

# TOILETRIES AND COSMETICS

THE CONSTANT FLOW OF PRODUCT LAUNCHES MAKES THE ALREADY COMPLICATED COSMETICS AND TOILETRIES SECTOR AN EVEN MORE DEMANDING ENVIRONMENT. ANDREW SMITH REPORTS.

## Staple products in the modern world

Just like food, cosmetics and toiletries are "staple" products in the modern world. Although not exhibiting dramatic overall growth – estimated to be 3-4 per cent in the UK to 2009 – the industry is a reliable one and in some areas new product development is pushing growth rates up into double figures. So, while fragrances are stagnant, skin-care is on a roll with a host of new products launched in the past few years on the back of increasing concern about the effects of the sun and ageing in general.

The plethora of new magazines devoted to health and lifestyle – for both men and women – which advertise an ever wider range of cosmetic and toiletry products is further testament to the virility of the business.

New product development is the modern way of keeping a cosmetic company's turnover ticking. No longer do women have a lifelong relationship with a moisturiser or particular nail varnish. Nowadays women, and increasingly men, are more adventurous and prepared to experiment and "trends" appear to have a decreasing lifecycle as the number and type of products and their variants widens.

As in most areas of industrial life, flexibility, speed and reduced downtime have already become standard mantras for cosmetics manufacturers, but the particularly capricious nature of the industry's younger customers perhaps make them particularly relevant. The constant flow of new products demands short-run trial batches, rapid-to-market times and a huge variety of pack and carton sizes and types, plus a bewildering array of different dispenser systems and labels, to name just some of the variables.



*One step processing: FrymaKoruma Dinex 5200 installed at contract packer ASM in Switzerland*

MIXING AND PRODUCT TRANSFER

## Flexibility and rapid changeover drive development

The very nature of this market inherently makes cosmetics and toiletries production a batch environment, which in turn makes flexibility and rapid changeover the key attributes for processing equipment.

The route chosen by Romaco to achieve these goals is through the principle of "one step processing" with its FrymaKoruma MaxxD and Dinex ranges – vacuum mixer-disperser-homogeniser systems based on the "one bowl" principle.

The dual system MaxxD – suitable for the production of lotions, cremes and gels – is said to provide rapid batch times, easy cleaning, high product quality and "unprecedented flexibility", allowing users to choose either a multi-chamber rotor-stator system or a colloid head, depending on the product. The ease with which the homogeniser head can be changed means

that, if required, the processing system can be switched from batch to batch.

The aseptic design of the MaxxD is optimised for feeding free-flowing solids or liquids directly into the working area of the homogeniser. Optimum mixing and heat exchange are facilitated through the application of a specially configured agitator, designed to ensure maximum product movement in all directions. Cleaning times are also minimised, increasing productivity further.

It is this flexibility that was the deciding factor for France's Thalgo Cosmetics, which recently installed a MaxxD for production of milks, creams, masks and gels.

A somewhat more obscure branch of cosmetics production is that of theatrical make up, but here too, the MaxxD is making its mark. The recently-launched MaxxD Lab is designed principally for development and scale-up applications but is said to be equally suited to the everyday production of very small batches – up to 5kg. This model has just been selected by Kryolan of Berlin, a company with a 60-year history in the supply of stage make-up and theatrical effects.

Stage make-up often has to be formulated for specific skin types or even to suit individual actors' special requirements. Kryolan says that the MaxxD Lab will provide an "efficient means of addressing this requirement".

Appropriate for complex formulations of semi-solid products, such as suspensions, emulsions and gels, the Dinex is also a one-step processing system offering advantages such as short batch times, high containment and a compact footprint.

Of particular interest is a newly-designed homogeniser. This operates on the proven rotor-stator system but with the added benefit of axial adjustment of the stator. The ability to adjust the shear force exerted on the product in this way is said to provide optimum flexibility in matching the process to the requirements of the product.

