

Instructions for Fortification Operations (from MI's Fortification Handbook)

The following step-by-step procedures should be followed in setting up and calibrating feeders.

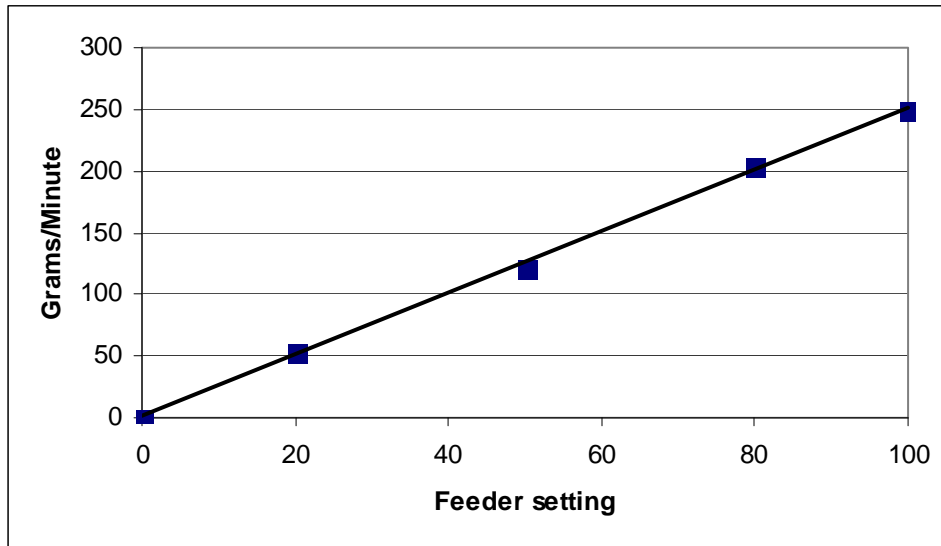
Feeder set up

1. Locate and install the feeder based on optimal mill equipment configuration. Note position requirement on flour collection conveyors for gravity feeder set up. Insure there is adequate mixing of flour after point of premix addition.
2. Install voltage regulator if there is a large variation in electrical voltage (over $\pm 20\%$).
3. Install the electrical interlock system either directly to flour collection conveyor motor or mill control panel.
4. Check to see that light indicating low premix level in hopper is operating.

Feeder calibration

1. Fill hopper about half full with premix to be added
2. Set feeder to maximum discharge.
3. Run feeder for 2 minutes.
4. Weigh premix.
5. Calculate maximum discharge per minute.
6. Optional: repeat above with different speed or percent settings.
7. Using graph paper or spreadsheet program, prepare a chart (see following figure for example) showing feed discharge rate per minute for different feeder speed settings from 0 to 100% of maximum discharge.

Figure 4 Example of feeder calibration curve



Flour Production Rate Determination

Use following procedure to determine actual flour production (not rated capacity) in kg or tons per minute.

1. While the mill is running count number of bags packed per 20 minutes or use on-line flour scale (if one is installed).
2. Calculate the flour production rate using the following formula. This is the actual production rate per minute.

Weight of bags in kg x number of bags per 20 minutes divided by 20 = kg flour per minute.

Premix Feed Rate Calibration

Use this is to determine the feed rate of premix in grams per minute required to fortify the flour at the recommended level.

1. Determine the recommended addition rate of premix (from supplier specifications)
2. Calculate premix feed rate per minute using formula:

Premix Weight in grams per tonne divided by 1000 = grams per kg flour

Premix Weight per kg multiplied by production rate per minute in kg = Premix Weight required per minute.

3. Adjust the control/dial on feeder to deliver weight of premix per minute.

Fortification Operation

1. Start mill up and let run for at least 15 minutes to reach normal production rate.
2. Start feeder at required setting.
3. Ensure feeder hopper contains premix.
4. Conduct check weighing (see following procedure) at start of mill production run and every 2 hours to verify correct addition. Adjust if addition rate is above or below target. Recheck addition rate using check weigh procedure.
5. Visually check feeder during production run to ensure sufficient premix in hopper and that feeder is operating properly.
6. At end of production run turn off feeder before shutting down mill.
7. Maintain production records showing:
 - a. Lot number of premix used
 - b. Check weights

- c. Time of check weighing
- d. Times of production run start and finish

Quality Control in Mill

Quality assurance and quality control for fortification is covered in Section 10. The following steps should be taken to ensure on-line quality control of the fortification process:

1. *Check Weighing:* The weight of premix discharged over a specific time (1 or 2 minutes) is measured and compared to the target weight for the premix.
2. *Iron Spot Test:* The iron spot test is carried out on the flour every 4 hours and at the start and end of each production run. (see Section 10 for method)
3. *Production Records:* Production records of the amount of fortified flour produced should be maintained.
4. *Inventory Records:* Premix inventory and usage records need to be kept.
5. *Premix Usage Reconciliation:* Reconciliation of actual usage versus target need to be kept.

Troubleshooting

Following are some of the problems that can occur with fortification and how to prevent them.

