Managing Feed Storage, Mixing and Delivery for Efficiency

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Take Home Message

Effect of increasing feed costs is compounded with several sources of inefficiencies during feed storage, mixing and diet delivery. Particular attention should be paid to inefficiency factors that mine away dry matter or nutrient value (wind, precipitation, spillage and feed predation losses), undermine consistency of nutrient delivery (TMR mixer condition, over- or underfilling, and mixing time) or reduce dedicated time to loading, mixing and delivering feed. Of these, feed losses due to predation, spillage, spoilage, or operating TMR mixers with out-of-condition auger or reel shafts. Lack of planning or preparation, which leads to distractions from operator's focus on loading, mixing and delivering feed can also contribute to loss of efficiency by delivering incorrect diet mixes.

Introduction

Corn and other commodity prices, fuel And other input prices have risen dramatically since the middle of the 2001 decade. As the price of feeding and managing cattle increase so too the sophistication of cattle feeders and dairy producers must increase in order to retain and gain efficiency of production. Most discussions on efficiency center on dietary manipulations, use of additives, grain processing and other similar strategies to reducing feed amount and costs per unit product. Several excellent reviews exist that address feeding and management strategies to gain feed conversion efficiency in dairy (Allen, 2000) and the feedlot (Nkrumah et al., 2008; Owens et al., 1997) cattle. Other factors that contribute to efficiency—mostly by retaining value of feedstuffs before they are delivered in the feedbunk—are simply overlooked or not mentioned in many scientific reviews of efficiency because they may appear menial or because the assumption is made that operators must strive to practice feed storage, mixing and delivery to perfection. Nothing can be further from the truth. As most feedlot consultants, feed sales staff, and many other observant visitors, many dairy farms and feedlots could benefit from dedicating time to self-analyze how feed losses during storage, mixing and delivery may be increasing operating costs. The following review of pertinent literature is intended for producers and their consultants to motivate them to initiate an in-depth review and evaluation of factors that may be leading to feed losses during storage, mixing and delivery. Because of declining budgets at all Land Grant universities there is a chronic lack of current information on this subject. Where available, the authors made an effort to use scientific basis to determine feed loss cause and effect.

Feed Storage

Feed losses result from a variety of conditions or situations occurring in feed storage and diet mixing areas. Because in many cases, farm layout evolved over many years, and generations, facility layout is not always the most appropriate for a given cattle-carrying capacity. Therefore, some conditions or situations leading to feed loss can be fixed at little to no cost, while others take more planning and investment to resolve.

TMR mixer loading area. Effective design of a windbreak barrier is needed to prevent wind losses or snow accumulation from the presence of a wind barrier. Figure 1 depicts wind barrier air flow for solid windbreaks. For every 1' in windbreak height a 9' long snow drift is expected affording up to 14' of wind reduction (MWPS, 1987). This is general guideline applicable to solid windbreaks to be considered when building structures to prevent excessive snow and wind in the TMR mixer loading and storage areas. Planning for these windbreaks must involve consideration of other structures already in place which may affect wind flow and effectiveness of windbreaks.