**Helical ribbon agitator**

The agitation system inside the main vessel is also novel. It incorporates a helical ribbon agitator, which allows the direction of product flow against the vessel walls to be varied upwards or downwards, depending on the direction of rotation. In this way, the user is able to vary the parameters of the mixing process to maximise product quality. The agitator also includes conical mixing nozzles, which produce a horizontal and vertical macro mixing action. These, combined with the action of the helix, are said to give optimum mixing, even for the most viscous products.

The Dinex also allows both internal and external recirculation of the product, a further contribution to process flexibility.

One recent installation has seen a Dinex 5200 going into production at Aerosol Service AG (ASM) in Switzerland, a supplier of contract manufacturing and packing services to international clients in the perfumery, cosmetics, pharmaceutical and chemical industries. One of the largest ever built by Romaco FrymaKoruma – it has a batch capacity of 200-4000 litres – the vessel is a multi-storey installation with only its base visible on one level and the lid on another.

Apart from the "standard" attributes of flexibility, speed and so forth, Silverson Machines says the cosmetics and toiletries industries are increasingly requesting process equipment to comply with hygienic standards normally associated with the pharmaceutical and food industries. It also says its high shear bottom entry mixers are frequently being specified by cos-

metics manufacturers for applications where focused high shear in-tank mixing is required.

As such, Silverson has used its expertise in the design and manufacture of "ultra hygienic" in-line and top entry batch mixers to incorporate specific features in its bottom entry mixers. These include a minimised number of product contact parts, crevice-free design, electropolished finish, and hygienic shaft seals. Complete documentation packages and data manuals including IQ/OQ documentation to comply with FDA and cGMP requirements can also be supplied.

The mixers can be used in conjunction with slow speed stirrer-scraper units as the action of the two are complementary, with the Silverson rotor-stator workhead providing high shear which stirrer-scraper units cannot impart. The stirrer-scraper unit complements the action by distributing the homogenised output of the bottom entry mixer uniformly throughout the vessel.

Silverson says this combination is ideal for high viscosity products, those that increase in viscosity on cooling and where heat sensitive materials such as active ingredients may only be added at low temperatures.

For lower viscosity products, bottom entry units can be used without any additional in-tank agitation. This is said to eliminate the problems associated with immersed shafts and difficult-to-clean scraper blades, "offering improvements in process hygiene, especially where large quantities of powder have to be dispersed into liquids using an in-tank mixer".

As with all Silverson mixers, a range of interchangeable workheads and screens is available for bottom entry units, allowing them to be adapted to perform a wide range of mixing tasks.

**Transferring viscous pastes**

Meanwhile Kecol says its air-driven piston pumps are ideal for transferring viscous pastes and creams – such as lotions, creams, scrubs, mascara, hair gels, shampoos, and sun lotions – from mixing vessels to the hopper of a filling machine. They can also be used to transfer base materials, such as lanolin or petroleum jelly from drums, process containers and IBCs.

The company says the main advantage of the piston pump on filling machine applications is that, unlike electrically operated pumps, they can be stopped and started frequently without damaging the motor. Also, the flow rate is infinitely variable simply by adjusting the air valve to the pump.



*Hygienic design: Silverson bottom entry mixer*

WEIGHING, FILLING AND CAPPING

**Getting the mix right with costly ingredients**

Getting "the mix" right in cosmetics and toiletries is essential. Many formulations are highly sensitive and inaccuracy in the proportions of ingredients can ruin a batch. Moreover, some of the ingredients can be highly expensive, especially the actives, so inaccurate materials weighing could have a "double whammy" on the bottom line.

So, for example, when L 'Oreal's Pontyclun plant needed to increase capacity and required accurate and durable equipment to integrate into its new raw material weighing facility, it turned to its long-term supplier in this area, Mettler Toledo.

The equipment chosen was the ID7 BasePac terminal which is IP68-rated and said to be tough but sensitive. Available in bench, wall or panel mount, it offers a wide variety of applications using the integral Pacs software to extend the basic weighing functions into areas such as counting, formulation, dispensing, totalling or checkweighing.

