Tips:

How to gain feeding flexibility with a modular feeder

Is your loss-in-weight feeder versatile enough to handle several ingredients, a wide feedrate range, and rapid product changeovers? Read this tip to learn how a modular feeder can provide this kind of flexibility in loss-in-weight feeding applications.

A modular feeder consists of three equipment modules:

- A hopper module equipped with components that supply gentle or strong agitation.
- A digital weigh module, including a loss-in-weight weighing system with load cells inside a NEMA 4 enclosure.
- A feeder module, including a motor, gearbox, and feeding element (a single screw, twin screws, or a vibrating tray). The screws can have any of several diameters and open or closed flights.

Each module can be interchanged on site with another to handle new requirements. This can eliminate the need to buy a new feeder or invest in multiple feeders for one feeding station. Each module's mating components (such as flanges) have standard dimensions that allow quick and easy replacement.

The modular feeder provides several benefits:

- You can custom-tailor your feeder's performance by selecting a combination of modules that allows the feeder to handle a wider feedrate range while maintaining your specified accuracy.
- You can change your feeder configuration on site quickly and easily to accommodate a new ingredient or changes in your ingredient handling characteristics.
- You can remove modules for quicker, simpler cleaning and maintenance, making the feeder suitable for chemical, pharmaceutical, and food applications.
- You can custom-design the feeder to fit limited headroom or other space requirements.
- You can save money by configuring a feeder from standard modules rather than designing a more expensive custom feeder.
- Your operators can quickly learn how to run multiple feeders in your operation when the feeders all use standard modules.

The following installation examples show how modular feeders have met different process needs.[1]

Handling diverse ingredients

A pizza franchiser wanted to expand into making microwaveable frozen pizzas for regional and, ultimately, national markets. The company's design consultant concluded that a sequence of four 2-week-long production runs would let the company cost-effectively produce four planned pizza varieties: cheese, cheese with sliced mushrooms, cheese with diced pepperoni, and cheese with ground sausage.

The consultant predicted that the long uninterrupted runs of each pizza variety on the automated line would save money by requiring only two loss-in-weight feeders for adding toppings: one to add cheese and one to add the other toppings. This would require establishing strict moment-to-moment feedrate accuracy for each topping to ensure the toppings met portion control standards at the line's planned speed.

However, the consultant's development tests revealed that the sliced mushrooms, diced pepperoni, and ground sausage had different handling characteristics that prevented using one feeder for all three toppings. Each topping required a different combination of screw style and hopper agitation to feed accurately at the desired rate:

- The sliced mushrooms fed best on an open-flight screw that didn't crush or degrade the topping. Fortunately, feeding the mushrooms required no hopper agitation, which could have degraded them.
- The diced pepperoni fed best on a large-diameter, closed-flight screw that assisted flow and ensured good screw fill. Guaranteeing gravity flow from the hopper into the screw required only gentle hopper agitation near the screw inlet.
- The ground sausage tended to compact in the hopper under its own weight and cling to either an open- or closed-flight screw. The sausage fed with the desired accuracy only when intermeshing, self-cleaning twin screws and strong hopper agitation were used.

Modular feeders can be quickly reconfigured for dispensing ingredients with different handling characteristics.

Based on the consultant's test results, the pizza maker assumed they would need to buy three custom-designed feeders to handle the noncheese toppings. This was especially disappointing because only one of the feeders would operate at any given time. But the consultant recommended saving the cost of three feeders by installing one modular feeder that could handle all three toppings.

Tests at a feeder manufacturer's lab[2] showed that a modular feeder equipped with two feeder modules (one with a single screw and the other with twin screws) and two hopper modules (one for strong agitation and the other for gentle) could accurately feed the three toppings.

Installing the modular feeder has allowed the pizza maker to economically handle the different toppings. When the line switches to feeding a new topping, the operator simply replaces one feeder module with the other or one hopper module with the other, or both.

