

# The Complete Guide to Feed Mill Automation

Everything You Need to Know About Automating Your Feed Mill



# INTRODUCTION

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Feed mill automation can help to substantially increase production, reduce costs, reduce error, increase safety, and generally increase efficiency at your facility. In this guide, we'll discuss complete feed mill automation upgrades from receiving to weighing and batching, mixing, pelleting, and more. We'll also discuss tips that can help you avoid problems and get the most out of your automation upgrades.

There are many opportunities for feed mill automation upgrades, and which are best for you will depend on the equipment and feed you're working with. You may already have some automation upgrades in place, or you may be just starting. Your plant may also have different requirements based on the feed you're working with. This guide provides an overview of general feed mill automation upgrades and helpful tips.

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# Receiving

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The receiving stage is the first opportunity to make automation upgrades at your feed mill. This includes receiving bulk ingredients, as well as minor or microingredients. This also includes routing your ingredients, and tracking them to comply with food safety regulations, such as FSMA, or other food safety regulations at your location.

# Barcode scanning

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With RFID tracking integrated with your automated system, you can be sure ingredients make their way to the right spot, and track them along their journey. If something goes wrong, or a recall is required, you'll be able to reduce the damage by tracking any contaminated ingredients along their exact route.

# Bulk bags

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While major ingredients are generally received in bulk, minor or micro ingredients may be received in 50lb bags, requiring employees to load and unload. Moving to bulk bags and upgrading the system with a bulk bag unloader can decrease employee injuries, speed up production, and lower costs overall.

## **Tips for Safe Bulk Bag Use:**

- ▶ Bulk bags should only be handled by a qualified forklift operator. To prevent the bag from tearing during loading and unloading, use a forklift with rounded or square tines, not sharp tines, to prevent tearing. No one should ever be underneath the bag at any time. This is especially important if you are using a hoist to lift the bag into position. The area underneath the bag should be clearly marked. The frame supporting the bulk bag should also be strong and stable enough to support the system in the long-term. If the bulk bag often loads improperly and it is crooked, the weight will distribute unevenly on the frame, causing it to bend and eventually break. When opening the bulk bag, a worker may cut the bulk bag spout with a knife to discharge it, but simply untying the bag is a much safer practice. Dust suppression should be used to prevent clouds of dust from escaping during opening.

# Automated downstream routing

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Automating the filling process ensures that materials move into the correct bin at the correct time. The filling process isn't stalled or paused if an employee moves away from their station, and automation aids in track-and-trace throughout the facility.

## **Tips for Effective Downstream Routing:**

- ▶ It's important to periodically validate that this automated process is working correctly.
- ▶ Damaged position sensors or level indicators can affect the turnhead's movement or cause the system to think an empty bin is filled

# Storage

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Storage bins should be constructed to promote freeflow of ingredients, eliminate dead zones, and ensure FIFO dispensation. This might mean adding Teflon coatings to prevent sticking/static, using a tapered bin construction or inserts to achieve a 60-80 degree incline and move material through the bin without dead zones.

## **Tips for Safe Ingredient Storage**

- ▶ A zero-entry policy is ideal for preventing deadly entrapment/engulfment situations in bulk silos or similar containers. Workers should never walk on the surface of the bulk ingredients, for any reason. Pest control is also essential for bulk, minor and microingredient storage, however pesticides, herbicides, fungicides etc must be kept a safe distance from the ingredients. Secure storage and raised storage can help to prevent this.



# Weighing and Batching

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Automating the weighing and batching process means quickly, yet accurately dispensing and measuring all ingredients, including macro, minor, and microingredients. Automation upgrades at this stage can significantly save time and increase the quality of the product. To get the most out of these upgrades it's important to consider your facility's design and how you can best coordinate your processes to reduce idle time.

# Scale Hoppers

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The supply hopper conveyor or gate should be designed to dispense material at a rate consistent with the scale's capacity. The material shouldn't move more quickly than the scale can measure, but not so slow that it slows down the process unnecessarily. The hopper should also prevent clogging as well as flushing. Vibration or agitation can prevent clogging, but can cause dust, so dust suppression may be needed.

## **Tips for Scale Hopper Design:**

- ▶ Limited vertical space in some facilities can prevent the use of some types of scale hoppers, like a conical scale. A roll-over tub or a multiple slide gate discharge may be a better choice for facilities with lower ceilings. However, since a roll-over tub discharges material all at once, this will only work if the downstream conveyance or next process can accommodate all materials. If your materials are better suited to pneumatic conveying, like fine powders, then a conical scale hopper will transition into the pneumatic system easier. If you prefer to skip conveyance and discharge into the mixer, a conical scale hopper or roll-over tub will work.