The new equipment is used to pre-weigh raw materials and is linked to a manufacturing software system. "The weighing equipment is used in a new state-of-the-art weighing area to weigh the specific raw materials in the exact amounts required for our manufacturing processes," explains L 'Oreal project engineer, Anup Dutt. "The equipment is integrated fully into three



**Choice of format:** Adelphi Response Automation System filling four different liquids into different bottles

laminar downflow booths giving operators full protection from raw materials during weighing processes.”

L'Oréal also required scale bases and the IP67-rated MultiRange was suggested as the best option, with the KA15, KB60 and KE1500 bench scales meeting the specified criteria.

As well as the scales and terminal, the company also required a precision balance. Mettler Toledo says the PG203-S chosen provides highly reproducible weighing results thanks to FACT – fully automatic calibration technology – allowing the balance to adjust itself, using the built-in weights, whenever ambient conditions change.

### **Semi-automatic machine**

The diversity of the cosmetics and toiletries industry in terms of product and pack types means that filling machinery needs to be particularly flexible, which supplier Adelphi Manufacturing tackles with a broad range of filling machinery.

One example is the Adelphi Response, a semi-automatic machine that can fill a wide range of products from alcohol to thick pastes. Optional accessories include two speed filling, heated hoppers, stirrers and augers, a large variety of nozzles and a spinning table for eliminating air pockets when filling thick creams or awkwardly-shaped containers.

To further enhance the package, Adelphi has introduced the Response Automation System, which automates up to four Response machines. With conveyor, diving nozzles and PLC controls it claims to provide even greater flexibility. It can be set up as an automatic four-head, in-line

filler to fill a large batch of product one day, but the next day each of the four machines can be taken away and used to fill smaller batches of other products.

The value of the Response is illustrated by the actions of a UK manufacturer of premier branded cosmetics, toiletries and fragrances, supplied by Adelphi for many years. The company had several of Adelphi's Centrair semi-automatic filling machines and during the development of the Response contributed a number of suggestions and ideas for the new machine. It then bought the first Response to be built and put it into its laboratory where new products are formulated.

Since then, the company has bought a further eight machines for use in production and Adelphi has supplied several special accessories including stainless steel turntables on which two Adelphi Response machines are placed back-to-back to allow instant changeovers. One machine can be used in production while the other is being stripped and cleaned for the next product.

Serac's latest offering is the Hera+8 volumetric in-line filler, which it says is specially designed for cosmetics that are difficult to handle. The machine is fitted with eight independent filling stations, each of them including a filling nozzle with a conical shut off with no seal; an electronic plunger nozzle system; and distribution with rotary valves.

The machine can be connected to a CIP/SIP able to work with high pressure water at 120deg C. Automatic cleaning and sterilisation can be programmed from the control panel and during the cleaning operation, the pistons move



**Rotary filler:** PKB Cosmo runs at speeds up to 200 containers a minute



**Sachet filler:** The MediSeal LA400

automatically into a cleaning “chamber” situated below the cylinders.

Serac says that the independent servo motor drive for each filling station allows easy and accurate adjustment of the volume from the touch screen, while servo drive for the nozzle support enables any type of bottom filling profile to be followed according to the product and the bottle shape. The volume of the cylinders and the course of the nozzles can also be memorised for each container size, making changeover “instantaneous”.

### High speed rotary

At interpack in April, IMA dedicated part of its stand to cosmetics and in this area showing for the first time was the rotary Multifill F840 high speed filler. Designed to GMP standards, the machine reaches output speeds up to 450 bottles a minute, with up to 24 volumetric filling heads with a maximum dosing volume of 1000ml.

Also on show in this section was a complete line which included a CO.MA.DI.S CD180 tube filler. This is a two nozzle machine with a maximum speed of 180 tubes a minute and was exhibited with an independent ergonomic tube feeding magazine and hot air sealing unit for both plastic and laminate tubes. Operated via a touch screen, the CD180 has easy access to all four sides and changeover is tool-free with graduated scales.

