

Pharma industry takes the role of Technology driver

EVERY INDUSTRY SEEMS TO HAVE A SECTOR THAT DRIVES TECHNOLOGY CHANGES FOR THE BENEFIT OF EVERYONE. IN THE AUTOMOTIVE INDUSTRY THE DRIVER IS FORMULA 1 RACING AND IN THE AIRCRAFT INDUSTRY IT IS THE SPACE PROGRAMME. IN LIQUID FILLING THE PHARMACEUTICAL INDUSTRY IS NOW THE INSPIRATION FOR CHANGE. REPORT BY MARTIN KEAY.

On the face of it, you might think the drinks industry is driving technology changes in liquid filling, since this is where machine speeds are highest, with canning lines running at up to 2000 a minute. But right now that's not so. The industry sector most actively driving developments in filler design and feeding new ideas to other industries is the pharmaceutical industry and its very close cousin the 'technical' cosmetics industry.

The reasons are directly comparable to Formula 1 and the space programme.

When very high value products are to be filled, small improvements in filling performance and accuracy justify a significant increase in the machine price, but the value of soft drinks is so low that there is no similar incentive to change the technology.

Even so, developments in the pharmaceutical industry are not just about accuracy of fill. Ensuring that a product has been correctly filled and sealed in sterile conditions has led to the development of isolation technologies that are now finding their way into the dairy and drinks industries for products such as milk and soft drinks.

Restricted Access Barrier Systems (RABSs) are a well established technology in the pharmaceutical industry, but have now proved the ideal solution for aseptic filling problems in the dairy and soft drinks sectors. Here, traditional methods of isolation were resulting in low air renewal rates in the enclosure, turbulent and uncontrolled airflow, and difficulty checking sealing quality, which all led to the need for frequent operator interventions and sterilisation cycles.

French filling machine specialist Serac has now adopted RABS in its latest range of aseptic filling machines, which are called SAS3,

for Serac Asptic System, third generation.

In contrast to a standard isolator, the RABS is not hermetically sealed but is an air barrier produced by positive overpressure inside the enclosure that protects the sterile area. Air is continuously circulated and renewed via a vertical unidirectional speed-regulated airflow.

Combining both these techniques eliminates the particles present in the enclosure and also protects against external contamination. By avoiding containment, the continuous air circulation extends duration of the aseptic state and, says Serac, provides up to 72 hours of non-stop production without the need for intermediate decontamination.

Surrounded by barrier zones

The sterile area is surrounded by barrier zones that are also subject to uni-directional airflow. These act as an additional protective envelope between the enclosure and the rest of the plant and make cleaning and maintenance operations on the machine easier.

The heart of the machine – the sterile enclosure – can only be accessed in production via glove boxes placed at critical locations along the filling line. However, all the other points – treatment, line input and output – can be reached via external doors with no need for operators to wear clean room clothing. All access into and out of the barrier zone is monitored and recorded to track operations.

The origins of this new type of RABS isolator stem directly from the pharmaceutical industry. Indeed to design the isolator for the SAS3, Serac says it drew inspiration from the definition given by the ISPE (International Society for Pharmaceutical Engineering) for the FDA.

This definition concerns seven criteria: solid partitions, providing a physical separation

between production and the operators; unidirectional airflow (ISO 5); gloves or an automation system to avoid access when filling; an equipment transfer system to avoid exposure to less clean environments; high levels of surface disinfection; ISO 7 environment class; and, finally, rare interventions to be followed by decontamination, doors to be locked and monitored, positive overpressure and ISO 5 environment class.

In filling terms, the SAS3 is said to be particularly versatile and offer speeds up to 50,000 plastic bottles an hour. A container neck transfer system also means that format changes can be carried out quickly with no need to access the sterile area.

