

Settling for success

UNLIKE LIQUIDS, THE FILLING CHARACTERISTICS OF POWDERS THAT APPEAR QUITE SIMILAR CAN DIFFER DRAMATICALLY WITH, FOR EXAMPLE, THE TIME TAKEN TO SETTLE A POWDER VARYING WIDELY. SO THE SUCCESS OF A POWDER FILLING SYSTEM OFTEN DEPENDS ON HOW QUICKLY IT CAN TAKE THE PRODUCT FROM THE DYNAMIC TO THE STATIC STATE.

The first thing anyone wants to know about a filling system is how quickly and how accurately it will fill their product: a simple enough question to ask of a filler manufacturer, surely?

And yet this is the one subject on which powder filler manufacturers are often most reluctant to commit themselves, although liquid filler manufacturers are not so shy. The reason is most likely that bitter experience has taught powder filler manufacturers that apparently similar powders can behave quite differently in practice.

In theory, the bulk density and angle of repose of a powder are the equivalent of the specific gravity and viscosity of a liquid and should therefore define the powder. However, unlike most liquids, the bulk density and angle of repose of a powder will in practice vary from batch to batch and even from dose to dose. Moreover, what is frequently not recognised is that powders have two states, a dynamic state in which they are fluidised and can be moved and a static state when they are settled.

The static bulk density can be measured, but the dynamic bulk density can often only be guessed at. The bulk densities of these two states can be quite different and the energy needed to fluidise and the time taken to settle a powder can vary widely. Large particle sized powders such as dry sand will fluidise and move very easily and settle very quickly, while small particle sized powders such as icing sugar take a lot of shifting when compacted but, when fluidised, behave like water and are slow to settle and compact.

From dynamic to static

Inevitably, most products lie somewhere between these two extremes, but the success of a particular powder filling system depends not only on the accuracy of measuring out the product and its ability to cope with changes in bulk density, but also on how quickly it can take the product from the dynamic to the static state.

Powders that are difficult to settle can be



Improved access: Theta vacuum assisted filler from Albro-Dico-Gravfil

dealt with in a number of ways. These include filling the fluidised product into an oversized bag and letting it settle off line before sealing, filling the fluidised product and extracting excess air by vacuum on line (a process sometimes called vacuum densifying), or filling the product in a compacted state. Settling by vibration is probably the most widely employed.

Arodo has developed a new pack de-aeration system – based on the vacuum densifying principle – that enables all air to be removed from the product and the bag or sack sealed without perforations. Originally aimed at the cement industry, this process has now been found suitable for any powdered material that packs with entrained air, such as milk powder. In fact, Arodo reckons that bag volumes can also be reduced, in many cases up to 50 per cent, and has a self-contained pilot plant that can be

shipped to a potential customer's site to test the process under real conditions.

"Our experience tells us that factors such as temperature, moisture and the type of transfer system to the packing line can dramatically affect a material's characteristics, which cannot sometimes be re-created in tests within our factory," says Arodo.

Indeed, the vacuum densifying approach has a number of advantages in bulk packaging, not least that the density of the product can be adjusted to give sacks the optimum rigidity for secure palletising. Cleanliness and lack of dust is another.

Dual head system

Bottom up filling is also a way of countering dust and helping the powder settle quickly.

For example, All-Fill has just supplied a dual head automatic system to Rettenmaier in Germany, for dosing drums with 75kg of micro-cellulose powder, replacing a large weighpan type system which required violent vibration and was extremely dusty.

The solution provided by All-Fill features tare weighing of the empty drum, full height container lift to provide a bottom-up fill of the powder without aeration and consequent dust generation at the first bulk fill head, and gravimetric weigh-filling to an accuracy of 20g at the second top-up head.

Controlling the de-aeration of fluidised powders is also a problem for high speed glass jar filling machines. Inevitably both the consumer and the marketing department want to see the product fill the jar as near to the top as possible. But when the powder is put into the jar in its fluid or dynamic state it will have a volume greater than the jar, so what do you do with the excess product until it has settled to its static state?

One solution is to put the powder in a bit at a time. Bulk fill and top up systems allow the main fill of product to be settled before the top up is

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added. Another solution is to increase the volume of the jar by the addition of a funnel for the length of time it takes for the product to de-aerate.