France’s PKB has two filling options suitable for the cosmetics sector which are built on a balcony basis and have in-situ cleaning enabling filling to be carried out to the standards of the pharmaceutical industry. All its

machines also feature tool-free quick changeover.

The servo-driven Flexo, a mass flowmeter machine, is suitable for small and medium batches and has a specially developed flowmeter which means the filling cycle is linear throughout its trajectory with no retention point. The Virtuo has a servo drive on each pump which allows each pump to be regulated during running making it suitable for handling two or three phase products. Another servo-drive controls movement of the dipping nozzles, optimising their speed according to the contours of the bottle and the properties of the products being filled.

Finally, the Cosmo rotary filling machine is designed for use with all liquid and semi-liquid products, including siliconised and foaming products, providing doses of 30-500ml at speeds up to 200 bottles a minute. To cope with the diversity and output rates of the products it may have to handle, the Cosmo is configured as a bottom-up filler and uses seal-free ceramic pumps, which means there is no retention area.

PKB also offers the Robo positive placement unit for crimping capillary pumps on perfumes.

### Tube filling lines

Meanwhile in France, two companies have recently installed fully automatic Romaco tube filling lines comprising the Unipac U-2080 tube filler and the Promatic P91 horizontal cartoner.

SVR Laboratories specialises in high-performance dermatological products, some of which are available on prescription only. Already a user of Unipac tube fillers, the company was seeking a fully automatic line for installation at

its newly-expanded site close to Paris. “We researched the market thoroughly and concluded that Romaco’s equipment best met our criteria, which included quality, ergonomics and availability,” says Mr Veret, managing director of the SVR site.

“For us, a key attraction is the easy exchange of format parts – the line is used for sun, skin and haircare products, necessitating 16 sets of format parts.”

The U-2080 is capable of handling products from low to high viscosities as well as those containing alcohol and the hot air sealing head is said to produce a high quality finish.

In similar vein, Dipta of Aix en Provence was expanding to satisfy increasing demand and a key element of its strategy was to replace age-

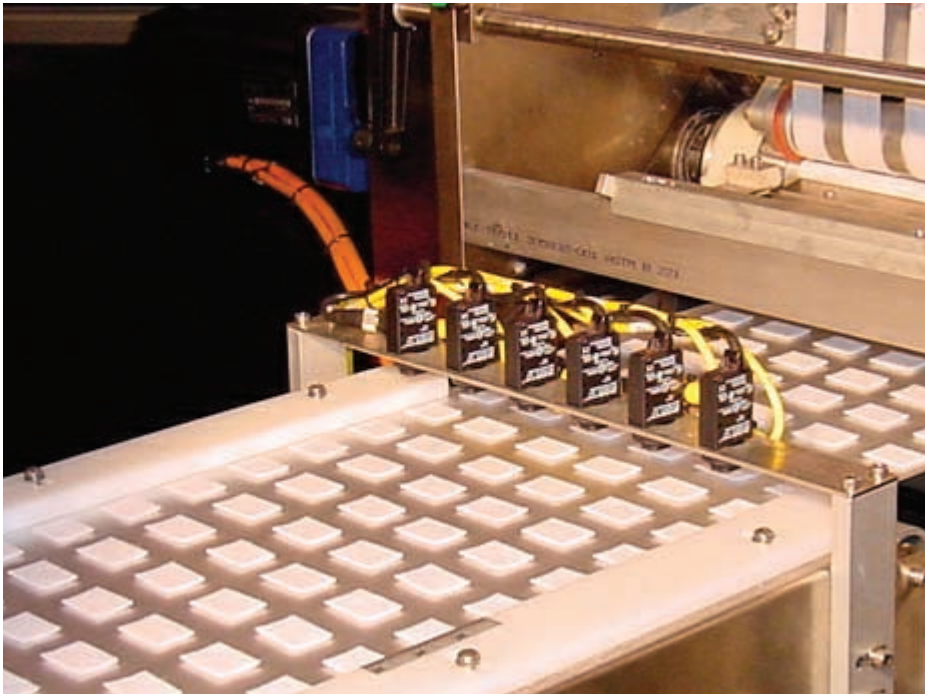
### LIPSTICK PRODUCTION

## Silicone rubber moulds cut costs and lift quality

**A** lipstick production system that uses silicone rubber moulds to provide a high surface finish – without the need for re-flaming or silicone spraying – and reduce the cost of the moulds themselves is now available in the UK from Logic TPS, agent for the Korean manufacturer Woojung.