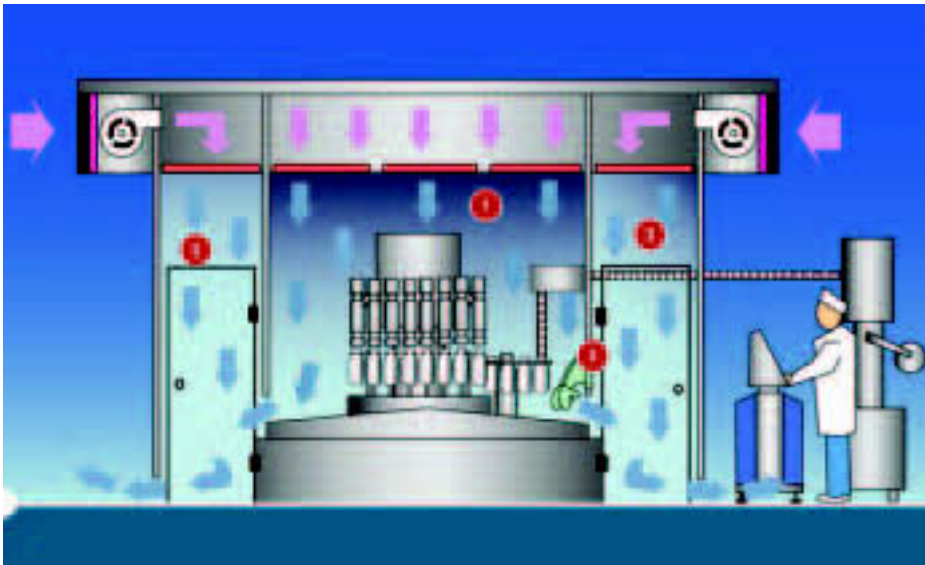
But the exchange of technology between the pharmaceutical and drinks industries is not just one way. Automatic inspection for damaged bottles, short fills, incorrectly torqued caps and correct labelling has been a feature of high speed bottling lines for many years, but is now becoming the norm in pharmaceuticals and the 'technical' and more demanding sectors of the cosmetics industry. The need for validation of high value and sensitive products is requiring the use of technologies that in other industries would only have been justified on a high speed line.

Difference less obvious

Indeed, according to Springvale Equipment, which represents Serac's Barcelona-based cosmetics/pharmaceuticals division in the UK, the company is finding that the difference between filling pharmaceutical products and filling new 'technical' cosmetic products is becoming less obvious. Options such as detecting incorrectly placed caps by vision system, torque checking and rejection of out-of-torque caps,



RABS for aseptic filling: Above: Serac has applied pharmaceutical industry RABS technology to the drinks industry, offering 72 hours continuous production with no need for intermediate decontamination. Below: The concept: 1: Sterile area. 2: Barrier zones. 3: Glove boxes for access to sterile area during operation



and Ethernet connection to export data, are being requested by both industries to minimise the risk of out-of-tolerance containers reaching the market place.

A particular niche area for Serac has been filling-capping machines for oxygen sensitive cosmetics packed in an 'airless' environment using Airless Systems' dosing heads and Valois pumps. Filling and capping takes place under a vacuum to prevent bubbles being trapped in the product during filling followed by nitrogen purging between filling and capping. Plugging, crimping and capping also takes place under vacuum. Speed is up to 60 a minute for containers up to 250ml.

As most of these high quality cosmetic containers are unstable the machines usually

incorporate a puck system and neck locator device to position the container or puck under the filling nozzles.

Filling method

It is often said, but worth repeating, that there is no one ideal liquid filling technique. They all have their advantages and disadvantages and so the choice should depend on the nature of the product, the volume of fill, the type of container being filled, speed of fill and the cleaning or sterilising requirements of the product.

So level fillers are the preferred machine in the soft drinks and brewing industries but are considered too inaccurate for oils and also unsuitable for creams, pastes and products with particulates.

Volumetric piston fillers have the merit of being able to fill a very wide range of product types accurately, from thin liquids to thick pastes and products with particulates, but are slow by comparison with level fillers, have lots of moving parts and are difficult to clean in comparison with other types of filler.

Weigh fillers have the advantage that there are very few parts in contact with the product and so are easy to clean and lend themselves to both small and very large fills. But on the minus side their load cells and electronics make them quite complex.