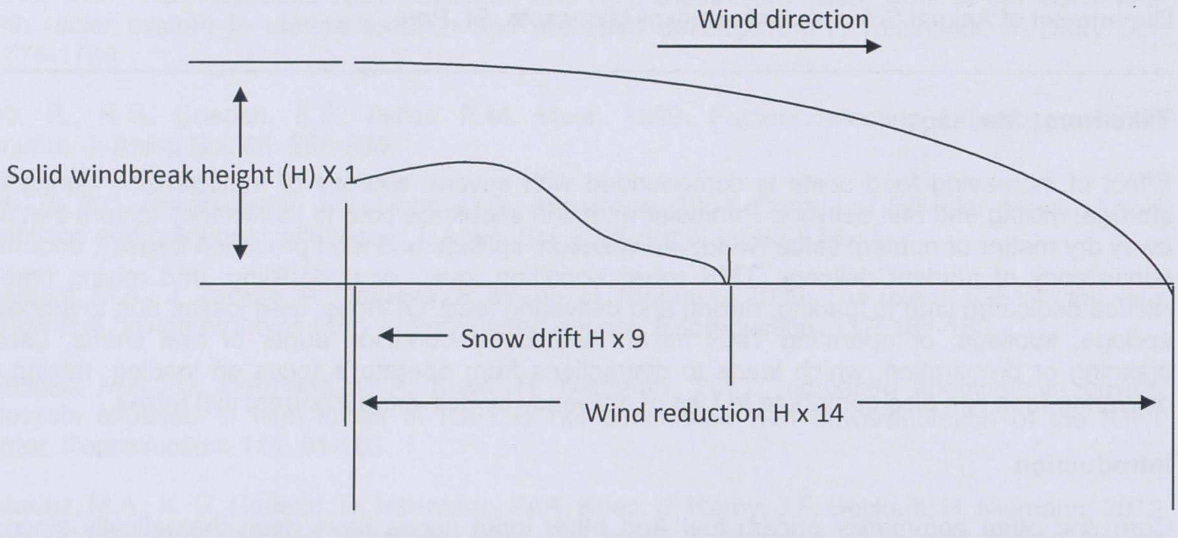

Figure 1. Typical wind and snow patterns. Adapted ((MWPS, 1987) and (Harner et al., 2011).

During ingredient loading of TMR mixers, especially dry ingredients, wind can reduce amount of product that reaches the TMR mixer. Windbreaks for the TMR mixer loading areas must take into consideration the height at which ingredients are loaded, ingredient characteristics (particle size and moisture concentration), wind direction, and existing structures. Thus, on a mostly open area, a windbreak barrier hung as close to the TMR mixer, and with its lowest edge level with the top edge of the TMR mixer, must rise at least 4' higher than the top edge of the mixer to be effective. Liquid supplements are not exempt from effects of wind. Using flexible hoses long enough to reach below the top edge of the TMR will reduce wind loss and guarantee correct product application site.

Feed storage. Using simple approaches to provide surfaces or walls for feedstuff storage is both economical, and protects large investments in feed. Concrete or pavement pads can eliminate feedstuffs mixing with soil or gravel. Old road barriers can be used as an economical solution to contain feedstuffs into piles, preventing mixing feedstuffs during storage or feed preparation, and reducing wind effect losses.

One of the easiest ways to reduce feed loss is to consider ingredient placement relative to TMR mixer loading area. Under most circumstances, it may seem most cost effective to put dry roughages closest to the TMR mixer loading area because roughage is the bulkiest ingredient; but, actually, having high-moisture feedstuffs such as earlage, silage or high-moisture corn closest to the TMR mixer loading area will prevent excessive losses during transport to TMR mixer loading area.

For feedstuffs stored over 250' away from the TMR mixer loading area, hauling heavier loads in the TMR mixer or truck rather than a skidsteer or payloader bucket at a time improves efficiency; this simple action will decrease feeding time and reduce the compounded feed loss effect (from each time a trip is made). Using an estimated 850-lb load in a skidsteer bucket and loss during transport of 1% results in $1.23 loss for every trip made (Table 1). Applying this calculation to a skidsteer bucket loaded with 250 lb hay, and 5% transport loss reduced transport loss in almost half ;

$0.72/trip (Table 1). In addition, feedstuffs that are transported from a distance away by frequent trips (skidsteer or payloader bucket) may increase feed shrink due to spoilage resulting from tracks generated by equipment going back and forth to the feed pile. This action also can add organic matter to gravel driveways and deteriorate their condition.

Table 1. Estimated ingredient loss while hauling feedstuffs in a bucket over long distances (as fed).

