With escalating feed prices, all aspects of the dairy should be examined for opportunities to improve efficiencies to reduce shrinkage, including losses at the bunk.

What is shrinkage? It simply is defined as the amount of feed delivered to or raised on the farm that is not consumed by the cattle for which it was intended. However, if you don’t measure the shrinkage, you can’t manage it.

Shrinkage Can Be Costly

Feed shrinkage is caused by many factors, including delivery weight errors, wind, birds, rodents, tires, tracked feed, cattle tossing feed, silage bunker losses, feed refusals, bunk heating and spoilage, moisture losses, mixing errors, scale accuracy, push-up blades, comingling of ingredients, feed wasted by feeders and drives, feed bunk management, plastic management, moving/storing feed and water damage.

What is typical? You always are going to have some shrinkage, and, of course, the goal should be to minimize it. For example, in a recent study by an Arizona dairy, the managers measured shrinkage during a 60-day period. They found losses of mill-run feed of more than 16 percent, dry distillers grain of more than 9 percent, commercial soybean meal of more than 9 percent, alfalfa hay of more than 7 percent and corn silage of more than 16 percent.

The nutrition consultant for this dairy helped it reach a goal of only 5 percent shrinkage. The value of all feed lost at 5 percent was nearly $175,000 per year, based on 2012 feed prices, compared with the 12 percent, or nearly $420,000, of lost feed the previous year. That means the dairy saved $245,000 when it put the effort into reducing shrinkage. These losses occurred on a 1,000-cow dairy and included the cost of the feed for the milking herd, dry cows and heifers, but not the calves.

High feed costs and low milk prices increase the importance of reducing the overall feed cost. Lowering feed shrinkage is an economic opportunity for nearly all dairies of any size. Shrinkage comes in many forms, and many factors result in feed waste. Feed shrink can represent from 5 to 15 percent of the total feed cost on the dairy, and wet, as well as the more expensive, ingredients represent the greatest concern for farm managers.
Feed efficiency may be called milk production efficiency or dairy efficiency, but all these refer to the same thing: how efficiently a dairy cow converts feed to milk. Far more important than the name is how this efficiency can affect a dairy’s bottom line.

The potential impact of feed efficiency on the economic performance of the dairy enterprise is undeniable. From the perspective of efficiency, if feed waste is reduced and production (such as milk yield or pounds gained) is maintained, then when waste is reduced, efficiency will improve. Certainly, you have several ways to analyze efficiency, but the critical point to keep in mind is if you can’t measure it, you can’t manage it.

An improvement in feed efficiency for the milking herd can result in three possible scenarios:

1) An increase in milk yield with no change in feed intake
2) A decrease in dry-matter intake (DMI) with no change in milk yield
3) A slight increase in milk yield with a slight decrease in feed intake

Regardless of your approach as a manager, watch for trends in the herd or on a farm through time. Ultimately, you are attempting to reduce costs and increase income.

One simple way to improve feed efficiency is to employ good bunk management.

Table 1. Minimum bunk space requirements and suggested dimensions for post- and rail-feeding fences and waterers.

<table>
<thead>
<tr>
<th>Months of age</th>
<th>3-4</th>
<th>5-8</th>
<th>9-12</th>
<th>13-15</th>
<th>16-24</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Feed always available:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hay or silage</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Mixed ration or grain</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td><strong>All animals eat at once:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hay, silage or ration</td>
<td>12</td>
<td>18</td>
<td>22</td>
<td>26</td>
<td>26</td>
</tr>
<tr>
<td><strong>Height, inches</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Throat</td>
<td>–</td>
<td>14</td>
<td>16</td>
<td>17</td>
<td>19</td>
</tr>
<tr>
<td>Neck rail</td>
<td>–</td>
<td>28</td>
<td>30</td>
<td>34</td>
<td>41</td>
</tr>
<tr>
<td>Maximum water</td>
<td>–</td>
<td>29</td>
<td>31</td>
<td>33</td>
<td>34</td>
</tr>
</tbody>
</table>

Source: P. Hoffman, University of Wisconsin, June 2009
Feed Sorting

Research at the University of Wisconsin has demonstrated that heifers will sort feed very similarly to lactating dairy cows. Heifers, like lactating dairy cows, will choose to consume the shortest particles first and refuse long feed particles.