The new kids on the block are the flowmeter fillers which have the advantages of the weigh fillers with few moving parts and without the complication of the load cells. However, induction flowmeters are only suitable for aqueous and largely uniform products.

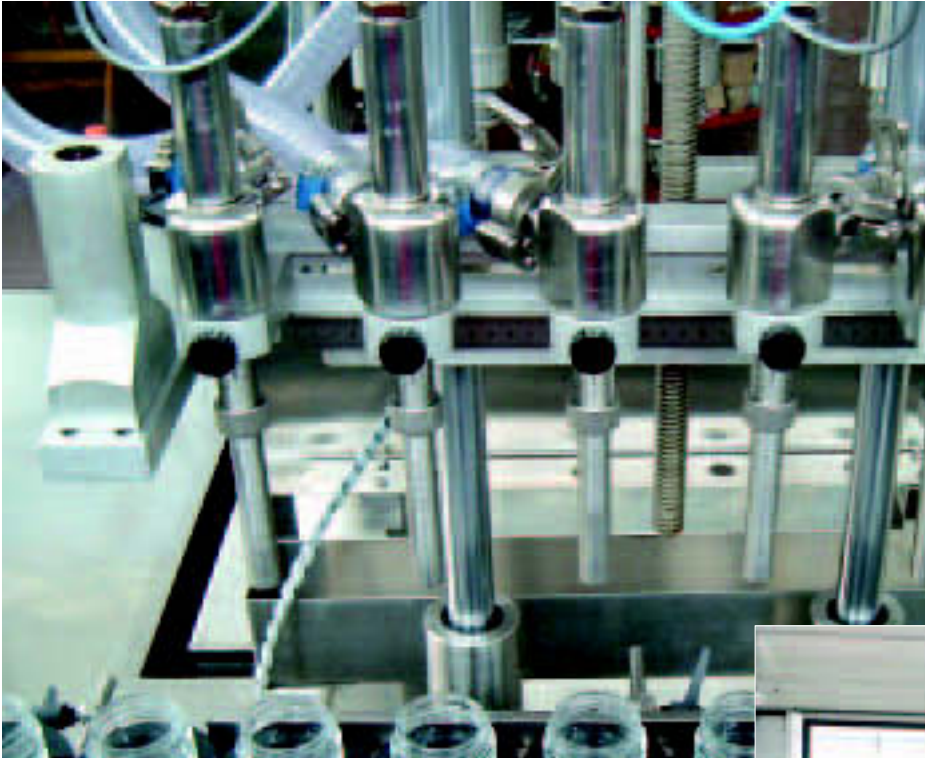
Mass flow meters are an alternative to induction flowmeters that do not depend on the product being aqueous or uniform, however the product contact area is greater than induction flowmeters and weigh fillers.

In applications where only one product is being filled the task is simply to identify the most suitable filling method for the product, but on lines that have to fill a range of product types, as is often the case in the pharmaceutical or cosmetics industries, this presents a dilemma. Do you choose a filling method such as volumetric piston filling that suits a wide range of product types and accept the longer downtimes for cleaning, or do you choose a filling method such as flowmeter or weigh filling that minimises the CIP or SIP issues but does not give ideal filling accuracy on all products?

Of course the ideal solution is to have separate filling heads for each product type and this is the solution offered by Italian manufacturer Omas, represented in the UK by Excel Packaging Machinery. The Omas Total modular filling line can be equipped with a variety of different filling heads which can be moved into position on the filling line as required, to fill products varying in consistency from thin liquids to thick pastes, but making use of the same container handling equipment.

The machine was launched in the UK at last year's PPMA show and, says Excel, has proved particularly successful.

The Total filler can be supplied with a range of roll-up units to suit the customer's products and containers. The docking filling unit fits onto the base machine allowing the user to choose from volumetric, hot filling, gear pump,



Interchangeable filling method: Omas Total filler employs a series of roll-up filling units

vacuum, peristaltic and flowmeter filling modules all of which fit onto the same base unit.

