Feed Mill Design

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Planning

- Determine Needs
- Determine Purpose
- Design to Requirements
Product Mix

Bulk Feeds
- Mash
- Pellets & Crumbles
- Textured Feeds
- Miscellaneous
Product Mix

Bagged Feeds
- Mash
- Pellets & Crumbles
- Textured Feeds
- Whole/Processed Grains
- Premixes
- Scratch Feed
Product Mix

Bulk Feeds
- Mash: 8.1%
- Pellets & Crumbles: 20.3%
- Textured Feeds: 48.6%
- Miscellaneous: 1.4%

Total: 78.4%
Product Mix

Bagged Feeds
- Mash: 1.4%
- Pellets & Crumbles: 5.4%
- Textured Feeds: 8.1%
- Whole/Processed Grains: 2.7%
- Premixes: 1.4%
- Scratch Feed: 2.7%

Total: 21.6%
Product Mix

- Bulk Feeds 78.4%
- Bagged Feeds 21.6%

100.0%
Cost Centers

Receiving
Sizing
Flaking/Crimping
Batching/Mixing
Pelleting
Continuous Proportioning Mixing
Bagging
Warehousing
Bulk Loadout
Process Flow Diagram
Production Capacity

Initial:
2000 MTPW / 40 Hr./Wk. = 50.0 MTPH
(1 Shift @ 5 days per week)
Production Capacity

Intermediate:
3000 MTPW / 50 Hr./Wk. = 60.0 MTPH
(1 Shift + @ 5 days per week)
Production Capacity

Final:
5500 MTPW / 96 Hr./Wk. = 57.3 MTPH
(2 Shifts @ 6 days per week)
Design Production Capacity

Required Capacity = 60 MTPH Average

Design Capacity = 60 MTPH/0.80*
Design Capacity = 75 MTPH

* 80% Efficiency Factor
System Capacities

Individual processing systems in the total production process must be able to support the plant production requirements to avoid restricting production rates.
System Capacities

Equipment sizing is based on the production rate(s) required.

As an example:

If the majority of the formulas made use a maximum of 65% ground grains, the grinding equipment should operate at no less than 70% of the plant production capacity.
Bin Types

- Round, Square, Rectangular
- Metal or Steel
Bulk Ingredient Bin Sizing

- Based on Delivery Unit Capacity (Tons/Load)
- Minimum of 1.5 times smallest delivery unit.
- Sufficient capacity to store needed amount between deliveries.
- Sufficient capacity to receive and store total shipment. (ie, unit train)
- Sufficient capacity to meet variations in delivery schedules
- Sufficient capacity to meet daily production needs.
Bulk Liquid Storage

- Tank size based on size of shipment plus reserve.
- Liquid and tank construction must be compatible.
- Locate bulk tank for easy access by supply truck or rail car.
Tote Bags

- Use for micro or low use ingredients.
- Can be used to directly refill micro batching system bins.
- Reduces labor and disposal of paper bags.
Receiving System

Minimum receiving capacity should be 2 times the plant production capacity.

Other factors affecting receiving capacity include:
- Receiving operating hours
- Availability of shipments
- Size of shipment
- Permitted unloading times
Receiving System

- Large pit openings and deep pits can accommodate full truck or rail car loads, but require dust control systems to keep free falling ingredient dust within the pit.
- Dust control system requires 45 cm/m of air per 1 square meter of grate area.
- 3M x 3M grate requires 406 cm/m of air for dust control.
Receiving System

- Alternate receiving system uses high speed unloading equipment and shallow or no pit.

- Trucks and cars are dumped into conveyors and form choke feed stream that produces little dust.
Ingredient Processing

Hammermill

Hammermill capacity should be designed to operate near full motor capacity.