Ingredient	Travel loss, %	Skidsteer bucket capacity (lbs as fed)	Ingredient price (ton as fed)	Loss per bucket trip
Mod Distillers	1	1200	$110.00	$0.66
Earlage	1	600	$143.33	$0.43
Corn Silage	1	600	$75.45	$0.23
Corn, cracked	1	850	$290.00	$1.23
Hay	5	250	$115.00	$0.72

Environmental exposure losses must also be considered. Feedstuffs stored with no cover permit direct sunlight or moisture (from precipitation) exposure, which can change dry matter content. Drying due to sun exposure increases dry matter content, leading to inadvertent increases in dry matter offerings. Similarly, moisture added from precipitation reduces dry matter content, and increases nutrient leaching. Mold growth is commonly observed in feedstuffs stored out in the open, because nitrogen, energy and oxygen: conditions supportive of mold growth Nelson (1992) are present in feed and feed piles.

Commodity sheds are an investment to reduce environmental exposure from the sun, rain and snow. When building commodity sheds, it is important to use plastic as vapor barriers in the floor to eliminate moisture. The open face of commodity sheds should be faced south to avoid moisture and other debris from reaching stored feeds.

It is also important to slope pads away from buildings to prevent water pooling inside of bays. Number and size of storage bays and size should take into consideration current and future storage demands. A 12' wide bay or wider should be considered so semi-trailers can easily back up into them. A larger number of smaller bays with the same cubic feet storage capacity as would be provided by a smaller number of larger bays is more desirable. This will permit complete cleanout of one small bay before fresh feed is dumped into a single larger bay preventing spoilage of feed remaining in areas of the large bay inaccessible to payloaders or skidsteers.

Left without repair, holes caused by wildlife or equipment in plastic silo bags can result in spoilage of a minimum of 15% to the entire contents of the bag Muck and Holmes (2001). Considering the costs of concrete, tin and lumber structures often seems prohibitive to many operators. Yet, when compared to ground alfalfa stored outside (Table 2), for which losses were measured at 10% to 20% of stored mass, losses from ground alfalfa stored inside a 3-sided building were only 5% to 10% (Kertz, 1998). At a price of $300/ton, these results would translate to would result savings of $45/ton. Using feed piles quickly (fewer than 7 days), and emptying storage bays completely before placing new product in them is important to prevent spoilage and dry matter losses.

Table 2. Approximate feed loss (shrink) due to storage and handling (% as-fed).

Ingredient	Open, uncovered piles	Covered, three-sided	Closed bulk
Alfalfa, chopped	10-20	5-10	-
Beet pulp, dried	12-20	5-10	3-5
Distillers, dry	15-22	7-10	3-6
Distillers, wet	15-40	15-40	-
Dry grains, typical	5-8	4-7	2-4

Adapted from Kertz (1998).

Feed predation. Rodents and birds attracted to feed storage and preparation areas may appear to be more of a nuisance than a threat to financial losses or cattle (and human) health. However, a study conducted by Bessler et al. (1968) demonstrated that starlings alone can consume up to 1.5 lb of a diet or ingredient per bird during normal monthly occupancy of 80% of the days in a winter month. In the same study, redwing black birds consumed 0.4 lb/bird at an occupancy rate of 50% in a winter month. At an estimated count of 250,000 starlings and 300,000 redwing black birds in a 40-square mile area of 250 feedlots in Colorado, the economic losses represented 743 ton (as-is) at $140/ton or $103,950 in just the months of December to February (West et al., 1968). In dealing with feed predation by most birds such as starlings, scheduling feed delivery time when birds return to their roosting area at dusk (Besser et al.,1968) is a strategy to reduce predation. Greenquist et al. (2004) observed that feeding 30 min before dusk instead of AM feeding, to avoid bird feed predation, had no impact on gain but it led to a reduction of 3.36 lb DMI/hd daily. Although in this study DMI reduction could have also been attributed to greater feed efficiency resulting from less heat load in the summer, and advantageous use of heat load in the winter, evidence from another study supports the possibility that feeding right before dusk prevents feed predation by birds. Delivering a finishing ration calculated to feed 612 cattle into a bunk in an empty pen over a 47-d period resulted in predation losses of 5,130 lb DM (Depenbusch et al., 2011). When expressing this loss as lb DM/hd daily, a total of 0.18 lb DM/hd daily were lost to bird predation. At current prices, this value represents a loss of $0.03/hd/d or $1.41/hd during the experimental feeding period.

