

## ARTICLE

# Adding Flexibility to Large Volume Spray Drying Plants

Usually 'added value' powdered Dairy products start their life at the outlet of a Spray Dryer. Metaphorically, the Spray Dryer is the 'oil tanker' of the process industry; it takes a long time to get going, is difficult to alter course and should only be stopped when absolutely necessary. They are very efficient at doing one task for long periods of time; therefore Spray Dryers are used to make the 'Base Powder'.

Base Powder is not something a business can thrive on alone, consumer demand dictates that different nutritional and health benefits are gained from the product. Marketing inevitably believes that an array of ever changing packaging will gain market share and Research & Development will always be bringing in new products. All of these products consist of Base Powder mixed with various Vitamins, Additives, Colorants and latterly, Probiotics.

Disregarding the developments made in extending the shelf life of these products, if the manufacturing process is not flexible and agile, it will inevitably lead to manufacturing for stock, not manufacturing to meet customer orders. The resulting finished goods warehouse could therefore be huge. It is not uncommon for companies, whose manufacturing process dictate their stock levels, to have multi million £s of stock inventory, money that could of course be better utilized.

If the spray dryer is the 'Oil Tanker', then packaging is the complete opposite. Packaging machines are the multi directional speedboat, capable of starting and stopping quickly, changing direction several times a day (possibly hourly) and are always in a race with several other packing machines. What happens in between is the key to getting multi products to market, without massive inventories.

Process steps can be broken down as follows:-

- ***Spray Drying***
- ***Formulation***
- ***Mixing***
- ***Quality Assurance***
- ***Packing***
- ***Cleaning***

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### Spray Drying

Careful thought should be given to where in the process the minor and micro ingredients are added. This needs to take into account any potential damage that may occur if these important and sensitive ingredients are added prior to spray drying. Damage could be caused to the functionality of the vitamins, additives and especially the probiotics due to the heat, but more importantly spray dryers are enormous process vessels that take days to clean, therefore any changes in recipe (which have to be regular occurrences to avoid build up in stock) means large amounts of down time.

### Formulation

The recipe of minor and micro additions necessary to produce any variation to the base powder should now be formulated 'off line'. This can be done by simple hand formulating or if volumes are sufficient, then automated formulating is preferable. These unmixed formulas are then premixed to allow automated addition to the main base powder mixer.

Formulated minors and micros are usually added to an IBC as it is transportable and the premixing can be carried out in the IBC. The benefit of mixing in an IBC Tumble Blender is that the next Recipe IBC can contain a completely different formulation, so there is no static mixer to clean. The 'variety' can be added to the base powder with no interruption to production.



***Flexi-Batch Micro***



***Fully Automated Flexi-Batch IBC System***

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### Mixing

This can be either continuous or batch. For the purpose of this paper and due to the fact that continuous mixing requires automated, continuous formulating, we have selected Batch Mixing to discuss further.

Typically Batch Mixing can be carried out in one of two ways:-

- *Tumble blended in an IBC* - the base powder and the formulation of micros and minors are added to an IBC, the IBC is then tumbled to produce a finished mix.

Typically this can be achieved using the same Tumble Blender that is used for the formulation premix.

- *Static Mixing* - the base powder and formulation can be transferred into a fixed static mixer. If a fixed static mixer is used, then clean down time between different recipes has to be considered, albeit the number of batches per hour can be quite high.

With tumble blending, any cleaning between recipes is carried out 'off line'. Although the total batches capable of being produced are less, probably in the region of 4 batches per hour, the mixing time for a tumble blender is longer than a static mixer.



### Quality Assurance

Typically Quality Assurance takes place after Mixing but before Packing. This can lead to large amounts of work in progress as Quality Assurance may take in excess of 24 hours. Working on a basis of 5 tonnes per hour, this means in excess of 100 tonnes is waiting for Quality Assurance to clear the product ready for Packing. The modern alternative to this is to allow Packing to take place whilst Quality Assurance is clearing the product. Product traceability is critical to allow this to happen, however this has only moved the 100 tonnes to the finished goods warehouse.

A well designed factory will enable a process to be validated. Provided of course that the raw materials entering the process are constant and within tolerance, it should not be necessary to check the finished product quality. The exception to this is periodic Quality Assurance to ensure validation is maintained. A sensible compromise is to continue the Quality Assurance procedure on a reduced scale, allow the product to be packed and enter the logistics chain. In the event of any rare compromise to the quality, the product can be retrieved before it is on the shelf, due to the product tracking.