Because long forage particles and corn cobs generally contain more neutral detergent fiber (NDF) or less energy than small feed particles, such as grain, heifers may consume diets higher in energy than formulated. Likewise, if heifers are allowed to refuse long feed particles, heifers will not reach fill limitations as soon and, subsequently, dry-matter intake will increase.

Hoffman (2007) demonstrated the effects of reducing feed offerings to heifers, forcing the heifers to consume all or most long feed particles. A fair assumption from this research is that anytime a producer allows a dairy heifer to waste feed or throw orts away, it increases cost per pound of gain. The result is a slight decrease in feed intake while maintaining the rate of gain and, hence, improved feed efficiency and decreased cost of gain.

Research data from South Dakota State University (Pritchard 1993) suggest heifers (or steers) should not be overfed on a daily basis. Precisely monitoring and controlling feed intakes and feeding heifers to exact intakes (very minimal feed waste) will reduce feed wastage and increase feed efficiency. The combination of proper bunk design and feeding heifers to exact intakes has been shown to result in 10 to 15 percent improvements in feed efficiency. To feed cattle to exact intakes, a bunk scoring vocabulary should be utilized. A simplified bunk scoring vocabulary is found in Table 2.

The objective of a controlled bunk management feeding system is to feed heifers to a bunk score of 1 every day. If bunks are empty (score 0) or excessive feed is remaining (scores 2 and 3), then feed intakes should be moved up or down in small increments (2 percent daily) to facilitate feeding heifers to a bunk score of 1. This type of feeding management also helps assure heifers consume all large feed particles and feeds such as corn cobs. Full consumption of the diet also assures the formulated diet actually is being consumed in its entirety.

Armentano and Leonardi (1999) and Martin (1999) observed extensive total mixed ration (TMR) sorting in the feed bunk in university and on-farm trials.

The intake of coarse particles appeared to be less during hours 0 to 12 after feeding and more during hours 13 to 24 after feeding. For an on-farm evaluation of sorting, analyzing particle size (Lammers et al., 1996) of the TMR and orts is important.

<table>
<thead>
<tr>
<th>Score</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No feed remaining</td>
</tr>
<tr>
<td>1</td>
<td>A few small particles of feed remaining</td>
</tr>
<tr>
<td>2</td>
<td>Many feed particles remaining, concrete still visible</td>
</tr>
<tr>
<td>3</td>
<td>Large amounts of feed remaining, no bunk concrete visible</td>
</tr>
</tbody>
</table>

Source: P. Hoffman, University of Wisconsin, June 2009

Data on particle size (ANSI, 1988) of TMR and orts and intake indicated that cows sorted against the coarse particles (Armentano and Leonardi, 1999). This was more evident for TMR containing 40 percent than 20 percent (DM basis) alfalfa hay. The variation in sorting among cows was large.
Factors that contribute to sorting include DM content of forage and feed mixes, particle size of forage and mix, cobs present in corn silage, amount of hay added to the feed mix, quality of hay, frequency of feeding, bunk space and feed access time.

If sorting is a problem, then one or more of the following may need to be considered:

- feeding smaller amounts more frequently
- adding less hay to the mix
- processing hay more finely
- using higher-quality hay
- using hay that is more pliable
- processing corn silage
- addition of water to drier TMR
- addition of a liquid molasses product to TMR to bind fines

**Social Effects**

Shaver (2010) addresses social rank. It often is closely related to factors such as age and body size. Therefore, in the grand scheme of management, special attention to first-calf heifers makes sense. As Botheras (2007) puts it: “These heifers often have lower positions in a group’s dominance hierarchy than older cows. Through the effects of aggression at the feed bunk on feeding behavior, it is often found beneficial to manage primiparous cows in a separate group.”

However, research investigating the effects on feeding behavior of housing first-calf heifers alone or together with their older cohorts is limited. Phillips and Rind (2001) found that a mixed group of mature and young cows on pasture grazed for less time than either age grouped alone. Krohn and Konggaard (1979) reported first-calf heifers housed separately from older cows increased eating time and had a higher DMI when housed in free stalls.

In contrast, Bach et al. (2006) observed primiparous cows that were loose-housed and milked with a robotic milking unit ate about 30 minutes longer when housed in a mixed-parity group than young cows housed alone. Obviously, more investigation is required to determine if managing age groups separately has any potential benefits on feeding behavior and DMI.

Yet the fact that smaller animals may be intimidated frequently by larger animals when individual animal weight within the group of heifers varies by more than 125 pounds is well-established. Consequently, intake is compromised and growth rates slowed, regardless of feed quality.

