

Weighing up the difference

POWDERS AND GRANULES ARE USUALLY SOLD BY WEIGHT BUT FILLED BY VOLUME, DESPITE THE FACT THAT PERFECTLY CREDIBLE POWDER WEIGHING SYSTEMS ARE AVAILABLE. MARTIN KEAY REVIEWS THE DIFFERENCES BETWEEN THE TWO METHODS.

There is a confusingly wide range of different types of powder filler on the market, but in essence they fall into two groups.

The largest group of machines includes fillers that measure out a volume rather than a weight of product. Typically the output of these volumetric machines will be monitored by a check-weigher and adjustments made to the volume delivered, to correct for changes in bulk density. However, **volumetric machines** are usually only considered suitable for powders that have a consistent bulk density.

The second group of machines are those that measure and adjust the weight of every fill to ensure that it is within the legal limits. These gravimetric powder fillers may include one or more volumetric filling devices but, in principle gravimetric filling machines should be able to cope with rapid and significant variations in the bulk density of a powder.

So before even thinking about buying a powder filling machine, you need to find out as much as you can about the powder you want to fill. Bulk density, usually measured in grams per litre, is the key indicator, but a single bulk density measurement for a powder can be misleading. Is this the highest bulk density, the lowest, an average, the bulk density when the powder is being filled or when settled in a container?

It is important to know the highest bulk density and perhaps more importantly the lowest bulk density of the powder, if only to check that the required fill of powder will actually fit in the bag or container at its lowest bulk.

A crucial factor when selecting the type of filler needed is to know how rapidly bulk density will vary in the powder. Will the bulk density vary significantly from one fill to the next, as you might find with a product like granulated coffee, or will the bulk density of successive fills

be fairly consistent, as you might find with spray dried milk powder?

But even all this information is not enough because you need to know how much your powder aerates when it is moved and how quickly it settles down again once placed in a container. Finely divided powders will often aerate to the

fat milk powder may be quite sticky and, conversely, there are other powders such as icing sugar that can flow like water through a pinhole when aerated, but will refuse to move down a 25mm diameter pipe when compacted.

The classic form of gravimetric filler is the net weigher. This comprises a feeding mechanism and a weighpan mounted on a load cell or force balance which accepts the complete fill. The feeding mechanism feeds product into the weighpan until a preset "cut-off" weight is reached. Feeding then stops and the fill is discharged from the weighpan, typically through "bomb doors" at the base of the weighpan.

Net weighers

In recent years there have been comparatively few developments in net weighers for powder filling, but, at Interpack earlier this year, German manufacturer Multipond launched a new series of powder fillers.

Called the DW 640A range, the new Multipond weighers are available

with two, four or six weighing heads depending on the speed of operation required, with the six head weigher, for example, able to fill 1000g of powder or granules at speeds up to 120 containers a minute.



Multihed for powder: Multipond's new DW640A in six-head format

point where their bulk density halves and may require vibration or application of vacuum to de-aerate quickly.

Then there is the question of flowability. Some powders flow easily, while others like full-

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The heads are arranged in a circle and each is equipped with its own dosing hopper, which is fed with product by gravity from a single central feed hopper. Each dosing hopper fills its weigh hopper to the correct target weight through a pivoting gate with a varying opening profile. The weigh hoppers have "bomb-door" opening for clean product discharge while all product contact parts are made of stainless steel.

"Although only launched at Interpack this year, the DW640A machine is already proving popular with customers for free-flowing products such as detergents and sugar," comments Geoff Tandy, managing director of Multipond in the UK.

An alternative to net weighing, where powder is weighed into a weighpan, is to do the reverse and measure the weight of product that has been discharged from a hopper, which is known as loss-in-weight weighing.

Overcoming limitations

For example, Ward Bekker's loss-in-weight auger filler was specially developed to overcome problems such as dust contaminated seals, accuracy variations and limitations on speed associated with automatic weigh filling of powders into vertical form-fill-seal baggers.

Product is dosed immediately above the cross seal on the bagging machine so dust formation is kept to an absolute minimum. Accuracy variations as a result of product bulk density changes are minimised, enabling tolerances as close as ± 0.25 per cent to be achieved on a 25kg fill.

The Ward Bekker weigher's controls incorporate an extra bright high contrast LCD screen, which can be mounted on the machine or remotely, and uses the latest software which simplifies set-up with 'home' and 'return' keys to give easy programme navigation. Programmes for up to 100 different products can be stored in memory.