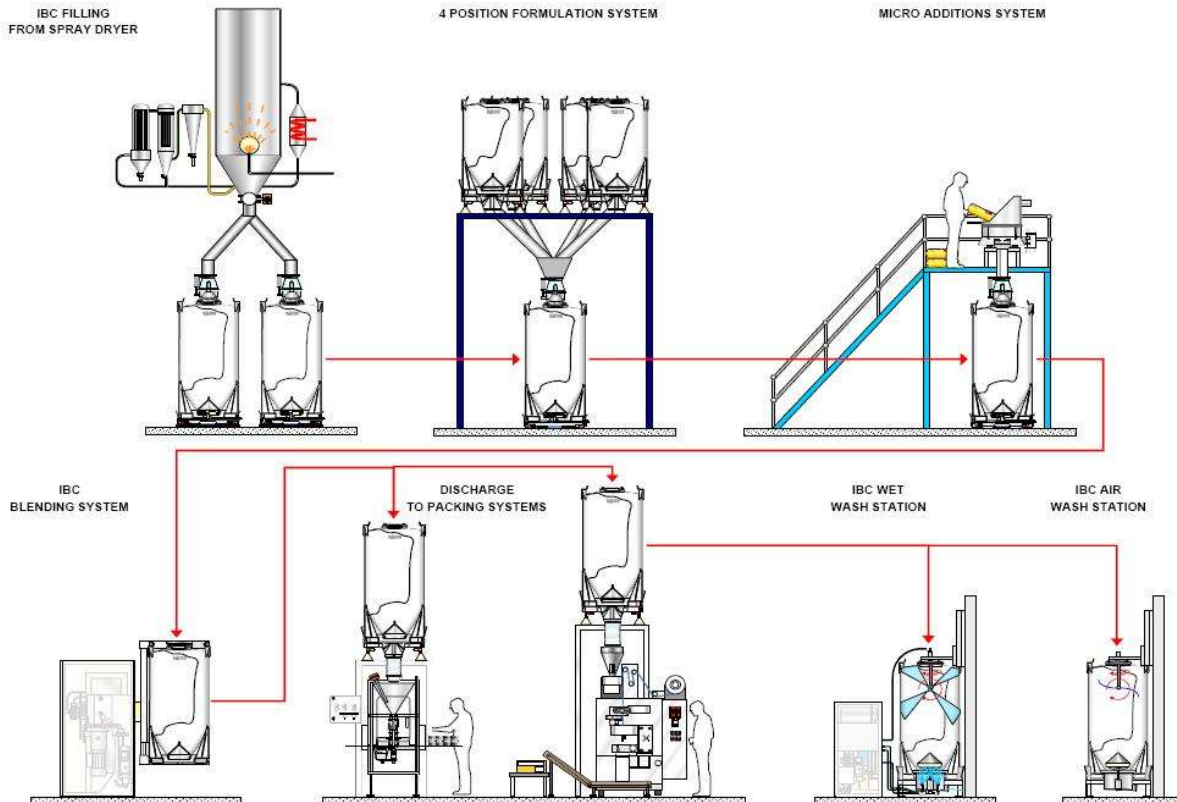
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### Packing

With changing pack sizes and product recipes, it is customary to have several different packing machines. When the process includes a fixed static mixer, it is essential to decouple the mixer from the packing machines to allow production flexibility. Where tumble blending is utilized, the Mixer is already decoupled and the means of transporting product to the packing machine exists — the rigid IBC used for blending.

IBCs allow total flexibility with either mixing process. If the requirement for large amounts of product in a Quality Assurance queue has been removed, then the number of IBCs is reduced.

Packing into canning lines at rates in excess of 15 tonnes per hour can be achieved. These machines normally exceed the production rate of the spray dryer, therefore it is questionable whether 3 or 4 smaller and cheaper machines should be used, giving far greater flexibility to production. It is certainly not 'Lean' to run a single, large packing machine for 4 hours and then clean for 6 hours; it would be more efficient to run 2 or 3 machines for 8 hours and then clean for 2 hours.



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### Cleaning

The use of IBCs for the premix and between the Mixer and Packing Machines eliminates the use of static pneumatic systems, which are difficult to clean. Cleaning the IBCs 'off line' allows production to continue. Traditionally, this has been done using water as the washing media, however this is time consuming as a typical wash and dry cycle can be 40 minutes. Air washing of IBCs is now available, which cuts the cleaning time to around 10 minutes, with the benefit that there is no effluent, other than airborne dust to deal with. IBC numbers can be substantially reduced, as they are returned into the process within a matter of minutes.

### Conclusion

If the 'Lean Manufacturing' philosophy is employed post spray drying, the use of an IBC System is paramount to allow:-

- Premixing of the Minors and Micros
- Decoupling of the Mixer to Packer chain
- Batch traceability
- Possibility of mixing the finished product.

There is no reason why facilities cannot manufacture to client's orders or achieve weekly or even daily forecasts. Finished goods warehousing should become a thing of the past, as should large amounts of semi-finished products in a process chain.