Indeed one variant of this type of machine is the rotary auger filler, in which one or a number of continuously running auger fillers discharge powder into a rotating ring of hoppers, which in turn discharge the powder into the jars or other containers positioned beneath them. Vibration is usually employed to help product settle quickly.

However, while auger fillers are versatile, they are not suitable for all applications. Fragile granules can easily break down in an auger filler and for these products an alternative filling system is required.

Gentle handling

Vacuum assisted powder fillers combine gentle handling of delicate products with the ability to fill rigid containers – or semi-rigid containers supported by a shroud – at high speeds. And, since powder is drawn into the container, rather than simply allowed to fall in, de-aeration is a controllable part of the process.

The Theta rotary powder filler is the latest development in the line of vacuum assisted machines built by Albro-Dico-Gravfil, featuring a number of developments that improve access, changeover time and hygiene. In particular, its open design meets American USDA 3A sanitary standards for dry powders.

The machine is mounted on a fabricated, rather than cast frame and can be readily built to accommodate 12-36 heads, following a modular style of construction, which also allows more competitive pricing, says Albro-Dico-Gravfil. All-round visibility of all working parts is provided via full length polycarbonate guards.

Like its predecessor, the Albro P and Omega series, the Theta draws powder into the container using vacuum, which is cut off at a level as the powder reaches the level of the gauze through which vacuum is applied. Varying the vacuum via feedback from the checkweigher compensates for changes in powder bulk density.

However, Albro has re-designed the filling heads using food grade polymer for the internal components, helping to reduce weight for tool-free changeover, which is said to take 10-15 minutes. Speed of the Theta is typically 150 a minute from a 12 head machine handling 500g fills.

One of the paradoxes of powder filling is, of course, that although powders and granules are sold by weight, most filling systems measure out the powder by volume, and only use weighing



Combination filler: All-Fill has developed a machine able to operate by volume or weight

devices to adjust the volume dispensed when the powder's bulk density changes.

However, All-Fill has developed a new range of combination filling machines, able to fill by volume or by weight, with or without vibration, and has supplied the first of these machines to a Russian coffee producer as part of a £600,000 turnkey filling line.

The coffee jars are indexed four at a time via a scroll. Agglomerated coffee, which All-Fill says can only be filled accurately by weight, is dosed into digital weigh-pans and then into the jars using vibration. Easier products such as freeze dried coffee can be dosed directly into the jars volumetrically giving a higher output.

Gravity feed at medium speed

The latest powder filler from Albro-Dico-Gravfil is the Alpha weigh-filler which was developed, says the company, to provide the product handling and cleardown advantages of gravity feed operation in medium speed machinery.

Available with four or six heads to give output typically in the range 70-80 containers a minute, the Albro Alpha is aimed at food, pharmaceutical and personal care markets where, up to now, medium-speed fillers for powders, granules or agglomerates have relied on auger dosing systems. Instead, the machine uses a gravity-

fed weigh-fill head in which product flow is controlled simply by air pressure.

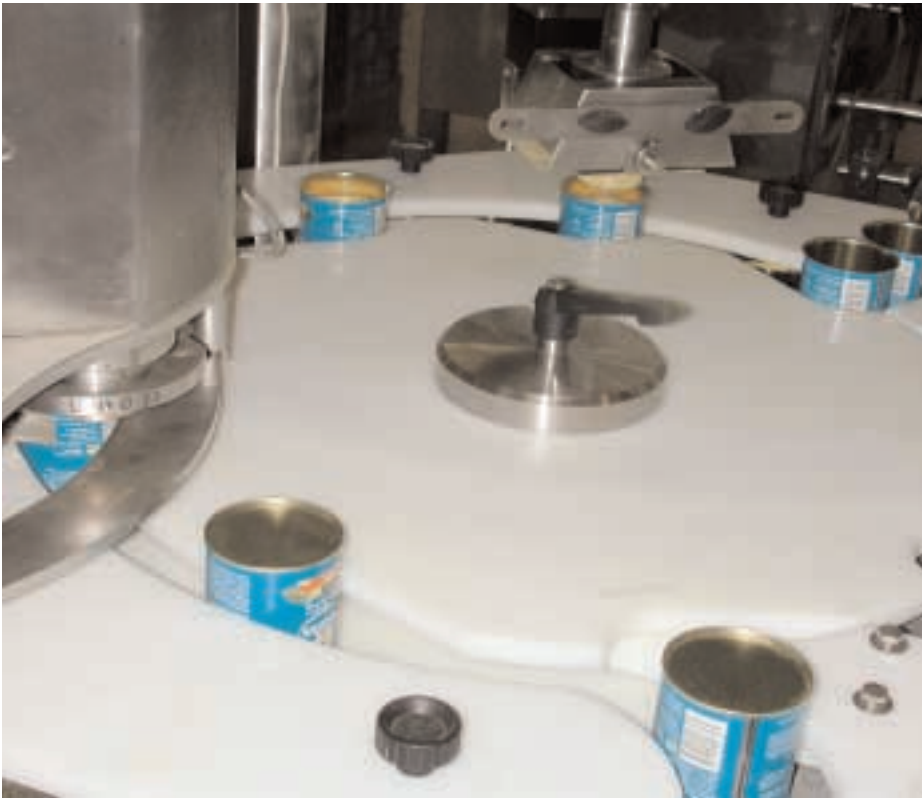
Unlike auger systems, there are no moving parts in contact with the product which, explains the company, avoids risk of damage to fragile powders and presents a smooth unobstructed flow path for easy cleaning. Accuracy is typically $\pm 1-1.5g$ on fills of 50g to 2kg.

