Optimising feed mill output

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An efficient feed production line is one that has been designed to handle the types and amounts of feed that need to be produced. Optimising the balance between batch size and batch frequency plays a pivotal role.

Two critical questions need to be addressed when designing the feed production line - "What is the optimum mixer size for the feed mill?" and "How many batches per hour should be produced?" It is important in every case to find a balance between batch size and batch cycle time.

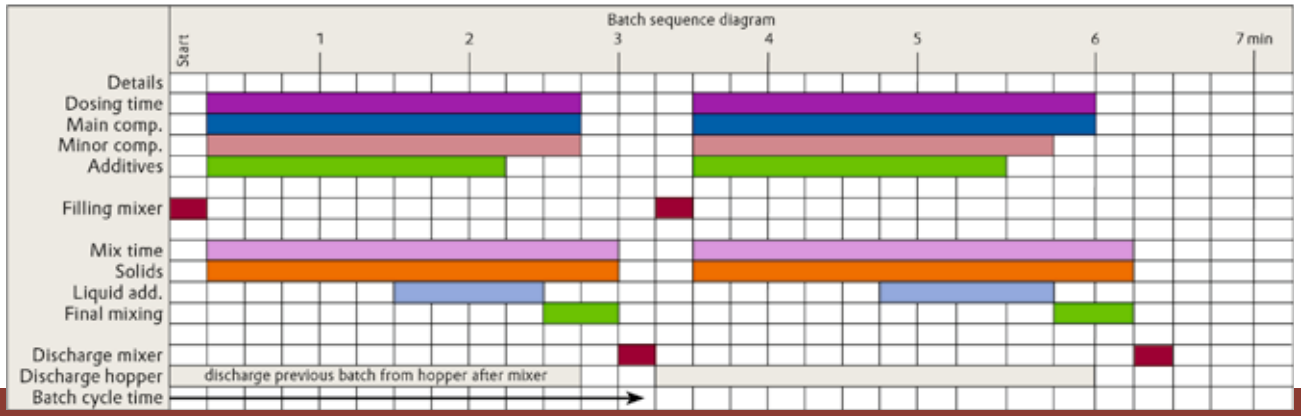
For example, if the aim is to produce 30 tonnes of feed per hour, the production line and equipment could be designed to produce 30 batches of one ton each per hour, 15 batches of two tons each per hour, or 10 batches of three tons each per hour.

Optimum mixer size

Typical mixer sizes in feed mills range from less than one ton to six-eight tons per batch. Most feed ingredients, about 95 percent, are usually added to the mixer as dry bulk. Process steps before and after the weighing and mixing line are virtually continuous and, therefore, the mixer must be able to keep pace with the pellet mills. The capacity of the mixing line is calculated as batch size multiplied by the number of batches per hour. For example, output (ton / hour) = batch size (ton) x number of batches/hours. Each given output can be met by varying the batch size and frequency.

Mix time

Depending on mixer design and quality expectations, mix time may vary from around 60 seconds to four-five minutes, or even longer. While in a double ribbon mixer it takes more than 200 seconds to achieve a good coefficient of variation, a paddle mixer may achieve a comparable level of homogeneity in less than 60 seconds. Considering the time requirements for mixer filling and discharging, total cycle times of two-six minutes might result, which corresponds to 10-30 batches per hour.



Sequence of the batch mixing process

The time sequence of the batch mixing process is illustrated in Figure 1 (below) and can be structured in four blocks:

1. Dosing time
2. Mixer fill and discharge time
3. Mix time
4. Discharge time of bin after mixer

The batch cycle time is the shortest time span in the diagram, after which the mixer may be re-filled. Figure 1 represents a best-case scenario. The batch cycle time in this example is three minutes and 15 seconds, while time for filling and discharging the mixer is 15 seconds each. The total mix time is two minutes and 45 seconds. Half of the mix time is reserved for mixing dry ingredients before liquids are sprayed into the mixer, while the spraying time is one minute with 30 seconds final mix time to incorporate the liquids into the dry mash. Assuming all batches take the same time, more than 18 batches would be produced per hour.

Attention to equipment and processes

Increasing batch sizes obviously has an influence on the size of the equipment involved. For example, the mixer size will increase proportionally with the batch size, just as the output per hour will increase, assuming constant number of batches per hour. There is also an influence of batch size on dosing time, weighing accuracy, as well as mix and spraying time.

Special attention should be given to the spraying time when liquid products are used. With increasing batch sizes, spraying time may increase relative to mix time with negative effects on mix quality. This effect is felt stronger with a modern mixer design and shorter mix times.

One last aspect is related to wear and tear of the equipment; with an increasing number of batches per hour, wear and tear will be increased on all those parts that are activated when changing batches such as: slide gates, pneumatic pistons and drives, and electric drives.

Balance between batch size and cycle time

Here are three options to achieve a mixing line output of 30 ton/hour:

- With 30 batches per hour and 90 seconds total mix time, the percentage of fill and discharge time of 30 seconds would amount to 25 percent of the total batch cycle and mix time would be 75 percent. This timing would imply that liquids are sprayed within less than 30 seconds with a dry mix time of 60 seconds.
- With 15 batches per hour and the same 30 seconds to fill and discharge the mixer, mix time is increased to three minutes and 30 seconds, an increase of 233 percent, even though the number of batches is reduced by just 50 percent. Consequently, the output of dosing equipment might be reduced as well, with positive effects on dosing accuracy and mix homogeneity.
- With 10 batches per hour, mix time would increase to five minutes and 30 seconds which is 366 percent of the 90 seconds in the case of 30 batches per hour. Again, there is a relative gain of productive dosing, spraying and mix time with positive effects on process quality.

All the options are technically possible, and the final choice will need to consider and evaluate factors such as dosing accuracy and homogeneity of the feed, suitability of spraying systems and, ultimately, the capital costs needed for the equipment.