# Macro Scales

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Measuring macro ingredients requires a scale and scale instruments that are fast and durable rather than accurate. While accuracy is important for all the ingredients, macro ingredients usually have high acceptable margins of error. This means the macro ingredient scale must be able to repeatedly withstand heavy loads and measure the load quickly.

## **Tips for Macro Scale Accuracy:**

- ▶ If the macro scales aren't accurate or aren't fast enough to keep up with the rest of the system, the load cell sensitivity or accuracy might not be correct. Interference can also disrupt the load cell, including vibration, heavy impacts, temperature extremes, or moisture, if the load cell is not hermetically sealed. Also, if the scale begins filling before the previous load is released, this can throw off the overall measurement. In this case, check scale gates for leakage.

# Microingredients

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Microingredients might include trace minerals, enzymes, or other ingredients added in very small amounts. For these, accuracy is important, however the system must also be efficient. With proper planning, you can strike a careful balance between speed and accuracy, and substantially increase efficiency.

# Microingredient Measurement

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Automating minor ingredients or microingredients can help to save time substantially and create a more uniform, quality product. Minor or microingredient automation requires bins and scales for each product. If the scales for multiple ingredients can fill simultaneously alongside the macroingredients, all the ingredients can mix together for optimal efficiency.

## **Tips for Accurate Microingredient Measurement:**

- ▶ The scale error, resolution and accuracy must all be aligned, especially for the tight tolerances of micro ingredients.
  - For example, if the scale can accurately measure within +/-5 grams and the required accuracy of the formula is 1%, you won't be able to measure 10 grams of a micro-ingredient, because the possible error will be 50%.
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# Microingredient feeders

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Measuring macro ingredients requires a scale and scale instruments that are fast and durable rather than accurate. While accuracy is important for all the ingredients, macro ingredients usually have high acceptable margins of error. This means the macro ingredient scale must be able to repeatedly withstand heavy loads and measure the load quickly.

# Mixing

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The receiving stage is the first opportunity to make automation upgrades at your feed mill. This includes receiving bulk ingredients, as well as minor or microingredients. This also includes routing your ingredients, and tracking them to comply with food safety regulations, such as FSMA, or other food safety regulations at your location.

# Optimizing the Mixer

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To be considered adequately mixed, you'll need a coefficient of variation of 10 or less. To work properly, a ribbon mixer must be filled to its swept volume. This means the agitator profile determines, in part, how much the machine can mix in one cycle. The mixer profile should not exceed 2.5 times the diameter of the agitator. Longer mixers will be able to mix more volume, but it will take longer, though this won't be a problem if the cycle times align with the weighing time. For lower mixing time and more volume, you'll need to scale up the ribbon mixer profile proportionately.

## **Tips for Mixer Maintenance and Reducing Downtime:**

- ▶ Adding a mixer can create a redundancy in case one mixer suffers a malfunction, and can also speed up production. In addition, preventative maintenance to the mixer can go a long way in preventing costly break-downs. Keep the drive components properly lubricated, monitor and replace seals when necessary, check the tensioning on the drive belt or chain, clean intervals regularly, and check that the mixer and mixer tub are properly aligned, and not scraping, or damaged by any foreign objects.



# Liquid ingredients

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Adding liquid ingredients into the mix, including fats, oils, enzymes, or molasses in the case of some cattle feed, can be difficult. Liquid ingredients will change the characteristics of the mix, particularly adhesion and flowability. Automating the liquid metering process during or just prior to mixing can help to ensure the liquid is added evenly.

## **Tips for Liquid Ingredient Pumps:**

- ▶ Finding the right pump and spray nozzle is essential to reduce maintenance and downtime. It's helpful to have a detailed understanding of the liquid ingredients and the environmental conditions. A centrifugal pump is suitable for light oils and steady flow, while a diaphragm pump or gear pump will perform better when working with thicker liquids and pulsation. A sinusoidal or progressive cavity pump is ideal for very thick or viscous suspensions.

# Coordinating run times

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To coordinate each process, it's important to consider cycle times, filling times, weighing times, and more. This often includes more than the process time itself, but also the time it takes for materials to fill, settle, and discharge. For example, if it takes 30 seconds to fill, measure and discharge each ingredient in a 10 ingredient mix, it will take 300 seconds total to weigh the material in the scale so the mixer could be waiting for the weighing process to complete. If the mixing time only takes 150 seconds, it will be idle half the time. To solve this problem and reach maximum efficiency, you might use two scales, each with 5 ingredients. Automated equipment and controls will make these processes work together seamlessly, with each starting and stopping automatically, at the right time.