The moulds can also be washed and reused over and over again and even in continuous production situations they are said normally to last 12 months.

In order to achieve an initial high quality



**Cosmetic wipes:** Doyen machine produces up to 2400 packs a minute

ing equipment. Although not obligatory for cosmetics producers, compliance with GMP standards as an indicator of quality is increasingly the norm in France and this was also an objective of Dipta's expansion plans.

The new line consists of a Unipac U-2080 tube filler, a Promatic P91 horizontal cartoner plus end-of-line equipment, all supplied by Romaco.

### Processing 14 sizes

"Our requirements were mainly linked with highly flexible usage and size changeover for our range of products," says Mr Benita, technical manager for Dipta.

"We currently process 14 sizes on this line, ranging from 15 to 200ml, including elliptical

tubes that are becoming more and more popular for top-of-range products."

"Time is a critical factor in the production arena but people often overlook its significance in the field of maintenance," adds engineering and maintenance manager Mr Parault. "The design of these machines actually ensures a productivity gain thanks to their ease of use and maintenance, as well as the speed of corrective and preventive maintenance".

Sachets are widely used in the cosmetics and toiletries sector – primarily for use in the hotel trade and for sampling – and the MediSeal LA400 vertical sachet machine from Koerber Medipak is claimed to be a highly flexible unit due to the use of quick-release tool holders, digital servo-drives, and the fact that the dosing

units are mounted on a trolley and can be wheeled away from the machine for off-line cleaning and set-up.

The modular unit is suitable for packing liquid and high viscosity products, powders, tissues, contoured sachets and sachets for magazine advertising.

Also in the sachet filling field, Doyen Medipharm has a high speed cosmetic wipe packaging machine which dispenses a small volume of a cosmetic product onto a wipe and then packs the wipe in a sachet. Suitable for products such as perfumes and lotions, speeds of up to 2400 packs a minute can be achieved with the products produced as either individual packages or perforated strip packs.

### Low cost tube filler

Meanwhile, a low cost tube-filling machine – said to cost 40 per cent less than comparable machinery – has been launched on the UK market by IWKA PacSystems.

Aimed at cosmetics, food and healthcare industries, the new IWKA model TFS10 provides speeds up to 60 tubes a minute and can be equipped with either hot air sealing for plastic and laminate tubes or a folding assembly to handle aluminium tubes. Its volumetric doser operates over the range 2-400ml.

The price, including print registration system, end-seal coding equipment and one set of tube size parts, based on the current exchange rate, is £57,500 ex-works.

"This is 40 per cent less than comparable tube filling equipment available on the UK market," says IWKA PacSystems sales and marketing director Mike Nicol. "An extensive programme of value engineering, the use of parts common to other IWKA machines and production in much larger batches than usual, have meant substantially reduced costs."

Finally, an induction heat sealing system able to operate without a closure in place – allowing it to run from a reel of material for cost savings – is now being used by a number of cosmetics companies.

Built by Relco UK, the FCS system uses a bulk reel of foil, cutting and sealing the material onto the container in one operation. An easy-peel tab system leaves no residue on the container and standard re-seal liners for closures can be used. The equipment is available in manual and semi-automatic formats and customers' samples can be sealed at Relco's R&D facility for evaluation and consumer trials before committing to production equipment.



**Rubber moulds:** Wojung lipstick filler provides high surface finish

finish on the lipstick bullets the moulds are pre-heated to a high temperature to eliminate any imperfections on the surface. Cooling the rubber moulds can also be controlled more carefully than metal moulds, says Logic TPS,

and is considerably faster.