Compaction and erratic flow of premix

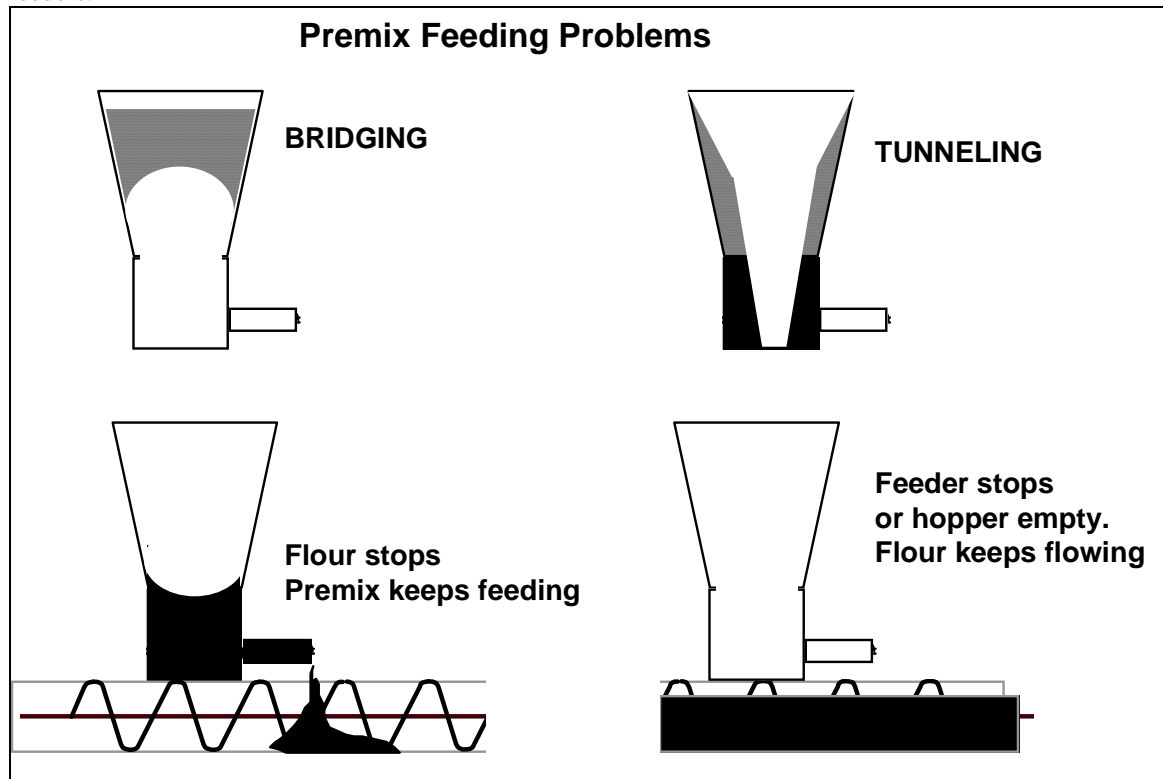
Compaction and stickiness contribute to the material balling-up, bridging or tunneling in the feeder. This can result in variability in the feed rate since a loose material will feed slower in weight per unit time than the compacted material.

Actions:

1. Have premix supplier change type or levels of free-flow agents used or type of diluent used.
2. Install mechanical agitation in premix feeder hoppers.
3. Dilute premix with starch or semolina.

Feeder Problems.

The following diagram shows the potential problems that can be encountered with premix feeders:



Actions:

1. Make frequent visual inspections of feeders.
2. Use a feeder with a different design or mechanical action.
3. Install mechanical agitation device on feeder.
4. Install electrical interlock between mill and feeder controls.
5. Install low-level alarm on feeder hopper.
6. Empty feeders if left unused for any length of time.

Electrical power supply variations

Feeders and controllers must operate in a consistent, uniform manner to ensure adequate fortification of the flour as it is milled. Electrical voltage power fluctuations do occur in many mills due to national grid supply problems and local generator variability.

Actions:

1. Use voltage regulators when single voltage feeder motors have been installed.
2. Use 3 phase motors.

Magnetic separation of iron

Elemental iron powders are attracted to magnets while iron salts (ferrous sulphate and ferrous fumarate) are unaffected. Magnets - made from iron, ceramic and rare earth elements - are used to remove tramp iron from flour. Only rare earth magnets are strong enough to actually pull elemental iron powders out of flour as it passes by the magnet. The magnet quickly becomes saturated with the iron powder and a state of equilibrium is reached causing no additional iron to be removed. Extensive experience and one study have shown it is possible to have magnets in the flour line with no removal or segregation of iron while still retaining the ability of the magnets to remove tramp iron. Tramp iron is thousands of times larger than the added iron powder and will be much more strongly attracted to the magnet. However, if a problem is suspected, first verify this by checking the surface of magnets to see if they hold large amounts of iron

powder. If the magnet has a manual cleaning system, as do most of the new tube magnets, check the amount of iron powder that is removed on cleaning. If there is a problem, consider the following actions.

Actions:

1. Install magnets so that the flour stream acts as a continuous cleaning mechanism as it passes over the magnet.
2. If the iron powder bridges between the magnet tubes, use a magnet system with a larger distance separating the tubes.
3. Place magnets prior to the addition of the premix and rely on sieves to remove tramp iron after that point.
4. Use a non-magnetic iron source.

Segregation and loss of micronutrients

Some of the added vitamins and minerals can be destroyed, segregated or removed from the flour or meal due to pneumatic suction, sieving and other milling processes. This can show up as low values of vulnerable micronutrients (vitamin A, riboflavin) in the flour.

Actions:

1. Confirm that the premix formulation is correct for the type of flour being fortified.
2. Check the dust collector to see if it contains abnormally high levels of iron or vitamins. Riboflavin can give it obvious yellow color, but other micronutrients will have to be analytically tested. If this is the case, alter or remove the pneumatic suction applied to the flour after the point of addition, or fortify the flour at a later stage in the milling process.
3. Make sure the flour is not exposed to high heat (>40°C) or light during pneumatic conveying.
4. Do not run fortified products through purifiers.

