

Equipment Considerations for On-Farm Feed Milling

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■ **Configuring Mill Components and Processing Sequence**

Proportioner Mills

This low capital cost, energy-efficient system was introduced in the early 1970's and was used extensively by western Canadian hog producers over the last 35 years. New technology has resulted in very few manufacturers or service providers for this type of feed mill. Therefore, this mill option will not be addressed further in this presentation.

Separate Grinding (Pregrinding) and Batch Mixing

This is the traditional commercial mill process. Any ingredients that need to be processed are hammered or rolled, then stored in bulk storage from which they are withdrawn in a separate batching and mixing process. This system requires additional storage bins plus another elevation after grinding. Separation of pre-ground ingredients often occurs and this affects consistency of finished rations. Pregrinding offers the lowest electricity cost for particle reduction as it can be done at non-peak times. It is also suited to high capacity facilities (>15 tonnes per hour). However, it usually has the highest capital cost.

Weigh and Grind As You Go

This configuration weighs and processes ingredients in individual ration batches. Batch size is commonly one tonne with some systems processing in larger batches up to three tonnes. There are numerous configurations of this process:

Weigh and Process Ingredients One at a Time

This is basically the same process used by portable mixer-grinders since the 1960's but with a scale(s) added and wheels removed. This process technology is quite old, and should only be considered for lower capacity applications as output rarely exceeds 2.5 tonnes per hour.

As Above but with a Surge Tank

As above but with a surge tank added in front of the hammer mill or roller mill. This allows all preground ingredients (soymeal, canola meal, minerals, vitamins and oil) to be weighed into the mixer while grain is being processed. This significantly increases the capacity of the system to up to 6+ tonnes per hour but requires specialized control systems capable of managing these multiple processes.

Pre-Weigh and Then Process

This is a popular configuration used in the UK in small commercial mills. All ingredients, preground and those needing processing, are pre-weighed into scaled surge hoppers and then processed or dropped into a mixer. This configuration usually requires multiple scales and as with all configurations other than separate grinding (pregrinding) and batch mixing, particle reduction equipment is generally the capacity-limiting component of this process.

Combinations of Above

Numerous combinations of the above can be used to customize a system to meet specific capacity and ration production needs. Properly configured systems can minimize the amount of idle time of any of the key components, and as a result, produce high capacities (up to 15 tonnes per hour) while retaining the benefits of a "weigh and batch as you go" system.

■ Equipment Options

The key considerations when choosing an equipment package are:

- Capital cost per tonne produced annually
- Operating costs per tonne, which incorporates energy efficiency, maintenance costs and output in tonnes per hour of finished feed.
- Quality of finished rations, including ingredient targeted particle reduction, addition accuracy, mixing precision, plus automation and records.

Capital and Operating Costs will be addressed later.

Particle Reduction to Maximize Growth

Most on farm applications have only one milling unit, but recent initiatives to control particle size for maximum pork production efficiency have reopened the debate on which mill or combination of mills is the best. Recommended particle size for hog rations is in the 600 to 800 micron range, and moving to this level from the more common 1050-1100 microns found on many farms can produce savings in excess of \$3 per hog marketed. At the same time, too many fines in a ration (<600 microns) can contribute significantly to stomach lesions and ulcers, often leading to death.

Hammer Mills

This has been the standard for producing hog feed, both commercially and on-farm in western Canada, where barley has been the predominant feed grain. Hammer mills do the best job of reducing barley awns to a size that limits impact on feed density, flowability, and solids accumulation in pits and lagoons. Screen opening and the condition of the screens and hammers determines the particle size of the processed feed. As mills become more automated, the option of changing screens for different ages or classes of hogs becomes prohibitive, so a median selection is often used for all rations. Hammer mills have the lowest initial cost.

Roller Mills

Roller mills are widely used for producing cattle rations and more recently, two-high roller mills have become increasingly popular for controlled reduction of corn and wheat for hog and poultry rations. Capital cost is higher than for hammer mills, and they are considered more energy efficient but when one considers rollers are used on feed grains that are more “brittle”, this benefit can be discounted. Their main advantage is the controlled reduction of the grain to a desired particle size with greater consistency and equipment durability.