Accurately controlling a wide feedrate range

A fertilizer producer developed a high-value additive consisting of a proprietary powdered compound. When mixed with the company's liquid fertilizer, the additive destroys the reproductive ability of certain insect pests that feed on crops treated with the fertilizer.

But to be effective without stunting crop growth, the difficult-to-feed additive must have an accurately controlled concentration in the fertilizer. Depending on the batch's targeted crop, the additive concentration must range from 0.1 to 5.0 percent. This means that the additive feeder requires a 50-to-1 turndown ratio.

During initial tests in a feeder manufacturer's lab,[2] technicians found that a standard loss-in-weight feeder with a single screw and 20-to-1 turndown ratio could accurately feed the additive at the middle and upper ranges. But the technicians had to change to a smaller screw size to achieve acceptable accuracy at the lower feedrate range.

For a standard loss-in-weight feeder, changing the screw size is a common way of achieving feeding accuracy below the feeder's normal operating range. (On a standard feeder with a vibrating tray, you can achieve this by changing out the vibrating drive.) But a screw change requires emptying the feeder. Even if the fertilizer producer installed a cutoff gate in the hopper, some of the expensive additive would spill during the 20-minute screw change. As a result, screw changing was impractical for the producer.

Yet even if the producer could change screws to achieve a wider turndown ratio, the feeder's performance would suffer. At low speed (high turndown), the feeder motor operates at only a fraction of its rated capacity. The feeder is like a race car that's designed to purr along at 200 mph but can only spurt and wheeze at 10 mph. Just as the car engine runs roughly at lower speeds, the feeder motor operates less smoothly — and feeding becomes less accurate — as the feedrate slows.

In subsequent tests on a modular feeder with external, easily accessible gears,[2] technicians demonstrated that *regearing* achieved maximum additive feeding accuracy over a wider operating range.

Regearing requires simply reversing the existing gears or replacing them with gears of a different ratio. The procedure typically takes less than 5 minutes, which is faster than a screw change and eliminates the need for emptying the feeder.

In the tests, the technicians found that simply reversing the gears on the modular feeder provided an effective turndown of as much as 100-to-1 while maintaining feeding accuracy within ±1 percent. Based on the test results, the fertilizer producer installed several modular feeders in its lines feeding the additive. The feeders accurately dispense the additive into the fertilizer.

Speeding ingredient changeovers

A plastics compounder supplies engineered plastic pellets to customers' exacting specifications. The compounder produces the pellets by extruding a base resin with various additives, including pigments, stabilizers, and lubricants. The customers process the pellets to form the final product.

Although the compounder generates more profit from long processing runs, more customers require short custom runs. To provide competitive process rates, the compounder wanted to minimize time between the short runs.

However, cleaning requirements made this difficult. During changeover from one formulation to another, purging ingredients from the line required extensive cleaning. Even a small bit of residue from a highly concentrated pigment or other additive in equipment upstream from the extruder could contaminate the subsequent run. Although the extruder was easy to purge, the standard loss-in-weight additive feeders (including single- and twin-screw and vibrating tray types) had to be disassembled, cleaned, and reassembled.

In a search for easier-to-clean additive feeders, the compounder investigated modular feeders equipped with screws and vibrating trays. A feeder manufacturer[2] demonstrated how a manually operated clamp easily releases their modular feeder's hinged feeder module so it swings away from the hopper module for quick, thorough cleaning. The screw (or screws) can be removed quickly from a screw-type module for cleaning.

Before the module is returned to the feeder, the hopper walls are also easy to access for cleaning. The weigh module has a NEMA 4 enclosure, which permits hosing down the entire feeder without damaging the load cells.

Based on the demonstration, the compounder installed several modular feeders in its extruding line. This successfully reduced time between production runs.

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References

1. Further application details are available from the author.

2. Tests and demonstrations conducted by K-Tron America, Pitman, N.J.

For further reading

Find more information on feeding equipment in articles listed under "Feeders" in *Powder and Bulk Engineering*'s comprehensive "Index to articles," elsewhere in this issue.