Feed consumption by other, larger wildlife may seem small; a single deer was measured by remote sensor video weights to consume 0.5 lb/d (Cooper et al., 2006). When considering size of deer, raccoon and other wildlife populations around livestock operations, the total amount of feed predation by wildlife can become excessive (Table 3).

Table 3. Wildlife grain consumption (lb/day).

	As-fed
Norway rat	0.06
Deer	0.50
Raccoons	0.41
Pigeon	0.08
Starlings	0.06
Redwing Black	0.02

Adapted from Besser et al. (1968), Meyer (1994), and Cooper et al. (2006).

Inclusion of high-fat diet ingredients such as distillers grains or liquid fat are highly attractive to rodents too, especially when spoilage is occurring. Minimizing rodent nesting areas around buildings, silos and under concrete structures where rodents live will contribute greatly to reduce feed losses. Removal of abandoned structures is a great way to reduce rodent housing. Also, keeping green areas around the feed preparation area trimmed short and devoid of dry or liquid feed spills minimizes housing and feeding environment for rodents.

Birds, rodents and other wild animals consume feed, increasing feed costs, but can also infect cattle with diseases such as *E. coli* O157:H7, *Salmonella* spp, *M. avium* subsp. *paratuberculosis,* coccidiosis, chlamydiosis (USDA APHIS 2000). Up to 8.3% of free ranging raccoons, rats and skunks carried *M. avium* subsp. *Paratuberculosis* (Corn et al. 2005).

Feed Mixing

Equipment maintenance. Weekly preventive maintenance of TMR mixers is important to reduce breakdowns and to ensure proper diet mixing. This maintenance schedule should include removal of twine and plastic from mixing augers and shafts. These foreign materials reduce effectiveness of the auger and shaft during mixing, and reduce bearing life. Auger condition was observed (Wager et al., 1993) to interact with mixing time on nutrient variation in resulting mixed diet. Acid detergent fiber in a finishing diet mixed for 4 min in a 4-auger TMR mixer with augers in good condition yielded a coefficient of variation of 5.03%. Mixing the same diet for the same time in the same design TMR mixer with augers in poor condition mixer led to a coefficient of variation of 64.50% (Wagner and Pritchard, 1993).

Knives on augers and kicker plates should be evaluated for wear and fractures. Dull knives will increase mixing time necessary to process forage to proper length. Worn kicker plates leave feed in mixer, which inhibits complete cleanout. Upon inspection, after delivering diets, observation of feed accumulation as a ring on outside perimeter of mixer is an indication that kicker plates should be replaced (Tegeler, 2011). Feed carryover for operations using the same TMR mixer to mix and deliver feed for conventional and natural cattle may affect the operation's ability to remain certified under certain programs.

Scale errors. Electronic scales should be checked during scheduled preventive maintenance, or at least once quarterly. This process need not be complicated. Simply using pre-weighed items commonly found around the farm such as feed bags, tractor weights, or driving the loaded mixer to a semi scale are some practical ways scales can be checked for reliability and accuracy.

Driving TMR mixers over road bumps puts extreme stress on scales. Inaccurate scale readings lead to weighing errors, particularly for operators running custom yards. Similarly, for all operators, inaccurate scales can be costly due to reduced efficiency in cattle or resulting metabolic diseases from feeding incorrect amounts. Ross (2005) discussed two types of scale errors. The first type of error is a scale reading that is incorrect by a consistent amount all the time. The second type of error is a scale reading that has no consistent correlation to the actual weight. This type of error is the most damaging to performance efficiency. Subsequently, (Harner et al., 2011) calculated a table (Table 4) where impact of errors as defined by Ross (2005) is determined.

TMR mixing evaluation. Preventive maintenance is important to ensure optimum mixing. Similarly, TMR loading, mixing and feed delivery are factors affecting efficiency of production.

