Feed Management —Bunker to Bunk

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INTRODUCTION

Feed efficiency is one of the primary factors driving cost of production of beef cattle. Much of the research effort in the United States in the area of nutrition and management is focused on methods and technologies to improve feed efficiency. Numerous articles and factsheets cover the recommendations and ideas that have been developed that impact feed conversion efficiency. Many producers and consultants work very hard to fine tune programs that optimize technologies such as implants, ionophores and beta agonists; nutritional factors such as energy levels, grain processing, protein type and level, minerals and vitamin supplementation; and receiving programs, market timing and co-product feeding. Certainly feed conversion efficiency, defined as dry matter intake per unit of weight gain, is important. However, losses in efficiency before the feed reaches the mouth is often neglected, or at least overlooked. This review will emphasize the opportunities to reduce feed losses through delivery, storage, feed management and feed delivery—bunker (or bin, commodity shed, etc.) to bunk. Some of the information referenced in this paper comes from the dairy industry. With more expensive feeds and more reliance on purchased commodities this area has been a management concern for some time in that industry. As feed costs increase in the beef industry, feed management is increasingly important.

FEED STORAGE AND SHRINK MANAGEMENT

Feed losses can be significantly greater than the typical improvements resulting from the technologies mentioned above. These losses come in several forms including losses during storage, losses during mixing and transportation within the feedyard, losses due to wind and weathering, and losses due to pests including birds and rodents. Table 1 shows typical feeding losses for common feedstuffs that have been observed. For many feedstuffs, the range in storage losses

Table 1. Typical Storage Losses

Feed	Shrink/Loss	Reference
Commercial feed mill–dry feeds	.3-.7%	(1)
Dry commodities–semi loads weighed in, mixing trucks weighed out	2-4%	(1)
Wet and modified distillers grains–weighed at ethanol plant, unloaded and weighed into storage	2-3%	(2)
Wet brewers grains– truck loads weighed in, mixing trucks weighed out	15-20%	(1)
Alfalfa–chopped and delivered or ground at feedlot	4-10%	(1)
Corn silage–stored in bunker	6-18%	(1)
	10-50%	(3)
	5-30%	(4)
High moisture corn	2-9%	(5)
Soybean meal–pushed into commodity shed, potentially windy conditions	8-9%	(4)
Wet and modified distillers grains–stored in bags or bunker (anaerobic), weighed at ethanol plant in and mixing wagons weighed out	7-17%	(2)

References: (1) Kuhl, 2003, (2) Loy et al, 2010a, 2010b, (3) Barmore, 2002, (4) Brouk, 2009, (5) Soderland , 1997

Table 2. Corn Silage Dry Matter Losses in Bunker Silos

Silage Density (lbs. DM/ft3)	DM Loss at 180 days (%)
10	20.2
14	16.8
15	15.9
16	15.1
18	13.4
22	10.0

Ruppel et al. (1992)

can be quite wide. This is due to several management factors that will be discussed. However, for most operations the first step is to identify the shrink of each commodity/feedstuff. This involves measuring shrink by weighing feeds into storage, and into mixing trucks or wagons destined to the feed bunk. Storage losses should be continually monitored, which may include periodic moisture tests. For high moisture feeds in particular, storage losses may partially be due to surface moisture evaporation, which would not contribute to storage losses. Once losses are known, management changes can be implemented that improve storage and feedout losses. These steps are the three M's of feed shrink management—Measure, Monitor, and Manage.

Some of the areas for improvement of storage losses and shrink include the management of silage and silage bunkers, management of wind losses, control of birds and rodents, and tires and tracking (Bourk, 2009).

Silo management: Storage losses in bunker silos are influenced by three main factors—proper moisture, packing density, and feedout procedures. The preferred moisture range is 60%-70% for corn silage, 60%-65% for hay crop silage (Bolsen 2002) and 26%-32% for high-moisture corn (Soderland 1997). If silages are stored wetter than these values some losses due to seeping may occur. At drier levels, packing may be compromised, which could decrease the anaerobic conditions. The feeding value of the silage may be normal outside of these ranges, but with some additional storage losses. Packing density can be improved by using a large, single track packing tractor and packing in layers no more than 6-10 in. Table 2 shows the effect of packing density on corn silage storage losses. Feedout rate should be at least 6-12 in to minimize storage losses. During periods of warm weather, this should be increased to 18 in, especially with high-moisture corn (Bolsen 2002).