The docking station uses servo motor drive with ball screw control of the diving nozzle system although other options include a mechanical cam or pneumatic nozzle lift. Volume adjustment on each roll-up unit is tool free and there is a CIP facility, although the complete filling system can be simply removed for off-machine cleaning.

Volumetric piston fillers

With the advent of weight and flowmeter fillers you might have thought that volumetric piston fillers would be in decline, but far from it. The piston filler remains popular not just because of its ability to handle a wide range of products but also because of its relative simplicity, reliability and high accuracy of fill.

For example, Premier Foods, Histon, has installed a 30-head rotary piston filler from Planet Flowline to handle preserves in jars up to 2lb at speeds in excess of 450 a minute. The machine was integrated into an existing line and close coupled to a glass jar inverter-rinser, which is driven by the filler itself.

Several jar sizes of different diameters and shapes are being filled. However, changeover can be carried out quickly since the infeed scroll need not be replaced and each filling station has adjustable pincers to hold the jars, eliminating size parts. Just as convenient, fill-

ing carousel height and fill volume are automatically adjusted by calling up the product/ container code from the operator touch screen. The valves themselves can fill homogenous products and also jams and marmalades with fruit particulates.

At Premier Foods' Bury St Edmunds site, another 30-head piston filler has been delivered by Planet Flowline for handling sauces, along with two vacuum fillers for use on pickle lines.

Edible oil has proved to be a major market for Gravfil's latest Excel in-line volumetric fillers, although the machines are suitable for a wide variety of liquids and container shapes as a result of being equipped with liquid flow regulation and a variable speed profiled filling rate.

Available with up to eight heads, three frame sizes and with four dosing cylinder capacities from 300 to 5000ml the Excel design is said to allow custom machines to be assembled readily to suit most products and industries including food, toiletries, healthcare

products or pharmaceuticals.

At the heart of the Excel design is the liquid flow regulation system and variable speed facility that drive the dosing pistons.

Handling foaming liquids

This provides reduced pressure throughout the entire filling cycle to handle liquids with a tendency to foam and allows tapered or stepped containers to be filled at full speed until the reduced profile poses risk of turbulence and cavitation in the liquid. At this point the fill rate is slowed, avoiding risk of air entrapment – particularly in oil-based products – and preventing spillage.

Output from the Excel depends on product type and fill, but is typically 80 a minute from an eight-head machine dosing 300ml. Accu-



No sizeparts: Thirty-head piston filler from Planet Flowline

racy is to better than ± 0.25 per cent of dosing cylinder capacity, for edible oil an accuracy of 0.1 per cent is said generally to be achieved.

Unlike most volumetric fillers, the Excel is able to handle foaming liquids without the need for dipping nozzles to provide a bottom-up fill, says Gravfil. This, the company claims, is the result of a filling nozzle design that gives turbulence-free flow for foam-free top filling and therefore reduced cycle times.

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Still with piston fillers, a recent installation made by Serac at Spanish cosmetics company Laboratorios RTB, Barcelona, for the Lida range of personal care products, shows how an in-line system can provide a particularly high level of versatility in handling products with varying viscosity and composition. Creams, shampoos, and gels are filled in nine different types and sizes of containers with eight different types of closure and the machine also meets Atex standards for handling products containing alcohol.

The Cronos machine supplied by Serac is in fact a combination of two other Serac machines: a Hera in-line filling machine and a Gaia multi-station capping machine linked with a closed-loop conveyor system.

For reduced changeover times the containers are handled in adjustable pucks that can be quickly adapted to the shape and size of the next product while machine settings are pre-programmed with, for example, filling nozzle speed and stroke selected and adjusted automatically from the control screen.

In addition, points out UK representative Springvale Equipment, the machine employs seal-less filling cylinders which can be cleaned and sterilised without being removed.

Weigh filling

Weigh filling has proved popular in the dairy and oil industries, but for different reasons. In the dairy industry the attraction of weigh filling has been the minimal product contact area which makes the fillers particularly easy to clean and sterilise, coupled with the ability to change from filling a 1 pint bottle to an 8 pint container at the press of a button and fill both with equal accuracy.