Disc Mills

The disc mill is a recently introduced European option for particle reduction. The grain is introduced to a chamber between one stationary disc and one revolving disc. The grain is crushed as it moves from the center to the outside of the chamber through reducing clearance between the discs. Adjusting the distance between the two discs controls the particle size, and this can be automated to allow different clearances for different feed grains in the ration. This is an attractive capability, but adjustment between grains reportedly requires about 2.5 minutes, which significantly increases batching time. As a result, many disc mill owners set their disc clearance based on the ration and run all grain through that same setting, with the same result as running all grains through one size of screen on a hammer mill. The discs are vulnerable to damage if foreign items (stones, sand, and metal) enter the chamber, and

due to the high cost of replacement discs, special cleaners are recommended for grain going into a disc mill. Currently, the capital cost of these units with required accessories can be many times the cost of an equivalently powered hammer mill. In samples collected and tested at an independent lab, the disc mill has not improved the particle size reduction and control compared to a hammer mill. Until this improvement can be verified, this milling option is difficult to justify based on its capital and operating costs.

Mixer Options

Horizontal Mixers

Horizontal mixers have been the standard of commercial feed mills. These are available as paddle mixers, ribbon mixers or combinations of the two. These mixers all have the ability to reach desired mixing accuracy with a relatively short mixing time (3 to 4 minutes). Due to the "lifting and tumbling" action of these mixers, they are not well suited to being mounted on a scale skid, because the fluctuations in scale readings created by this action significantly reduces their accuracy. If stopped while scaling in ingredients, the accuracy returns, but these mixers are difficult to start when full of material. These mixers are best suited to high capacity mixing applications where a scaled hopper to measure pre-processed ingredients is used to supply the mixer.

Vertical Mixers

Vertical mixers have been used extensively in portable on-farm mixers and can achieve acceptable mixing accuracy if the mixing time is monitored and controlled. They are low cost and have low energy requirements. They require about 8 minutes to reach acceptable mixing accuracy when all ingredients are added at once. However, when automated to introduce ingredients as they are processed and to control ingredient addition sequence, they provide consistent, compliant mixing accuracy about three minutes after the last ingredient has been weighed into the mixer. Due to their smooth mixing action, they can be operated on a scale skid without adversely affecting scale accuracy while weighing in ingredients.

Transverse Mixers

Transverse mixers incorporate the low cost and power requirements of the vertical mixers with the mixing capability and speed of the horizontal mixers, and as a result have become the most popular mixer for on-farm applications in western Canada. Although they are significantly more "aggressive" mixers than their vertical predecessor, they still mix smoothly without creating measurable scale fluctuations.

Scale Accuracy

Most systems incorporate scale components that are certified to be usable in “legal for trade” scale systems. However, do not be misled by literature or a sales pitch that “implies” that the feed mill skid is legal for trade as a result of using these scale components. While many of these milling skids are extremely accurate in weighing in ingredients, they

- are not legal for trade systems
- cannot be certified as legal for trade without significant engineering and design approvals, and
- cannot be legally used as the measuring device for selling feed, although this occurs frequently.

Ensure that the increments of the scale indicator support the addition levels of ingredients you expect to use. A scale that measures in tenths of a kilo isn't acceptable if you are adding amino acids or medications, nor is a scale on the main skid that weighs in increments of one kilo satisfactory if you plan to add micro mixes at addition rates of five or ten kilos. The margin for error in the latter example could be as high as $\pm 20\%$.

Level of Automation and Records

Canadian Quality Assurance (CQA) and Canadian Food Inspection Agency (CFIA) regulations both require accurate production records of all feed containing medications. Maximizing your hog production requires reliable records to make good management decisions. The level of automation for on-farm mills is at a comparative level to what is available for commercial mills. Reliable automation allows you to select lower capacity equipment to meet your feed production requirements as it can run unattended while you or your staff complete other duties in your operation. Like all computerized systems, it is important that you select the automation that provides the functionality you need versus “bells and whistles” that look good but offer no financial or management benefit to your operation.