Wind loss and weathering: Wind loss can be a significant source of storage and shrink loss in feedlots. Losses during hay grinding and storage are the most obvious, but can be sizable with any fine particle-size dry feedstuff. High-moisture feedstuffs can also benefit from covered storage by reducing weather losses and evaporation through reduced surface area exposed to the air and exposure to precipitation. Shown in Table 3 is the expected storage losses from common commodity feeds stored in open, uncovered piles; commodity sheds; or bulk bins (where appropriate). These numbers can be useful in budgeting potential payback to the construction of feed storage alternatives.

Control of birds and rodents: Starlings can have a significant negative effect on feeding and storage losses. Studies in Kansas have indicated that starlings can consume about 2 lb of feed per month, about 1 lb each from feed and feces. Flock sizes can be several hundred to several thousand. A flock of three hundred thousand birds would consume as

Table 3. Expected Shrink Losses from Common Feeds

Ingredient	Open uncovered piles	Commodity shed	Bulk bin
Alfalfa meal	7-15	5-10	2-5
Alfalfa, chopped	10-20	5-10	--
Bakery waste	8-16	4-7	--
Barley, whole	5-8	4-7	2-3
Beet pulp, dry	12-20	5-10	3-5
Brewers grain, dry	12-20	5-8	2-5
Brewers grain, wet	15-30	15-30	--
Concentrates, typical	4-5	4-5	--
Cottonseed, whole	10-20	5-15	--
Distillers grains, dry	15-22	7-10	3-6
Distillers grains, wet	15-40	15-40	--
Dry meal feeds, typical	5-10	3-8	2-4
Dry grains, typical	5-8	4-7	2-4
Wheat bran	15-28	6-12	2-5
Wheat middlings	14-22	4-9	3-5
Soybean hulls	12-20	5-10	2-5

Kertz (1998)

Table 4. South Dakota 4-point Bunk Scoring System

Score	Description
0 =	No feed remaining in bunk
1/2 =	Scattered feed present. Most of bottom of bunk is exposed
1 =	Thin uniform layer of feed across bottom of bunk. Typically about 1 kernel deep.
2 =	25 to 50% of previous feed remaining.
3 =	Crown of feed is thoroughly disturbed. >50% of feed remaining.
4 =	Feed is virtually untouched. Crown of feed still noticeable

Pritchard (1993)

much as 150 T of feed per month. Control methods that have been tested include habitat management, physical form of feed and bunk management, frightening devices, and toxins. Rodents can be reduced by limiting spilled feed; maintaining clean feed storage areas; reducing weeds, tall grass, and other cover in the feedlot grounds; or through the use of rodenticides.

Tires and tracking: Brouk (2009) lists feed losses associated with handling commodity feeds as another significant item in feeding operations. These losses include feed spilled during handling with a loader tractor or feeder truck/wagon and feed tracked by the tires of this equipment during loading and delivery. Reducing travel distances, premixing certain ingredients or more deliberate equipment operation can improve these losses.

FEED QUALITY CONTROL

Feed quality control begins with the management of storage, handling, and shrink losses mentioned above. Other factors include quality control of incoming ingredients and continual monitoring of potentially variable ingredients.

Quality control of ingredients: The first step in quality control of incoming ingredients is to purchase from a reliable source. This is particularly true for feeds that have increased risk of problems due to variability or short shelf life. Included in this category are liquid feeds, fats, and byproduct feeds. Routine testing at the supplier level and guarantees given by the suppliers have value. A protocol of inspection, testing, and rejection of incoming feeds should be developed.

Continual monitoring of potentially variable feeds: A silo or grain bin may contain feeds from different varieties that were harvested over different periods of time. All feed can change in storage due to evaporation, seepage, wind loss, fermentation, and spoilage. Change in moisture is the biggest risk, so frequent moisture determination allows for ration adjustments that can account for feed variation. Periodic nutrient analysis of other nutrients is also advisable; however, with the right equipment, moisture can be evaluated as frequently as daily. One approach is daily testing using a Koster tester or by the microwave method of the final mixed ration. Any deviation from outside a range of expectations would then trigger testing of individual feedstuffs. A ration that is off specifications in moisture level could be because of a change in ingredient moisture level or a problem in mixing, which will be discussed later in this paper.