Filling nozzles on the Alpha incorporate porous plastics inserts that allow product flow to be regulated and shut off completely by varying the air pressure within the nozzle. While product is being filled, to a weight controlled by the weigh cell, positive air pressure applied through the porous insert fluidises the powder to give a fast, bulk flow.

After 90 per cent of the fill has been achieved, air pressure is returned to atmospheric, reducing flow rate for final accuracy. At this point, a low vacuum is applied to the nozzle, causing the powder inside to bridge the aperture immediately and cut the flow cleanly.

To achieve maximum throughput, the Alpha is arranged on a stepped-in-line basis that minimises the delay associated with multi-head in-line fillers as containers arrive under the filling heads.

In place of a single conveyor, the machine is equipped with a separate infeed and outfeed, set



Compact and flexible: A servo controlled can presentation system is at the heart of Webb's latest machine

parallel, either side of the filling heads. This allows empty containers to arrive while the previous filling cycle is completed and then be moved sideways into position, under all filling heads simultaneously, displacing the filled containers onto the outfeed.

Acma GD has now developed two ranges of weigh-filling machines to handle powders and granules, from detergent to coffee.

Carton form-fill-seal

The NWF is a carton form-fill-seal machine which takes a carton blank, forms it, glues the lower flaps, fills by weight using a load cell under the carton, and then seals the upper flaps. Several machines have been sold, including one to a UK customer where, during tests in a production environment, accuracies of $\pm 6g$ were achieved on a 3500g fill. "On long, more consistent runs, this has improved even further, thus making the payback on the new machines extremely easy to justify," says Acma GD.

In addition to the NWF, Acma GD has continued to develop its WP weigh-fill machine for handling rigid containers, which works on the same principles.

At the other end of the weight spectrum is one of two fillers supplied by All-Fill to the European Commission, for dosing as little as 10mg at accuracies to $\pm 1-2mg$. Filling at just three vials a minute, this fully automatic system tare weighs the empty glass vial, and then fills in multiple stages with intermediate weighing and final gross weighing. The complete weigh-filling

system is incorporated within a purpose-built glove box isolation unit, with special seals to the glove box base slab to guarantee protection for both operator and product.

Optima has recently launched the high accuracy SL50 in-line pharmaceutical powder filler in the UK and also started building a new series of CFL multi-lane fillers to handle plastic and paper pods of ground coffee.

The Optima Pharmaline SL50 is a compact machine aimed at high accuracy applications within the pharmaceutical industry – such as dosing active and passive ingredients separately – and is able to operate with a repeatable auger control of 0.01 per cent.

Based on a modular concept, and built to operate in Class 100 clean-room conditions, the machine employs a servo driven 'rake' to carry bottles through the filling and closing operations. This allows standing time and transport time to be readily adjusted for different containers or doses, ensuring maximum throughput, which is typically 60-80 bottles a minute.

Modules include servo driven augers, weigh fillers, screw cappers, stoppering units, crimp modules and video quality control on the bottle neck. Snap-on change parts are used wherever possible. In addition, weigh cells built by Optima

itself are employed to tare empty containers, make an intermediate check between filling stations where more than one is employed, and to monitor the final gross weight.