**Meal Pattern**

Ruminal pH declines following meals, with the rate of pH decline increasing as meal size increases and dietary NDF concentration decreases (Allen, 1997). Bunk management practices that cause cows to eat fewer and larger meals more quickly may be associated with an increased incidence of ruminal acidosis and laminitis. Factors that can cause slug feeding phenomena of the TMR include:

- limited bunk space
- limited feed access time
- restricted feeding versus feeding for 5 to 10 percent refusal
- inconsistent feeding schedule, infrequent TMR push-up
- feed bunk competition

The combination of limited bunk space (less than 1.5 feet per cow) and time to access feed (less than 16 to 20 hours per day) is worse than either situation alone. Lock-ups decrease the number of spaces available but increase individual cow space and access. When overcrowding of free stalls coincides with limited bunk space, as is often the case, the potential for laminitis is greater because cows may spend more time standing on concrete than lying in stalls (Colam-Ainsworth et al., 1989).
Feeding the TMR in a drive-by bunk at 10 centimeters [4 inches] above the cow alley rather than in an elevated bunk increases salivary flow and reduces sorting (Albright, 1993), which may help reduce acidosis. Milton (1998) reported that feedlot cattle fed to a clean bunk had reduced frequency of meals (4.5 versus 8.2 meals per day) and greater average meal size (7.7 versus 3.5 pounds per meal) than cattle fed ad libitum. Milton (1998) also reported that deviations of two to four hours from a normal feeding schedule greatly increased the risk of acidosis in feedlot cattle. Frequent TMR push-up may encourage cows to come to the bunk more frequently for smaller meals.

First-lactation heifers fed in a separate group spent 10 to 15 percent more time eating and consumed 0.5 to two more meals per day than herd mates grouped with mature cows (Krohn and Konggaard, 1979). Adverse social effects of moving cows between groups on meal frequency, size and duration may be observed but usually last only a week following the move (Grant and Albright, 1997).

Feeding an ionophore (monensin) to feedlot cattle increased meal frequency and reduced average meal size in two trials reviewed by Milton (2000). Nagaraja et al. (1987) reported that several antimicrobial feed additives, including the ionophores monensin and lasalocid, reduced lactic acid concentrations in vitro through their inhibition of the lactic acid producer Streptococcus bovis.

Dietary supplementation of sodium bicarbonate buffers the decline in ruminal pH that is observed post-feeding (Erdman, 1988). The recommended inclusion rate for sodium bicarbonate is 0.75 to 1 percent of TMR dry matter.

### Feed Wastage Study

While feed losses during feed delivery can be the most significant for many feeds on the farm, they have not been well-documented, with few studies having been done anywhere in the world. In fact, even the methods used to quantify feed wastage rates associated with different feed-out methods have not been well-described.

To address this situation, Dairy Australia’s Grains2Milk program conducted a study of feed wastage rates on 50 commercial dairy farms that used different feed-out methods. Farms involved in the study spanned the six different feed-out methods described by Little, 2009 as used on Australian dairy farms.

1. **Temporary** – Rations are fed on bare ground under an electric fence line, in hay rings or old tractor tires using existing equipment. The cows are not grazing the paddock where fed, and the paddock commonly is referred to as a sacrifice paddock. This method does not have any prepared surfaces for the feed-out area. In this system, the feed-out facility can be moved readily to other sites around the farm as determined by circumstances, such as when the paddock becomes muddy.

2. **On pasture** – Rations are fed in the pasture where the cows are grazing. The feed usually is placed on the surface or under an electric fence using equipment such as a tractor and bucket or a silage cart.

3. **Semipermanent** – Rations are fed on a semipermanent, compacted surface that uses low-cost troughs, such as conveyor belting, second-hand feed troughs or other materials. The equipment used for feed-out is usually a silage cart or a mixing wagon.

4. **Permanent, basic** – Complex mixed rations are fed out using a purpose-built feed-out facility with a compacted surface that has concrete feed troughs or a narrow cement strip under electric wires or cable to prevent cows from trampling the feed. A mixing wagon usually is used for preparation and feed-out.

5. **Permanent, minimal waste, maximum control** – Complex mixed rations are prepared using a mixing wagon and fed using a purpose-built feed-out facility, most likely with a cement surface for the cows and one or more feed alleys. This may be covered with a roof and may incorporate a loafing area or cow stalls. Headlocks or cabling and, in some cases, an electric wire are used to restrain the cows to prevent feed losses due to trampling.