There are three cooling stations using chillers and cooled air. Once cooled to the correct temperature, the lipstick bullets are automatically de-moulded and loaded into the mechanism. An automatic wind down unit, capping station and labeller can be added to produce a completely automated production line.

It is also possible to use traditional metal moulds and to produce lip pencils on the new Wojung system.

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## LABELLING

## Meeting the challenge of pack format diversity

The diversity of pack formats and requirement for strong on-shelf branding, combined with the common need to cope in wet environments, can make labelling cosmetics and toiletries a challenging proposition.

For example, Bedfordshire-based Meller Beauty, manufacturers of own-label body care products, recently faced just such a situation when looking for a system to apply front, back and wraparound labels accurately on a range of toiletries – including bottles, tubs and flasks – for a major UK retailer.

Eventually the company purchased a Eurokett Mini-12 labelling system from Advanced Dynamics and currently the system is labelling 300ml containers and is networked to complementary machines that are collating, filling and packing the products.

Frank Slender, engineering manager at Meller Beauty, explains why the company chose Advanced Dynamics: "At the time I was looking for a labeller that would provide better accuracy on application and also more versatility with regards to front, back, and wrap labelling. Although existing machines on the Meller site do give versatility, I wanted something that gave better results and Advanced Dynamics was the only company that could provide a system that would apply the labels accurately enough to meet our customers' high standards.

"The Mini-12 is the ideal system and has the capacity to handle virtually any shape of package. It is a premium quality front and back labeller with the advantages of high speed, high accuracy and high quality engineering."

Another contract manufacturer and packer, Hampshire Cosmetics of Waterlooville, has for many years had a central labelling room, printing the many and varied labels required on an Avery Dennison, high speed, edge head printer with an automatic label rewinder supplied by Codeway.

Due to the increased demand for specific labels, the company considered the viability of on-demand labelling on each individual packing line on the factory floor. After extensive tests and a review of both the hardware and software options available, it plumped for Avery Dennison again, this time the 5.4 model dispense

printer driven by a networked version of Nice Label software. Codeway supplied the complete system, including installation on 11 production lines.

The 5.4 is a 12 dots/mm thermal transfer machine with built in Ethernet interface as well as USB, mini Centronics, and RS232 ports. The printhead and print roller are user replaceable, and the dispensing machine features a "label taken sensor" supplying the operator with one label at a time as required. It incorporates many of the features found in the Avery Dennison 64 bit high speed printers, which are also available in a print-apply version.

Meanwhile, Sovereign Labelling Systems says that having successfully installed a number of labelling machines applying small labels accurately to difficult shaped products, such as make up creams, eye liners, pencils, hand wash and deodorants, it is now designing a labeller to apply pressure sensitive labels to packs of oral products for a personal care company.

Sovereign also says decorative sleeves and tamper banding are important factors in this sector and that its Aegis range of heat shrink sleeving machinery, with horizontal feed and cut systems, are well suited for handling cosmetics and toiletries. The compact Aegis I applies only tamper bands, while the servo-driven Aegis II applies both full body sleeves and tamper bands. Heat tunnels are also available.

## CONVEYING

## The lifeblood of production

Conveyor systems may not be glamorous, but they are the lifeblood of most factories and to under invest could prove damaging since they can have a dramatic impact on production flexibility, uptime, profitability and eventually time-to-market.

One company that does not view the conveyor as a necessary, but unimportant, part of the manufacturing mix is Colgate Palmolive, which recently awarded Transnorm System a contract following a competitive pitch.

The contract was to provide controlled flow from two box sealing machines to a relocated automatic palletiser at its Manchester plant. Cartons of hairspray and deodorant cans are discharged from two machines onto close pitched powered accumulating roller conveyors. These lanes incorporate pneumatic blade stops which are operated by photoelectric cells.

Cartons accurately track around 90 and 180deg tapered roller bends. Accumulation takes place only on straight sections of the system, at optional manual palletising stations and just prior to the automatic palletiser. The hand palletising stations are controlled by a push button and provided system flexibility, enabling either of the two feeder lanes to be operated independently of the automatic palletiser.

