suitable for dairy products such as butter, cheese and deserts, bakery goods, including bread and biscuits, as well as convenience foods and confectionery products. It can also be used to blend soft ingredients such as mushrooms, ham cubes, shrimps or candied fruit.

Available in a range of capacities, from 200 to over 2000kg an hour, it is said to allow for precise control of feeding: for dry ingredients this goes from 2 per cent variation with a volumetric control, down to 0.25 per cent with loss in weight. The configuration of the ingredient feeding inlets and mixing elements also allows the mixer to be customised to best suit individual requirements and recipes.

Another French manufacturer whose products are available in the UK is CDH. Supplied through Multiplicity, the CDH processors are equipped with a variety of attachments which the company says allows a range of functions from emulsification to gentle blending of a number of food types, including meat, fruit, vegetables, fish and confectionery.

The machines are also said to allow a wide range of speed and time combinations, with blending times between 30 seconds and 5 minutes depending on the product. Available in sizes from 30 to 350 litres, typical applications include cold pizza sauces, sausage meat, and breadcrumb products through to nut crumble, powders and marzipan.

### High viscosity products

Heavy duty blenders from CDH for very high viscosity products such as flapjacks and heavy mayonnaise-based sandwich fillings are available in sizes from 200 to 900 litres.

They are also said to be suitable for gentle blending, such as chives into cottage cheese. Both ranges are built to IP65, including the touch screen controls, and optional extras include jackets, vacuum pumps and automated functions.

Multiplicity also supplies the Auriol range of mixing and blending vessels – available in 100 to 1000 litre sizes – including the Betonniere. This is typically used for tumbling and blending fragile products, such as parboiled potatoes with oil or pre-prepared salads with dressings, but is also suitable for powder blending for curries and other products.

The French in-line mixing specialist PCM, represented by Jagenberg in the UK, contends that mixers should not be considered as a piece of equipment, but as a function within a just-in-time process which begins with the injection of base product, followed by “added value” products, such as fruit, and conclude with the filling operation.

For example, PCM says that traditionally, all industrial processes in the manufacture of stirred fruit yoghurts are based on the mixing of

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the yoghurt and the fruit upstream of the packaging machine hopper.

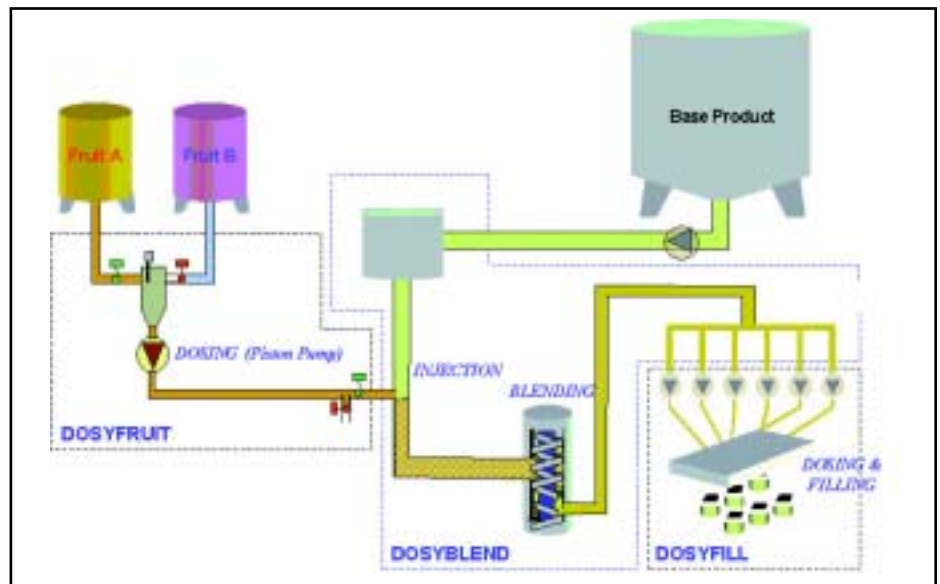
Although relying on complex control systems it is still difficult to guarantee the product would contain the correct proportion of fruit. Moreover, apart from imprecise fruit dosing, these systems require different hoppers for each flavour and decanting of the fruit pieces into the hopper. There is also said to be "considerable" loss of fruit during priming.

### Injecting and mixing fruit

The company's answer to these problems is the Dosityfruit, which it claims is a unique system for injecting and mixing fruit for stirred yoghurt. In this process, the discharge of each fruit dosing unit is synchronised with the intake of the filling dosing pump by injecting the fruit simultaneously with the base yoghurt at the very last moment, immediately upstream of the filling dosing pump.

The system consists of precision controlled-valve fruit dosers which PCM says are designed to guarantee safe handling of fruit pieces up to 25 mm in size. The automation of the process – which controls every phase of production, as well as handling any necessary fruit changes – is also said to make it possible to control changeover from an empty container to a full container without stopping the line, since sterilisation of the sleeves is handled off-line.

Precise fruit dosing is achieved because the



**Just in time:** Dosityfruit system adds fruit to yoghurt at the last minute for a more consistent mixture

dose is directly proportional to the volume ratio of the fruit dosers and the dosing pump. The company claims distribution of the fruit is tightly controlled, without the risks associated with decanting into piping and hoppers, producing a consistent mixture and maintaining the integrity of the fruit pieces.

PCM also argues that increased productivity and fruit savings can rapidly recoup capital cost. As the injection occurs immediately upstream of the pump, the pollution interval is minimised, dispensing with the need for cleaning between two flavours. The product is also drawn off from the storage container without any loss of fruit, in a totally sterile environment.

Coupling a Dosityblend mixing unit to the

loop is said to further promote even distribution of fruit pieces while maintaining the viscosity of the yoghurt. ■

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## Egg-based desserts are cooked in the mixing bowl

A specialist British food manufacturer faced a problem when it took on the task of producing quality patisseries and desserts for the volume private label market: how to maintain quality at high volume production rates?

"The company's products include a large proportion with egg ingredients," explains Andy Stevenson of Record Pelkman. "These are classed as 'high risk', since not only are the ingredients sensitive to start with, the products are designed to be eaten cold, without further heating."

The situation called for a high productivity processor that avoided all possible microbial contamination. Record Pelkman's solution was the Universal 3000 mixer system manufactured by Tonelli in Italy, which is able to complete the whole cooking process in the bowl.

Record Pelkman supplied two Universal 3000 mixers with six 200 litre bowls. In addition to a standard open bowl, three stainless steel bowls were supplied for heating and cooking and two



**Twin heads:** Tonelli mixer from Record Pelkman features twin heads and a scraping arm

jacketed bowls for cooling only. An automatic coupling system preserves an airtight link between mixer and bowl and the mixer was supplied with a specially designed steam aspirator for heating the jacket.

A programmable control board stores up to 50 recipes. Each recipe allows nine mixing stages with up to ten minutes for each stage and control of mixing speeds and times, descent of the bowl at the end of each phase and the ability to work with or without air. An alarm sounds to indicate the end of each recipe cycle.

Before mixing begins, the bowl rises up to the head and all mixing takes place in sealed conditions, although Record says ingredients can still be added during mixing, if required, via inlet holes in the bell. A view hole and interior light can also be provided for operating staff to monitor the condition of the mix.

Mixing, blending, whipping and cooking, or any combination of these can be carried out on the same machine and this flexibility allowed the manufacturer to cope with a wide range of products. The machine was also customised to allow clean-in-place via a motorised washing spray.

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