6. **Grain feeding in the milking parlor** – Supplementary grain or pellets are fed during milking. This system is used in conventional herringbone and rotary dairies. A wide variety of systems are found in dairies, ranging from more advanced and costly equipped parlors to rather basic. In the former example, feed allocation can be altered according to the manager’s requirements. In some instances, cows can be fed individually using one or more supplements, and the trough space may be divided among cows using physical barriers (gates or a looped rail) to separate the cows’ heads in the trough. The more basic systems delivered one supplement and/or amount, and the trough area had no physical barriers separating the cows from adjoining feed.

#### Practices that can save feed at the bunk include the following:

**Feed Ingredients/Rations**

- Pay close attention to chop length when cutting hay and silage.
- Protect hay and silage during storage to minimize dry-matter and quality losses.
- Offer fresh, palatable, high-quality feed at all times to the cows, and discard any spoiled or moldy feed ingredients.
- If feeding a partially mixed ration using a mixer wagon, take care to ensure the mix is not under- or overprocessed;
it should be processed according to the manufacturer’s instructions.
• Use ration conditioners such as molasses or oil to reduce fines, sorting of feed and rejection or wastage of feed.

Feeding Infrastructure Design
• Hay feeder design affects the amount of hay wastage. Feeders that encourage cows to keep their heads in the feeder opening, reach for feed and not back away easily, only to drop hay on the ground, are preferred (for example, a slatted bar design on a ring feeder that forces cows to rotate their heads when entering or leaving the feeder).

If using bunks:
• Ensure adequate space for the number of cows (recommend 2.5 feet per cow).
• Aim for a height that allows cows to eat with their head in a natural grazing position – about 4 to 6 inches above the ground – to promote more saliva production.
• Ensure surfaces are smooth to avoid a buildup of waste feed, mold and odors, and ensure they are easy to clean.
• Consider concrete aprons around troughs to prevent mud and slush that contaminates feed and reduces palatability.

Feeding Management
• Offer cows the right amount of feed at the right time of the day; don’t overfill troughs.
• Sequence feeds carefully during each 24-hour period.
• Clean feeding surfaces regularly.
• Consider cows’ social order (aggressive versus timid cows).
• Adapt to prevailing weather conditions.

Helping the Feeder
Minimize Batch Variation
Obviously, the performance of the feeder is an integral component in the accurate preparation of a load of feed. Most of the problems at the bunk are associated with production and procurement challenges before feedstuffs get to the feed yard. So instead of blaming everyone else, communicate! That is the key to team success.

The nutritional consultant, along with the dairy owner or manager, needs to work closely with this individual. Likewise, the feeder must understand how many seemingly small things can have a huge influence on animal performance.

Specifically, feeders need to understand the following areas (Stone 2008):

Basic Feedstuff Issues
• Dry matter – What it is, why it is important and how it should be calculated. Bucholtz (1999) reports that most feeders attending Michigan State University Feeder Schools were uncomfortable with arithmetic and had a poor understanding of the DM concept.
• Face management – These are methods to keep the silage face straight, with minimal disturbance of packed silage, and minimal amounts of loose feed left at the end of feeding.
• Silage collection for load preparation – Silage varies across the vertical face of the silo. Thus, silage used to prepare a load of feed needs to be obtained by uniformly removing silage across the height of the silo.
• Spoiled silage – Poor-quality silage that may be along the top and sides of the silo should be removed so that it is not fed and does not impair animal performance.
• Effect on animal performance – Layers of poor-quality feed in the bunker have potential effects on animal performance.

Load Preparation Considerations
• Ingredient sequencing and what order works best
• Ingredient accuracy when loading the mixer wagon
• Mixer operation, including length of time and run speed
• Minimum and maximum load sizes

The feeder has a difficult, but highly important, position on a dairy. Therefore, time and effort spent to make the job easier to achieve the desired results are resources well spent. Purchased or on-site ingredient mixes can be helpful for improving diet accuracy by minimizing the number of ingredients that must be added to each and every load, thus increasing the feeder’s speed and accuracy.

Even something as simple as printing load sheets that are in a font style and size that is easy to read from a distance and include multiple forage dry-matter increments and numbers of animals per pen can ensure feeders do their job more precisely. Scale displays should be mounted so they are comfortably visible from the loading tractor. Also, the scale should have a remote that allows it to be zeroed after the addition of each ingredient.