To facilitate passage of forklift trucks and operatives, a hinged section of gravity conveyor is easily removed to allow clear access. When this section is taken out, flow is prevented from getting to the gap and the conveyor automatically commences accumulation just prior to the access way.

Colgate Palmolive project engineer, John Grocock says: "The system is not overly intricate, but because operations are continuous for 24 hours, we needed to be sure the selected conveying system would work efficiently, giving maximum flexibility in handling product, with total reliability."

## CARTONING

## Ergonomic with rapid changeover

As part of a complete cosmetics line shown at Interpack, IMA demonstrated its Flexa horizontal cartoner which is available in both continuous and intermittent versions. The fastest model reaches speeds up to 300 cartons a minute and IMA says it is easy to use due to its ergonomic design and rapid changeover. Servo driven, it features a touch screen machine status monitoring system with easy access to size data and parameters.

The CAM range, available in the UK from Campak, includes includes vertical and horizontal cartoners, starting with the AV vertical low cost machine of which over 15,000 have been supplied world-wide. For more complex or higher speed applications, CAM has the AVC continuous motion vertical cartoner, or alternatively it can offer the HV/HG continuous horizontal system. These systems have positive mechanical carton skillet opening devices and come with a range of automatic feeding systems for products, leaflets, spoons, gloves and other products that need auto feeding.

Romaco has carried out a number of recent installations in France, featuring different types of cartoners.

For example, Shiseido International France



**Shelf-ready tray loader:** ETT TFS40 machine from Engsol handles "tottles" at 150 a minute

(SIF) has selected a Siebler CV1/060 vertical machine to handle packaging of Bio-Performance – a prestige cosmetic product – at its site in the Loire Valley.

"Our decision in favour of the Siebler machine was swift," says Jean-Michel Douvsey of SIF. "The cartoner offered the high degree of flexibility we were seeking and Romaco was able to deliver it quickly and in accordance with our project timescale."

The cartoning of Bio-Performance is achieved in fully automatic mode – with product and pack handling throughout via the use of four flighted belts – but the machine's flexibility means that SIF has the option to handle a range of products in either automatic or semi-automatic mode.

The vertical magazine on the CV1 means that the machine can handle cartons with very large A dimensions – up to 220mm – such as those used for perfumes. The modular design of the machine also allows separate carton opening and closing stations to be incorporated, with a variable product feeding area between the two. This is adjustable in the range 840-3200mm, to accommodate a variety of feeding options.

Meanwhile Décade, which manufactures and packs its own brands as well as providing contract services, has opted for another vertical cartoner from the Romaco range, the Promatic Bipak. This purchase represents the company's first step into automated cartoning to cope with increasing production volumes coupled with smaller batch sizes.

Again, simplicity and high levels of flexibility were key factors. "Our main requirements were for a machine that was easy to use and very

flexible," confirms Pierre-Yves Le Gallic, site manager at Décade. "We also need to handle a wide range of carton and product sizes – 70 per cent of our products can now be packed on the Bipak, which represents about 200 different sizes. And naturally, given this number of product and pack configurations, rapid format change is essential."

#### END-OF-LINE

## New glamour from shelf-ready packs

The rise of shelf-ready packaging has provided new glamour for the last phase of the packaging operation. As such its status in the packaging chain has risen accordingly and companies are increasingly turning their attention to this part of their packaging operations.

A recent example is a project commissioned by Engsol UK in conjunction with ETT Verpackungstechnik in March this year for a Reading-based "world class" producer of grooming and personal care products which needed to increase production throughput and reduce packaging costs.

The system for packing up to 150 "tottles" a minute uses ETT's standard pick and place module, the P888. It orientates the containers prior to the pick and place operation and erects the shelf-ready display tray at up to 40 a minute using the ETT TFS40 tray erector, before delivering the trays to the robot's loading position. Once the trays are loaded, they are transferred to a refurbished shrinkwrapping unit which performs the final process of the packaging. ■

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