Other equipment Considerations

Macros versus Micros

The ability to fine tune your rations to respond to genetics, health, temperature and nutritional advances is much simpler if you have a micro section as part of your on-farm mill. These systems can be automated to precisely add minerals, vitamin packs, amino acids or medications at levels as low as 100 grams per tonne.

Method of Distribution

The two most popular methods of feed distribution are pneumatics and feed trucks. Obviously, the proximity of your feed mill to the final feed bin destinations combined with a cost-benefit analysis of each option will determine your choice of distribution.

Pellets versus Mash

Numerous studies indicate a feed conversion advantage for pelleted feed, but the cost-benefit calculations have resulted in the majority of hogs produced in western Canada being fed mash rations. On-farm pelleting has never been justifiable due to the high capital, energy and labor requirements. In addition, feeding mash using wet/dry feeders increases intake nearly as much as pellets offered using dry feeders.

■ Start with Tonnage Throughput – Current and Future

The first consideration when planning a mill is the annual tonnage that you expect to produce with this piece of equipment. This is not only to determine the size and durability of your milling system, but it is the key number that will determine the level of capital you can afford to spend on this mill in order for it to be economically feasible. Ownership, or capital costs, are always higher than the operating costs, and it is the combination of the both that affects your bottom line.

Potential for future growth should be identified so that the mill design can easily be ramped up to meet those future requirements. However, be careful not to overbuild for future requirements that are a few years off because you will have to carry a higher fixed cost burden that could affect your ability to execute that future growth.

■ Ingredient Availability

On-farm feed processing is most attractive if you grow feed grain or if you are in an “ingredient rich” area where feed grains are discounted on a basis formula that reflects the distance from a major commercial feed milling center. This basis recognizes the cost of hauling the feed grain from your area to the commercial mill, and then you pay freight again to have that grain hauled back as part of complete feed rations. Eliminating that double freight charge can significantly reduce your feed costs. As well, having a number of feed grain producers in the area can reduce the feed grain storage capacity and amount of security inventory you have to maintain as part of your own feed mill.

■ Capital Costs & Ownership Considerations

Buy Your Own or Buy Theirs

You can buy your own or provide the commercial feed mill with the funds to pay for their mill. The margin you pay on every tonne of feed you buy from a commercial feed mill includes some percentage that supports the ownership or capital cost of that mill. This charge remains, even after the original capital cost of the feed mill has been recovered. Since it is tied directly to each tonne of feed purchased, this “ownership” cost is a variable operating cost to your operation.

Leasing Versus Loan Financing

When analyzing the financial feasibility of an on-farm mill, the simplest way to recognize the ownership cost is to use a monthly lease payment that includes both depreciation and interest costs. Even though lease interest rates tend to be higher than loan or mortgage rates, it makes an evaluation much easier for making your go, no-go decision on the mill, and then you can evaluate lease versus loan financing as a separate process. Also, a lease only needs first and last lease payments up front versus the standard 25% to 30% down payment needed to get a loan to finance your purchase, and this may be an issue when cash flow is pressured by low hog prices or high feed prices. If a positive financial benefit can be identified using a lease, the project will be just as viable using traditional bank financing. Consult your accountant or financial advisor to select the best option for your particular situation.

Ingredient Storage

The capital budget should allow for enough ingredient storage to provide a reasonably secure ability to meet immediate finished feed requirements. Large grain storage assets placed to store home grown feeds or to capture seasonal purchasing opportunities need to be justified by their own financial cost-benefit analysis. Hedging may be considered to achieve similar benefits without investing in the storage facilities.

Acceptable Level of Investment

Ownership cost will be the highest individual cost per tonne of feed produced on the farm. A reliable guideline for capital budget should not exceed \$125/tonne of annual feed usage, which will translate into about a \$17.50 ownership cost per tonne. This ensures your feed processing costs will be competitive with commercial feed costs. High volume producers can have this

cost below \$7.00 per tonne. The majority of on-farm mills generate ownership costs in the range of \$10 - \$12 per tonne.