Tom Oelberg (personal communication), dairy field technical specialist with Diamond V, notes dairies that do a commendable job of reducing refusals without negatively affecting performance typically follow these critical management steps:
• Measure moisture daily.
• Record weights on refusals.
• Feed pens the same time every day.
• Remove refusals right before feeding so cows are not out of feed.
• Adjust daily feed gradually (0.5 pound of DM/cow/day up or down).
• Communicate pen counts to whoever adjusts load sizes.
• Use feeding software to adjust load sizes automatically and to do split-pen feedings more accurately.
**Take-home Recommendations**

Feed bunk management is important for getting cows to consume the ration that has been formulated and mixed in amounts necessary to support growth and milk yield.

**The following items should be reviewed to identify any factors that may adversely affect intake (Bernard 2008):**

- Fresh feed should be available immediately after milking. Cows typically eat after milking, and this delays lying down so that the teat sphincter has time to close.
- Excess feed refusal is expensive, but slick bunks can reduce milk yield. Refusals can be 4 to 5 percent of the amount offered for fresh and high-producing cows but 1 to 2 percent for lower-producing groups of cows.
- Calculate daily dry-matter intake based on the TMR amount offered, TMR amount refused and ration DM content. Plot the daily intake for each group, along with milk yield, to monitor changes.
- Evaluate the ration in the feed bunk immediately after feed delivery to make sure it was mixed properly.
- Use 100 percent of the feed bunk space for feed delivery.
- Provide 18 to 30 inches of feed bunk space per cow. Fresh cows should have more space than lower-producing cows. Multiple feed deliveries should be made when the amount of bunk space is less than 24 inches per cow.
- Evaluate the ration approximately four to six hours after feeding and before the bunk is cleaned to determine if the cows are sorting the ration.
- Push feed toward cows four to six times each day, depending on the number of feedings, to keep feed in reach.
- During heat stress, feed approximately 65 percent of the ration during the cooler parts of the day and increase the number of feedings.
- If feed in the bunk is heating, add an organic acid to prevent secondary fermentation.
- If bunks are pitted, consider fitting them with a plastic liner or resurfacing them. This will encourage greater intake and reduce spoilage.
- Design feed bunks properly. Dry-matter intake is greater when cows eat with their head down as if they were grazing, curb heights are limited to 21 inches and neck rails are 46 to 48 inches above the floor, providing the cow room to reach feed on the outside of the bunk.

---

**Summary**

Feeding behavior of group-housed dairy cows is influenced by management practices at the feed bunk and factors associated with the physical and social environment. The feeding pattern of group-housed dairy cows is largely influenced by the timing of fresh feed delivery, and the delivery of fresh feed has a greater impact on stimulating cows to eat than does the return from milking. Delivering fresh feed more frequently improves access to fresh feed for all cows and reduces sorting of the TMR. This potentially will reduce variation in diet quality consumed by cows, with benefits for milk production.

The use of headlock feed barriers may reduce aggression at the feed bunk and give subordinate cows more access to feed, particularly if cows are overcrowded at the feed bunk. As commonly stated, the basics of feed bunk management are:

> “Provide the RIGHT feed to the RIGHT cows at the RIGHT time in the RIGHT place at the RIGHT price.”

The same considerations apply to managing replacement heifers and dry cows, whether housed and fed in confinement or on pasture.

---

“Reducing waste through more precise feed delivery can reduce feed costs and add revenue to the dairy enterprise.”
References


All photos by J.W. Schroeder

For more information on this and other topics, see www.ag.ndsu.edu

NDSU encourages you to use and share this content, but please do so under the conditions of our Creative Commons license. You may copy, distribute, transmit and adapt this work as long as you give full attribution, don’t use the work for commercial purposes and share your resulting work similarly. For more information, visit www.ag.ndsu.edu/agcomm/creative-commons.

North Dakota State University does not discriminate on the basis of age, color, disability, gender expression/identity, genetic information, marital status, national origin, public assistance status, sex, sexual orientation, status as a U.S. veteran, race or religion. Direct inquiries to the Vice President for Equity, Diversity and Global Outreach, 205 Old Main, (701) 231-7708.

County Commissions, NDSU and U.S. Department of Agriculture Cooperating.

This publication will be made available in alternative formats for people with disabilities upon request, (701) 231-7881. 300-8-13