Meanwhile, Mettler Toledo reports that there is a growing trend to using manual weighing of critical ingredients in bulk powder dispensaries.

Manual weighing dispensing systems take the form of an operator terminal linked to floor mounted weighing equipment. A single terminal will support more than a single weighing platform, allowing resolution critical weights to be performed on a smaller capacity platform where required. Mettler Toledo's operator terminal is PC based with text and graphical information guiding the operator through the dispensing process.

Peripherals in the form of barcode readers and label printers may be included, depending on the level of control and traceability required. Data for the formulation dispensing is held in a standard database format.

Manual dispensing of ingredients need not be considered in isolation from the overall manufacturing process. Where factors determine that a formulation is part bulk dispensed and part manually dispensed, data links to plant control systems will allow data to each accordingly.

The manually dispensed ingredients will typically be weighed out and recorded, before returning back to the mixing process along with the major bulk components for the completed formulation.

While weigher based systems ensure consistent accuracy, even with powders that vary in bulk density from one fill to the next, they are relatively slow and expensive when compared with volumetric filling systems.

One of the most cost effective methods of filling powders into containers is the rotary auger filler. This consists of one or two fixed augers, which discharge a continuous stream of powder into a rotating ring of hoppers that guide the measured volume of powder into the containers being filled.

This method of filling is suitable for products such as talcum powder that have a relatively consistent fill-to-fill bulk density. Indeed, All-Fill International has recently supplied a complete turnkey line for filling talcum powder that incorporates a rotary auger filler, a rotary container unscrambling table, a checkweigher and a rotary capping machine.

The checkweigher weighs and records the fill weights of the containers, and incorporates a reject system that detects irregular fill weights. It also has trend feedback control which monitors the range of fill weights and signals the auger filler to either increase or decrease speed to ensure that the fill weights remain within legally permitted limits.

Minimise build-up of dust

The continuous motion rotary filler has a fully enclosed dust retention and extraction system to minimise the build-up of any dust, a particularly important feature when handling talc. The filler also features a turret jogging system which assists in settling the product through the transfer funnels and compacting the product into the containers.

There is a large full colour touch screen panel

to control all machine functions, including touch sensitive display, programmable recipe selection, containers per minute display and fill motor speed display. A special feature is the graphical trend display which shows the fill weight performance in real time as the machine is operating.

Another approach to volumetric filling is to use the container as a constant volume measure and fill to a level either under gravity or with the assistance of vacuum. This powder filling technique is favoured by PLF International for filling dried milk products.

In a recent installation, PLF delivered one of its vacuum fillers to a major milk powder manufacturer in Thailand, to fill baby milk in powder and granular form.

Vacuum fillers are particularly suitable for products such as baby milk because there are no moving parts in contact with the product. Another benefit of the vacuum filler is that it is possible to add nitrogen or carbon dioxide to the container during the filling process to enhance the shelf life of the product.

The Thailand machine incorporates PLF's re-designed nitrogen gassing system, which has a gas recycling facility. The nitrogen or carbon dioxide gas discharged as containers leave the outfeed of the filler is collected and recycled back to the filler's infeed section, to minimise gas usage.

Powdered milk line for Iran

GEI Albro has just won an order worth over £1.4 million to supply a turnkey milk powder canning line to MMP Industries in Iran. Designed to operate at speeds of 150 cans a minute, the line will be capable of handling a range of milk powder products and two sizes of can, 450g and 900g.

Installation is due in September next year, and the turnkey contract includes the entire canning operation, from depalletising through to end-of-line packaging.

The system will also incorporate Albro's pre-gassing technology to precondition the powder before filling on the Theta high accuracy rotary vacuum filler with tool free changeover.

Filling large volumes of powder into paper or plastic sacks is difficult under most circumstances, but particularly challenging if the powder has a tendency to aerate when conveyed or filled. This was the problem faced by Granfix Products, Alfreton, Derbyshire, which makes a range of powdered building products, all of which have a tendency to aerate. These are

packed in open mouth paper bags in weights from 7.5kg to 20kg.

When Granfix wanted to automate its bagging operation to keep pace with increased sales, Pacepacker was selected as the filler supplier and only minor modifications to the standard Pacepacker T21 bag placer and closing system were required.

The Pacepacker machine lowers the filled bag gently from the filling head and then grips the top of the bag tightly as it passes through the bag top folder and then the stitcher. This allows one person to run this entire line, including palletising.