The Optima CFL (cup filling line) is available in 4-12 lanes and capable of handling both rigid pre-made plastic pods for ground coffee and operating on a form-fill-seal basis with paper to make soft pods. Filling is via servo driven augers, with the option for integral weighing. Closing is by heat and there are gas flushing facilities.

Coffee pod market

Most machines built so far have been for the coffee pod market, but the machines are also able to handle snack foods, powdered soups, pharmaceuticals, detergent and so forth as well as piece products. A small scale version for laboratory work and test marketing quantities, the CFL Mini, has also recently been launched.

Indeed the need to dose small proportions is not confined to containers, but is also important in adding ingredients to bulk goods.

For example, following an approach from one of the UK's largest animal feed milling groups Game Engineering has designed and built an automatic system to add small quantities of ingredients to batches of bulk product within a

mixing system, rather than hand weighing and tipping.

The new system employs ten stainless steel bins, four to hold about 1000kg of ingredients and six to hold about 250-300kg of ingredients. Each of the micro-ingredients to be included in a batch mix is automatically

weighed and discharged into a central weigh hopper – mounted on load cells – which is then discharged and blown into the designated mixer. On completion, the system shuts down and proceeds to make up the next batch.

Meanwhile, Webb Automation has supplied two particularly flexible powder filling lines to Podravka of Zagreb, one of Europe's largest seasoning manufacturers, to handle its Vegeta range.

At the heart of the machines is Webb's recently developed servo controlled intermittent IT200 rotary can presentation system. Filling is

Breaking the speed barrier

All-Fill International has "broken the speed barrier" with two fillers, each operating at 1750 fills a minute. The purpose-designed Multi-fill systems each comprise several servo driven augers mounted in a common filling head assembly that also has an agitation capability. The two fillers are being integrated with other machinery for installation within Europe, a third unit for the US being produced by All-Fill's US sister company.

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via a Servofill SF3P auger which doses 50-500g of powdered seasoning into the can, with vibration applied to assist settling if required. At the next indexing station the built-in check-weigher confirms weight and provides any correction feedback that may be necessary before the can is presented to the integrated Lanico can seamer for the lid to be attached.

Cans and composite containers of 49-153mm diameter can be handled at speeds of around 60 a minute which, says Webb, provides a compact, flexible and cost effective system, well suited to the seasoning, coffee and milk powder industries as well as contract packing.

Complete containment

Finally, complete containment to avoid spread of dust and noise is often required, which is one reason German filler manufacturer Behn + Bates – represented in the UK by Springvale Equipment – has recently broken into the animal feed market with the Integra Plug 'n Pack system.

Springvale points out that the Plug 'n Pack system combines the bag placement, filling and sealing stations in one compact cabinet so forming a dust-tight and low-noise fully automatic filling plant that can be housed in tight places. As a result commissioning times are also said to be particularly short, hence the Plug 'n Pack name.

The machine, already used in food and other industries, has gone to a German animal feed producer for filling grass seed and animal feed into 10 and 25kg polyethylene and paper valve sacks at the rate of 180 bags an hour. The air



Short commissioning times: Integra Plug 'n Pack filling system from Behn + Bates

filling technique, with the product transported by air rather than mechanically, was chosen for this application since it can be adjusted to suit the high number of different products being handled, all of which vary in bulk density and flow characteristics.

Further fillers from Behn + Bates extend from semi automatic models through to high speed eight-head fillers producing up to 2200 bags an hour. ■

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

Strip sacks keep clean inside

Strip sacks, with an inner polyethylene bag which is completely separate from the kraft outer, are now providing an answer for handling food ingredients or other hygiene sensitive products, according to sack closing machine supplier Meypack, represented in the UK by Sigpack Services.

The sack outer, which may become contaminated during transit, can be easily removed, possibly using a tear open strip, before the inner bag with its contents is taken into a clean area.

The open mouth sacks themselves are manufactured with the inner polyethylene sack stuck to the upper edge of the kraft paper sack, for filling and seal zone cleaning purposes.

However, simple modifications to a sack



sealing machine allow the area of paper/pe bonding to be cut away, with the result that the inner sack, hermetically sealed through the paper layers, is no longer stuck to the paper. Closure of the paper outer is via stitching or fold-over.

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