Under-mixing diets can lead to costly losses in performance due to improperly dosing vitamins, mineral and additives. Every producer must evaluate their TMR mixer with their own unique diets and mixing conditions. One simple mixing integrity assessment is to conduct a Penn State shaker box test to determine the length of mixing time required for a consistent mix across all bunks fed from the same load. Generally, Penn State shaker boxes have three tier trays; the top tier tray retains particles over ¾" size, the middle tier tray retains particles between 5/16" and ¾", while the bottom solid tier tray retains all particles under 5/16".

Table 4. Potential weight (lb) error depending on mixer capacity and scale accuracy.

	Scale Accuracy (%)			
Mixer Capacity (tons)	0.1	0.5	1	2
1	2	10	20	40
2	4	20	40	80
4	8	40	80	160
6	12	60	120	240
8	16	80	160	320
10	20	100	200	400

Adapted from Harner et al. (2011).

Particle size distribution tests should be conducted on weekly to quarterly depending on the size of the operation. This is accomplished by sampling three spots at the beginning, middle and end of the bunk. If a load is used to deliver for multiple bunks, then all bunks should be sampled in this manner to determine particle size uniformity across pens. A 1-lb sample should be put on the top tier tray of the shaker box. Shaking the box entails a motion that pushes the box away from, and then pulls the box back to the operator, five times while facing each of the four sides for a total of 20 shakes. Contents of each tier tray are then weighed. The weight of each tray divided by the total sample collected, and transformed to percentage by multiplying by 100, will yield a percentage representative of each particle size retained by each tier tray. Consistent particle size feed delivery is represented by percentages that deviate less than 10% from the mean, or coefficient of variation (CV, standard deviation divided by the average) for each tier tray within a bunk or within a load. Coefficients of variation ranging from 1% to 2% are expected for new mixers, where loads delivered are mostly corn silage or haylage. Between 3% to 5%, CV are considered acceptable. When CV reach 5% to 7% overfilling the TMR mixer or under mixing may be occurring while CV in the range of 7% to 10% represent possible need to conduct TMR mixer maintenance. Coefficients of variation over 10% reflect issues in need of immediate attention such as augers or screws worn out or out of condition, wrong loading order or other serious issues (Oelberg, 2010).

The use of a Penn State shaker box is a direct evaluation of particle size distribution and consistency of this distribution within or across bunks. However, consistently achieving CV under 5% for particle size distribution is no assurance of adequacy in nutrient concentration delivery. Adequacy of nutrient concentration delivery is measured within and across bunks using specific nutrients expected to reach a target concentration based on weighted average nutrient concentration of each dietary ingredient (precision) or consistently achieving the same nutrient concentration (accuracy), albeit off target. Nutrients chosen to represent mixing precision and accuracy must be nutrients that are typically added in a small inclusion ingredient such as supplements. In the case of feedlot nutrition, monensin has been used to measure mixer precision and accuracy. However, because protein and mineral sources of Ca, P and Zn are often included in the supplement, these nutrients are also good indicators of mixer precision and accuracy. Using candy pieces as markers instead of ionophores or dietary nutrients supplied by supplement is not recommended as they were observed to be unreliable (Johnson et al., 2000).

Using CP, Zn, Ca, and P concentrations of a given swine diet, mixed independently by 25 different experiment stations and sampled at various stages of unloading, a mixer consistence test (Cromwell et al., 2003), revealed that mixer precision and accuracy were independent of mixer type. Only 6 out of the 25 experiment stations mixing the same diet managed to have a consistent nutrient concentration as determined by CV under 5% (Figure 2).