# Conveyance

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Getting materials into and out of the mixer requires some type of conveyance. The most efficient type of conveyance is through gravity, however this is not always an option, especially for facilities with low vertical clearance. In these cases, you might use pneumatic, belt or drag conveyors. When using belt or drag conveyors, it's important to prevent contamination from one batch to the next. Materials, powder or coatings that become stuck on the belt can not only damage the belt and cause it to stick or slide, but can also contaminate new material. Use scrapers or brushes to prevent material build-up on the conveyor. It may also be advisable to run a flush material through the conveyor to clean off the residual material.

# Pelleting

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Many feed mills utilize a pelleting process. This process also varies depending on the type of feed you're working with. For this process, it's critical to maintain the right levels of heat and moisture to make sure the feed is properly pelleted, but also safe from bacteria and other pathogens.

# Moisture and Temperature Control

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The pellet mill runs more efficiently if ingredients are gelatinized, so temperatures around 180°F should be maintained. However, this puts the pellet mill closer to plugging, which is an arduous problem to solve, so it's tempting to use lower temperatures. Sensors integrated with your controls and automating control of the dump chute can help to keep the pellet mill at the right temperature and moisture level, while still preventing plugging.

## **Tips for Pellet Mill Safety:**

Running at temperatures that are too low can cause pockets of bacteria to remain, especially in feed with high fat or oil content. Monitoring the pelleting temperatures closely and testing the finished products for dangerous pathogens (most commonly, Salmonella, E. Coli and Listeria) can help to prevent this.

# Post-pelleting Coating

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Some liquid coatings, particularly those with high fat or oil content, can clog spray nozzles frequently, requiring repeated maintenance and reducing product uniformity. A rotary atomizing liquid coating system uses spinning disks to instead turn the liquid coating into a fine mist, which evenly coats the material as it falls through the coating chamber.

## **Tips for Efficient Post-pelleting Coating**

- ▶ Traditional spray coaters can quickly eat into time and cost-savings on even the most efficient systems. Repeatedly unclogging spray nozzles takes time and energy, and the pressure imbalance that can occur when one spray nozzle becomes clogged can damage the coating equipment. A rotary atomizing system like the Mistcoater not only prevents clogs, but also provides even, uniform coating. Since the chamber is fully enclosed, it also prevents overspray, product loss, and time-consuming clean-up.

# Controls

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The system cannot function properly without direction from the right controls. With the right control system and integrations, each of the machines' timings will work together seamlessly, saving time and keeping the mill running smoothly. The right controls and sensors can also help to prevent costly downtime, repairs, and even prevent dangerous hazards.

# PC or PLC

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Whether you are using a PLC or PC, the control system should be able to sample each scale quickly and stop feeders without a long delay, otherwise overfilling may ruin the batch. The system should also be powerful enough to control all scales, feeders, mixers, metered liquids, and other functions with accuracy. Finally, the control system should be enclosed if dust, moisture, heat, vibration or other hazards are a concern. A PC may be used outside the factory floor for extra processing and data storage power, and communicate with a more durable PLC directly controlling equipment.

## **Tips for PLC Reprogramming:**

- ▶ Many controls use proprietary programming languages, and can be difficult to reprogram when adding equipment or changing ingredients. Use a reprogrammable logic controller with a flowchart interface and operators can make changes without the need for specialized computer engineering experience, or the need for a visit from the manufacturer's experts.



# Track and trace

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A PC system integrated with RFID tracking will make track and trace much easier, and make recalls much easier. This system will track ingredients using RFID tags and, with automated measurements, it will report which ingredients went to which finished products. This not only aids in FSMA compliance, but also reduces errors that can occur by mismarking ingredients and allows for almost effortless tracing.

# Sensors

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Shut-down conditions can also be prevented by monitoring vibration or the temperature of the bearings on a machine. For example, if a grinder, conveyor, or another machine is vibrating excessively, this might indicate an unbalanced load, or a foreign object has entered the mix. Sensors monitoring the temperature of bearings can also detect even more urgent issues. If bearings are not properly lubricated, or if they are damaged, affected by a foreign object, or another issue, they can overheat through excessive friction. Where dust and powders are present, can become a fire or explosion ignition device. Temperature monitoring sensors will detect this problem and alert operators before it becomes a hazard.

# Automate Your Feed Mill

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If you're wondering about the most efficient or cost-effective ways to improve your feed mill through automation, we can help. Give us a call to talk to an engineer and discuss automation upgrades that suit your ingredients, products, and facility.

[Request a Quote](#)



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