The addition of an air assist system on the hammermill will increase capacity by 10-15% while narrowing the particle size distribution band.
Ingredient Processing
Hamermill

Magnet
Feeder
Grinding Chamber
Ingredient Processing
Hammermill
Air Assist System

- Air required is .007-.009 cubic meters of air per square centimeter of hammermill screen area.
- Air assist forms negative pressure inside hammermill.
Ingredient Processing

Roller Mill

- Requires less energy than hammermill.
- Use 2 or 3 pairs of rolls to grind in steps for better particle size control.
- Does not grind fiberous materials.
Ingredient Processing
Steam Flaking

- Pre-conditioning by adding water prior to steam chest.

- Steam chest should have a minimum of 1 hour capacity at processing rate.
Proportioning Systems

- Batching System (scale hopper – individual ingredient addition)

- Continuous System (continuous feed – simultaneous ingredient addition)
Proportioning Batching System

- Capacity must be fast enough to keep up with mixer cycle times.
- Multiple scale hoppers shorten batching time requirements.
Proportioning Continuous System

- Ingredient addition rates must be closely monitored to assure accuracy.
- Individual continuous scale feeders for each ingredient best.
Mixing Batch System

- Cycle time must be long enough to fully mix dry ingredients and added liquids.
- Cycle time must allow time for filling and discharging the mixer.
- Size of mixer based on required mixing time.
- Standard ribbon mixer requires 3-5 minutes for mixing.
- Twin rotor and special agitator mixers can fully mix in 1-1 ½ minutes.
Mixing Batch System

- Cycle time example:
  - Design capacity = 75 MTPH
  - Assume 4 metric ton capacity mixer
  - Batches per hour = 75/4 = 18.75
  - Cycle time = 60/18.75 = 3.2 minutes
  - Cycle time = 3.2 x 60 = 192 seconds
Mixing Batch System

Cycle time = 3.2 x 60 = 192 seconds

Assumptions
- Mxer fill time = 15 seconds
- Mixer discharge time = 15 seconds

Mixing time = 192-30 = 162 seconds

Mixer must be able to fully mix in 2.7 minutes
Batching Scale & Mixer

- Scale Hopper
- Liquid Manifold
- Mixer
- Inter-vent
- Surge Bin
Twin Rotor Mixer

- Mixer
- Inter-vent
- Surge Bin
Pelleting System
Pelleting System

- Capacity is dependent on drive horsepower.
- Capacity varies by ingredients used, liquid added, and pellet size.
- A minimum of 2 mash bins should be located above mill.
Pelleting System

- Horizontal Cooler
  18-21 cubic meters per minute of air per metric ton of capacity.
  High maintenance.

- Conterflow Cooler
  12-16 cubic meters per minute of air per metric ton of capacity
  Low maintenance.
Bagging System

- Manual bag placement and sealing.
- Requires 1-2 people to operate at capacity.

Manual System
6-8 bags per minute
Bagging System

- Automatic bag placement, filling and sealing.
- Requires restocking of new bags in bag hanger.

Automated System
18-20 bags per minute
Bagging System

- Bagging system capacity based on amount to be bagged and time allowed to do it.
- A minimum of 2 supply bins should be placed above packing system.
- Supply bin capacity based on batch or lot size to be bagged.
Warehousing
> Warehousing

- Allow adequate space for storage of individual bagged products and supplies.

- Products should be arranged so oldest products are used first (FIFO).

- Products should be located in warehouse to minimize travel distances to and from storage area.
Bulk Feed Loadout
Bulk Feed Loadout

Scaled weight required for selling product.

1. Truck scale
2. Weigh Lorry
3. Batch weight
Bulk Feed Loadout Bins

- Number of bulk product bins based on amount of feed made, number of products made, truck capacity, available loading time, scheduling.

- Capacity of bulk product bins based on lot size, batch size or use requirements.
Summary

- The product mix for the facility must be clearly identified and understood.

- Production requirements for each type of product must be determined to identify equipment needed.

- Plant capacities both current and future must be determined to make sure key systems will handle all capacity levels.
Summary

- The process flow of the mill must be defined and drawn before any physical layout of the mill is started.

- Provision for future equipment and systems must be included in initial mill design.