In the oil industry the attraction of being able to fill 1 litre and 5 litre containers on the one machine has been linked with the fact that filling by weight is the ideal method of filling oil which varies significantly in volume with temperature.

For example, the OCME range of Libra R5 rotary weight fillers is able to handle viscous liquids such as detergents, petrochemicals and edible oils at speeds from 3600 to 60,000 containers an hour, running with plastic, glass or metal and with capacities from 50ml to 5 litres. All electronic components are placed above each filling head and each circuit board is located on the outer part of the header tank for easy access.

The new filling nozzle, with external valve



Versatility: Serac Cronos filler handles variety of containers for Laboratorios RTB with (below) adjustable pucks

actuator, has pneumatically operated actuators for two-stage filling – coarse and fine fill. The nozzle is in fact equipped with a concentric aperture that allows additives such as perfume or colour to be dosed simultaneously with the main product or for two products to be filled at the same time.

Another useful feature is that the filler can continue to operate even if one of the load cells goes down. The double infeed worm screws have independent drives, which means that the operator can simply bypass the faulty load cell until maintenance can be arranged.

OCME's range of fillers also includes Libra R30 rotary weigh fillers for pails and small drums of 20-30kg, the Libra LT 300 in-line weigh fillers for large drums up to 200kg, the Lynx in-line and rotary volumetric fillers for viscous liquids and Hydra fillers for beverages such as mineral waters, soft drinks and spirits.

Induction and mass flow

Flowmeter filling is now a well established technique offering significant advantages in key areas of liquid filling. The low product contact area of the induction flowmeter filler is not only finding applications in situations where the machines require frequent cleaning or ster-



ilising, but also in applications where the nature of the product means that conventional product contact materials such as stainless steel cannot be used. So, when filling products such as bleach or other corrosive chemicals it may be necessary to use PVC or glass product contact parts.

For example, Italian manufacturer Marin, represented in the UK by Excel Packaging Machinery, builds a range of in-line mass and inductive flowmeter machines in four, six and eight head versions for use in the detergent, cosmetics, oils and liquid chemicals industries. Fills are from 50ml to 200 litre and PVC and glass contact parts are employed for filling acids and bleach.

Another interesting development is that the rotary flowmeter filler is increasingly being seen as the ideal machine for contract packing companies who can be called upon to fill a wide range of products in a diversity of container shapes and sizes, at a moment's notice. This is



Flowmeter filling: The heart of the new Nufarm line is an eight-head Masterfil machine

because of the ability of flowmeter fillers to fill a wide range of volumes at the press of a button.

This concept has been developed by Italian manufacturer Ronchi – represented by Propack Automation Machinery – based on the Exacta flowmeter filler which is available as a stand-alone machine or monobloc with the servo capping system.

While these machines are relatively small, the entry level machine is capable of outputs up to 120 bottles a minute on a 300ml fill and larger machines with up to 60 heads give line speeds exceeding 500 containers a minute.

Indeed, Propack Automation says that the Ronchi RX entry level eight head filler is ideal for contract packers seeking to compete with branded manufacturers' costs on short product runs. "The RX combines the advantages of flowmeter technology and the rapid set up of a rotary machine in an affordable standard unit," the company states.

A variety of container sizes are also handled by an in-line flowmeter filler installed at agricultural chemicals manufacturer Nufarm at Belvedere, Kent, which last year brought its packaging in-house with a £1.2 million investment in a new automatic filling line.

This is capable, ultimately, of handling some 20 million litres of herbicide a year should the company eventually opt for three shift working. In the meantime, the line is on single shift and on schedule to pack some 6 million litres in its

first year of operation, from an area of just 25 metres x 25 metres. Only three operators are required.

Central to the line is a purpose-built Masterfil eight head mass flowmeter filler, chosen for the intrinsic accuracy of flowmeter machines, ease and security of cleaning, and the capacity to handle a broad range of container sizes, from 1 to 20 litres.

Reliable form of measuring

"Bringing all packaging in house gives us better control of quality and logistics," explains Phil Dickinson, formulation manager at Nufarm's Belvedere plant. "Mass flowmeters are used elsewhere on the site and we find them to be one of the most reliable forms of measuring available. Cleaning is also very secure, since they are based on a straight through tube."