Bunk scoring and intake management: Another factor that can affect feed waste is bunk management. Systematic bunk management was popularized in the early 1990s by Pritchard (1993) and his development of the South Dakota bunk scoring system (Table 4). The majority of feedlots in the upper Midwest today utilize some version of this system to make feed delivery calls each day. The well known benefits of utilizing a bunk scoring system include acidosis control and improvements in feed efficiency through reduced cycling in feed intake and slight feed restrictions that can occur when bunk scoring is coupled with a slick bunk protocol. Basically a slick bunk protocol involves managing the feed calls in a way that maintains bunk scores in the 0 to ½ category.

An example of one approach to guidelines based from Krehbiel and Holland (2009) is shown in Tables 5 and 6. This shows suggested adjustments to feed deliveries based on an

Table 5. Daily adjustments to feed delivery

Previous day's PM feed call	Today's AM feed call	Adjustment (lb/head)
Feed remaining	Feed remaining	See table 6
Feed remaining	Slick	+
Feed remaining	Slick (but increased delivery yesterday)	No change
Feed remaining	Slick (but decreased delivery yesterday)	+1/2 of yesterday's decrease
Slick (first consecutive day of slick bunk)	Slick	+1
Slick (subsequent consecutive day of slick bunk)	Slick	+ lb per head regardless of any previous increases

Krehbiel and Holland (2009)

Table 6. Adjustment to feed delivery based on amount of feed remaining

Amount remaining (lb/head)	Adjustment (lb/head)
<1	No change
1	-0.5
2	-1
3	-2
4	-3
5	-4

Krehbiel and Holland (2009)

assessment of bunk scores. Each producer will have slightly different philosophies on how much and how rapidly to make feed changes. Ultimately there will be a tradeoff between feed waste and feed intake.

A contrast to a slick bunk management program would be a maximum intake management program where cattle are fed well above their expected intake to ensure the greatest intake possible. Many dairies are managed this way. Research cattle are also often fed this way to measure differences in treatment effects for feed intake. The excess feed, called orts, are weighed back and discarded. The cost of maximum intake feedbunk management system is additional feed waste.

FEED MIXING ASSESSMENT

In a paper given to the High Plains Dairy Conference, Turgeon (2006), a feedlot nutritional consultant, explained what he called the five R's of feed bunk management. Those five R's are as follows:

Right Feed: Proper formulation of the ration and constant adjustments for moisture variations (Turgeon advocates daily, on-site monitoring for moisture)
Right Pen: Proper pen and bunk space, surface management and water cleaning
Right Amount: Feedbunk management
Right Time: Timely and consistent feeding
Right Way: Reducing variability in feed delivery

He also mentions three C's of feed milling and mixing. Those are consistency, consistency, and consistency. One of the areas where adjustments can be made to improve consistency is through feed mixing. Each mixer is different and may be more effective with alternative ingredient sequences and mixing times.

Also, a periodic test of feed mixing can indicate changes due to wear and needed maintenance. A mixing test is usually done by sampling approximately ten bunk samples as the mixer unloads in the feed bunk. Then each sample is sent for analysis. Compounds analyzed would represent the components of the ration of interest. Typically, samples are analyzed for dry matter, protein, fiber, at least one major mineral, and perhaps a feed additive.

The results of the ten analyses are then used to calculate a coefficient of variation (CV) for each nutrient. If the calculated CV is less than 10%, the general rule of thumb is that mixing is adequate. A good goal would be a CV of less than 5%. A high variation in a specific nutrient or ration component would represent a mixing problem with the feedstuffs that vary most in those nutrients.

Figure 1. Ration in white tray and components in four trays from Penn State Particle separator. (Dahlke and Strohbehn, 2009)

One problem with this method of mixing analyses is the large number of feed analyses required and the potential cost of those analyses. This cost may limit the frequency in which some producers may conduct this analysis. Often mixing issues relate to problems with uniform distribution of feeds that differ in particle size.

One lower cost alternative to evaluation mixing efficiency more frequently is using the Penn State Particle separator, which separates the feed sample into four trays by particle size. Then a CV can be calculated on the percent of the ration in each tray. Often the large particles (top tray) will be unloaded later if there is a problem. An example of this was outlined in a recent Iowa State University study (Dahlke and Strohbehn 2009).

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