■ **Operating Cost Considerations**

Utilities

Electricity will be the major utility cost in your milling operation, and actual costs from producers are recording these costs in the \$0.60 to \$1.50 per tonne range, depending on demand, phase, and level of usage.

Repairs and Maintenance

These costs vary depending on whether you are buying both services or performing the maintenance portion yourself. The latter option would increase the labor requirements. It is critical to maintain your hammer-mill/roller-mill/disc-mill as part of a preventative maintenance program if you want to control particle size, capacity and energy costs. Our owners are expensing maintenance ranging from \$0.85 to \$1.30 per tonne.

Labor

Regardless of how automated you make your mill, there is a time commitment to making your own feed, whether you do it yourself or delegate the responsibility to other staff. Some tasks can be performed by external providers (sourcing ingredients, ingredient analysis, ration balancing and nutritional consulting, testing mill accuracy, and maintenance) while others will need to be managed internally (receiving ingredients, housekeeping, record maintenance, and general operation). Many operations are not large enough to justify a dedicated individual to complete these tasks, but it is important that it is recognized as a cost of making your own feed. Our customers are recording labor charges ranging from under \$3 to \$3.40 per tonne.

Ingredient Inventory and Operating Interest

The major portion of your ingredients will be feed grains, and whether purchased locally or through a broker, expect to pay for these ingredients on receipt or shortly after. The inventory level of each ingredient will be determined individually based on:

- Availability
- Economic purchase quantities, considering bulk discounts and freight considerations

- Extended purchasing contract agreements
- Turnover
- Shelf life

Some additional operating funds may be needed to fund the ingredient inventory and if so, an appropriate interest charge recognized in your calculations. An allowance of \$0.50 a tonne should be sufficient.

Government Certification Costs

By December 2007, all feed mills that incorporate medication will need to be licensed by CFIA. This requirement is consistent with the Canadian Pork Industry's initiatives on Quality Assurance and food safety. This requirement should not be considered a restriction to milling your own feed, as proper equipment, operating procedures and record keeping will ensure compliance. The financial benefits of consistent, accurate, well-mixed rations are realized in the performance of your hogs and compliance with CQA and the CFIA licensing process will discipline your mill management to ensure you realize those benefits.

The certification of your feed mill to meet the CFIA regulations will require an external service contract to check scales on your mill. If possible, combine this with other quality control services, like mixer test, particle size analysis, document and record verification, and equipment preventative maintenance. The cost of this service will depend on your volume and location and as a result, will range from \$0.30 to \$1 per tonne.

Cost Summary

Numerous variables influence the total feed production costs using an on-farm feed mill. A properly designed mill system will process your feed at an all inclusive cost ranging from \$13 to \$25 per tonne,

■ Selecting a Supplier

When choosing the designer and provider of your mill, consider the following:

Service Capability

Do they have a qualified service department with at least a call-out program that operates on weekends and holidays.

Knowledge and Experience

Avoid “we can do that” sales pitches. By the time you verify with personal experience if they can deliver to such a claim, it’s usually too late. Ask for demonstration or independent proof of claims.

Get References

Learn from other’s experiences, both good and bad. Ask for ten names and phone numbers of owners so you can independently ask pertinent questions on equipment performance and customer satisfaction. Independent producers should recognize that Hutterite Colonies have a number of additional buying criteria that affect their decision-making, and therefore, may not be the best references, and similarly, independent producer’s references won’t necessarily satisfy the needs of a Colony.

Business Security

Be comfortable that the supplier is financially sound and committed to the feed mill industry for the long term. This is particularly important when selecting an automated control system, as you can expect to need some ongoing technical support for the life of the equipment.

■ Summary

In the past 35 years, on-farm feed processing technology has progressed from portable mixer grinders and proportioner mills to very sophisticated, computerized, weight-based batching systems controlled by automation that rivals anything available on the commercial market. However, regardless of the type of mill you use for particle reduction, or the type of mixer or distribution system you incorporate, the results will reflect the level of management that is applied to the feed milling system. Proper maintenance, monitoring and record keeping are critical. That being said, an on-farm feed mill, properly sized to your operation and feed demands, could be key in your ability to survive and remain competitive in the hog industry in the 21st century.