He adds: "Flowmeter filling means we have been able to set ourselves tighter tolerances than legislation requires." For example, although average weights legislation demands no more than a $\pm 150\text{g}$ tolerance on a 10 litre container, Nufarm says it is able consistently to obtain considerably higher accuracy.

The new line was designed and supplied by Masterfil and runs down three and a half sides of a refurbished 25 x 25 metre building. It extends from a pallet lift and infeed table for the containers, stretch sleeving, filling, capping,

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labelling, checkweighing and induction sealing through to end-of line case-packing, palletising and pallet wrapping. Speed is 14 containers a minute for 20 litre jerrycans through to 40 a minute for round 1 litre bottles. Other sizes handled are 5, 10 and 15 litres.

With minimum space available, and little or no room for accumulation between the various items of machinery, start and stop queuing and control of container flow has been crucial, as Phil Dickinson explains.

"There is less than a metre between some machines, yet when the line is working on 20 or 15 litre containers – which have the same footprint – we're looking at controlling a block of eight containers 2.4 metres long. In spite of the space restrictions, Masterfil has provided an excellent means of controlling the line, which we can set up to optimise production on the different size containers."

Level filling

Level filling is the oldest filling method, but as with volumetric piston filling, it is still largely favoured in specific market sectors. For instance, in the wines and spirits industry vacuum level filling is still the preferred filling method, not least because when products are sold in a translucent bottle consumers expect all to be filled to the same level and will reject a bottle with a lower level than others on the shelf.

Stork Bottling Systems is one of the leading manufacturers of filling machines for the spirits industry and has concentrated development work not only on the fillers themselves but on the filling valve and designing a considerable number of measures to reduce alcohol losses.

The latest generation of air return tubes in Stork valves results in faster filling times and increased cleanability. In addition, they can be mounted and dismantled without tools or put into existing vacuum fillers as retrofits. Also, a hood is provided over the air return tube with an insert to prevent any glass particles from entering the product within the filling bowl.

All the capping options

Of course the complexity of liquid fillers does not end with the filling machine. Most rotary fillers are now supplied in monobloc form either mechanically or electrically synchronised to a capping machine and in some cases to a rinser.

The range of closures in use is always increasing, again particularly in the pharma-

ceutical and cosmetics industries where the choice can include screw caps, push-on caps, aluminium ROPP caps, droppers, reducers, pumps and dip tubes.

For instance, IMA has developed its F800 series of pharmaceutical industry high speed fillers and cappers to provide output up to 27,000 bottles an hour with up to 24 filling heads and 10 closing heads. Dosing volume can be set up to 1000ml.

Thanks to a modular design, the closing turrets can be equipped with various types of closing heads for all types of closures, such as screw caps, push-on caps, aluminium ROPP caps, droppers, reducers, pumps, and dip tubes typical of pharmaceutical applications.

The closing turret can also be equipped with brushless motors on each individual capping head to allow orientation of push-on caps and torque control during the tightening operation with monitoring of the force applied to each single bottle. Automatic adjustment of dosing and closing turret height by means of servo motors is also available.

Depositors

There is a fine distinction between a filling machine and a depositor, indeed the same machine can be sold as a volumetric piston filler and as a depositor. The essential difference between a depositor and a filling machine is what happens to the product after it has left the machine. The assumption with a filling machine is always that the product will go into

some form of container whereas with a depositor the product may be going on to a baking tray, a pizza, cake or a plate of food, or into a pie, a baking tin or a ready meals tray.

Another difference between depositors and fillers is that while with a filler the object is simply to get the product into the container as quickly, cleanly and accurately as possible, with a depositor the shape of the product or the way that it is placed may be much more important than other considerations.

This is the case with a range of decorating heads now available from Turbo Systems for its D150 depositor, aimed at the confectionery industry for simultaneous multi-filling of small quantities of ingredients.