Powder de-aeration system

When Weitek's range of bag and sack filling machines are specified to handle powdered products that have a tendency to aerate, they can now be equipped with the company's new

powder de-aeration system, which consists of a vertical screw, to de-aerate the powder as it is lowered from the discharge of the weigher into the bag. Weitek's UK agent Aetna says that this can double some powder's bulk density between the weigher



Loss-in-weight: Ward Bekker machine improves bagging efficiency

and the bag. Weitek's latest filling machine is the WRF 2000, a continuous motion carousel machine which can be fitted with four or six filling spouts and will handle powders and flour based products at speeds up to 2000 bags an hour.

It is a frequently overlooked fact that the performance of a powder filling machine often depends on the delivery system that feeds it with product. If the feed arrangement allows powder particles of different sizes to segregate or a variable head of product to press on the filler, performance will be adversely affected.

One method of isolating a powder filler from these effects is to fit a short horizontal screw conveyor, sometimes known as a crossfeed conveyor, between the bulk feed hopper and the infeed to the powder filler. When linked to a level probe in the powder filler infeed, a cross-feed conveyor will maintain a constant product level in the filler, which allows it to work at its optimum performance.



Talcum powder line: All-Fill turnkey installation is based on a rotary auger filler

Space and layout considerations also mean that a simple conveyor or elevator system is sometimes necessary to provide a mechanical feed to powder filling machinery. However, when screw conveyors are used, special consideration needs to be given to easy cleardown facilities, especially if there will be frequent batch or product changes.

Quick and easy cleardown

Powder handling specialist Guttridge Services manufactures a range of crossfeed screw conveyors which incorporate several features that make cleardown quick and easy. These include easy release tube clamps, slip-fit screw connections and swing-away drive mountings.

The Guttridge Easyflo mobile screw elevator is another alternative where a waist level feed point is necessary or where its 70 litre hopper provides useful on-demand intermediate storage, linked to the powder filler's level probe.

High grip conveyors handle bags of carbon black

An automated handling system, with two high grip conveyors, has been built by CKF Systems for carbon black manufacturer Sevalco, Avonmouth, to carry 15kg bags of carbon black from two bagging machines.

The bags, nominally 500mm long x 250mm wide x 250mm deep, are carried by the first conveyor at a speed of 30 metres/min giving a total throughput of 14 bags a minute.

Product is then deposited onto an inclined conveyor, raising product at 13.5deg from



500mm to 1 metre at a speed of 60 metres/minute. This increase in speed extends product pitch, giving the gap necessary for presentation to a checkweigher.

Both conveyors are fitted with special high grip, grooved belts to maintain product stability throughout transportation, and incorporate local motor isolators and fixed product guides.

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"The Easyflo can handle a huge range of different materials, including starches, cocoa powder, spices and many materials with poor flow characteristics – making it a particularly versatile machine," says managing director Peter Guttridge.

Another method of feeding powder or granules to a powder filler, particularly favoured in the pharmaceutical industry is to use a vacuum or positive pressure conveying system.

Ytron Quadro reports that the use of automated conveying and loading systems may be considered a luxury in many instances, but can be essential for products which might be hazardous in nature, and where the level of containment achieved by vacuum transfer during the loading operation ensures there is no operator contact.

A further benefit is that the need for an operator to continually check and top up the buffer hopper is eliminated, freeing him/her up for other tasks, and removing the risk of health and safety issues concerned with lifting and repetitive strain.

The principle of operation is simple. A transfer hopper, usually shaped as an inverted cone houses a product filter on the underside of the

lid. Vacuum is pulled on this hopper, through the filter, drawing product from its remote location, along a conveying hose or lance, and into the hopper body.

Once the hopper is full, the vacuum source is removed, and the product is allowed to exit the hopper under gravity through a discharge flap valve. When the hopper is empty, the flap valve is shut, and the cycle runs again.

Simple venturi may be used

The transfer hopper is generally located immediately above the vessel or equipment it is required to load or fill, and may be interconnected to this vessel by any number of fixed or flexible connections, depending on the process containment requirements.

For low fill rates of less than 200kg/hour, a simple venturi system may be used as the vacuum source, while for higher rates a side channel blower is generally used.

The venturi unit is normally sited very close to the transfer hopper – generally directly onto the hopper lid – whereas the side channel blower can be located more remotely, even in a ceiling void or an adjacent room.

A typical vacuum transfer system is easy to

clean. When empty, the transfer hopper is easily handled, and may either be washed in place or manually cleaned.

With virtually no moving parts, routine maintenance is extremely straightforward, and the only items which will require periodic inspection and possible replacement are the hoses and filter. ■

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