Types of ingredients include chocolate, caramel and fondant, while typical applications include warm chocolate filling centres and tempered liquid chocolate. The heads have twin skin jackets and are capable of circulating warm water to keep chocolate and other fillings flowing freely.

Capable of depositing up to 24 fillings simultaneously, the decorating heads operate at speeds up to 25 cycles a minute and are available in a range of variants, including decorative print heads, star tube print heads, rotating heads, shower nozzles, multiple outlet rotary spade nozzles and heated jacket nozzles.

Raque Food Systems supplies depositors able to handle products ranging from thin fluids to chunky pastes and aerated materials using different valves to suit the application, for exam-



Pot filling: Packaging Automation's latest Starwheel machine is capable of 100 a minute



Multilane rotary: Waldner rotary eight-lane machine for filling and lidding aluminium cups

ple a wide spread for gravy or precise location for cream or butter. The standard machine is fitted with a newly designed diaphragm valve which is said to give a particularly clean deposit of these liquids, essential for avoiding contamination of the container flanges.

The machines are designed with an angle of 135deg, rather than 90 deg, between the dosing cylinder and horizontal delivery, so providing gentle handling of all types of product.

Cup filling equipment

When the term 'rotary filler' is used in most areas of liquid filling it usually implies a machine with several filling heads that rotate with the containers on a carousel to produce a higher output than a machine where the filling head is fixed and products are fed to the filling head or heads intermittently, generally known as an in-line machine. So a rotary filler will almost always be faster than an in-line filler.

However in the field of cup filling, rotary machines are often the slower machines with one or two fixed filling heads and the rotating mechanism used to move the cup under and then away from the filling head.

So in-line cup fillers, with several lanes of cups being filled at the same time, are often the higher throughput machines. Even so, rotary machines are sometimes equipped to handle multiple lanes, significantly improving speed from what usually remains a relatively small footprint.

Packaging Automation's latest Starwheel rotary machine can be supplied in either a single or a double starwheel format and can achieve speeds up to 100 pots a minute. Specifically designed for rigid walled and non de-nestable containers the machine is used by dairy companies, as well as for mineral waters, fruit juices and sauces, vodka shots, sandwich fillings, clotted cream and baby foods.

Outside the food industry the machine is being used for products such as cosmetics, household cleaning fluids and jewellery polish. Size range is 30-102mm diameter and 20-110 depth while closure options include film feed, pre-cut diaphragms as well as clip-on overlids.

Meanwhile German manufacturer Waldner recently launched a new entry level Dosomat rotary machine for soup, petfood, salads, dairy products, cosmetics and confectionery.

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Mechanically driven, the machine can be uprated in the field with secondary fillers or lidding stations.

At the other end of the scale, the Waldner Dosomat multi-lane 16AS is able to provide outputs up to 500 a minute and is available with hydrogen peroxide pot and ultra-violet lid sterilisation. All equipment, linear or rotary, is available either fully mechanical, servo-mechanical or completely servo, depending on customer requirements.

High speed in-line

Waldner's most recent in-line machine was developed for Kraft General Foods to provide output of 72,000 an hour for liquid coffee and chocolate as well as powders: tea and freeze dried coffee. The machinery offers on line checkweighing with a trend facility, gas flushing and a no-cup/no-fill arrangement.

At the same time, Del Monte in the US has just installed the largest linear pot filler produced by Waldner. This has 24 lanes, multiple filling stations for fruit pieces and a brim-full fill of fruit syrup, and is producing retortable packs of Fruitini at 72,000 an hour.

From Grunwald, Germany, comes the

Combiflex in-line machine, the first from the company to be capable of filling both cups of different shapes and sizes and buckets – with or without handles – up to 1.5kg. Automatic press-button format change replaces time-consuming exchange of cup slats or cup rings.

The speed of the Combiflex is 40 cycles a minute and the dosing range is 20ml to 1.7 litres, depending on the filler chosen. It can be supplied with up to five lanes and with a double advance feed to provide speed up to ten containers per cycle. ■

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For full details of all PPMA members able to supply liquid filling machinery, consult the PPMA machinery finder service, tel: 020 8773 8111, or visit www.ppma.co.uk