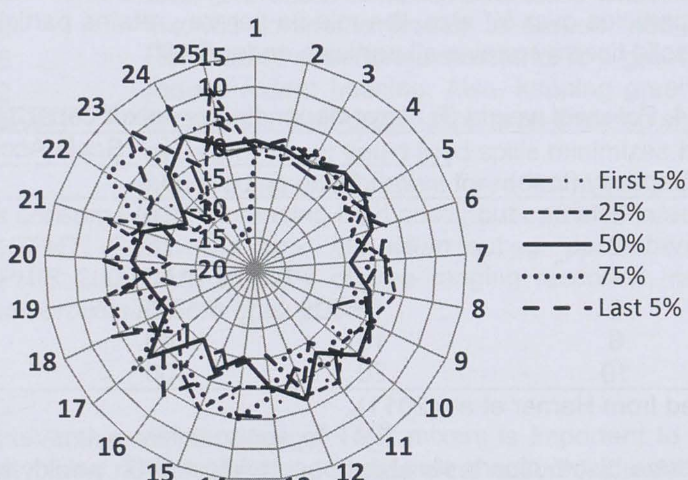

Figure 2. Variation in mixing for sub-samples of a single diet mixed by 25 different research stations. Samples represent the first 5%, 25%, 50%, 75%, and last 5% of load (Cromwell, et al. 2003). Value for each sample site represents the average deviation from expected CP, Ca, P, and Zn concentration.

Mixing time. Mixing time and loading sequence interact to determine consistent mixing. Manufacturers of TMR mixers typically recommend mixing times to range from 3 to 6 minutes (Kammel, 1999). Mixing a diet over 15 minutes relative to manufacturer's recommended mixing time, using a vertical TMR mixer, reduced hay particle size distribution from 33% for particles recovered in the bottom tier tray, to nearly 48% for small particles recovered in the bottom tray (Rippel et al., 1998). In contrast, over mixing by 15 min using a horizontal TMR mixer did not lead to similar reductions in particle size (Rippel et al., 1998).

Over mixing typically happens when attention is taken away from the mixing procedure. Delivering a single diet to multiple pens can also cause over mixing. This is a situation that may occur when multiple pens are fed on a single TMR mixer load. Shaker box tests (Oelberg, 2008) demonstrated a 25% reduction in particle size for pens fed last (Table 5).

Table 5. Impact of multi-pen delivery from a single TMR batch on particle size distribution.

		Penn State Shaker Box tier tray		
Delivery Order	Bunk location	Top	Middle	Bottom
1st Pen	Near end	6.7	51.0	42.3
1st Pen	Middle	6.2	46.9	46.9
1st Pen	Far end	7.1	46.0	46.9
2nd Pen	Near end	3.7	43.9	52.4
2nd Pen	Middle	3.9	42.7	53.4
2nd Pen	Far end	5.2	41.4	53.4

Adapted from Oelberg (2008).

Under-mixing affects variability of fiber concentration within the bunk when feed is delivered before the recommended 3 to 6 minutes of mixing time. Variation in NDF concentration reached 15.6% and 17.8% CV for a 4-auger or reel TMR mixer when the diet was mixed for only 2 min. Permitting mixing time to reach 4 min reduced CV for NDF concentration to 5.0% or 5.7% for 4-auger or reel TMR mixer, respectively.

Various experts agree that counting auger or screw revolutions would better reflect mixing performance. However, to this date, no published report exists of ease and application of revolutions to optimize TMR mixing efficiency.

Ingredient loading. In theory, loading sequence should be only dependent on ingredient characteristics (particle size, moisture concentration) and amount in the mix. However, in practice, other elements such as site and distance to feed ingredient storage play a role in determining loading sequence. For most TMR mixers and diets, the loading sequence that provides the best results includes loading roughage ingredients first. Loading roughage first permits more time for combined action of knives and weight of denser ingredients to reduce forage particle size. Fermented feedstuffs should be added next, followed by wet co-products such as wet distillers grains or corn gluten feed. Dry ingredients including rolled or high-moisture corn and dried or liquid supplements should be added last.

Ingredient landing site in the TMR mixer, particularly for small inclusion ingredients, is also important. Vertical mixers should never be loaded directly over the center screw as small inclusion ingredient or liquids can be caught on top and never be blended. At the same time, when making small diet batch sizes in any mixer type, one must ensure ingredients are not loaded where they stick to the side of the TMR mixer or any other place which might prevent proper mixing.

Mixer capacity. Concerns when handling large volumes of feed, due to inclusion of high-moisture forages or co-products, include overfilling TMR mixers. Kammel (1999) recommended keeping TMR mixer loads to 60% to 90% of the capacity of the mixer to ensure proper mixing. Similarly, vertical TMR mixers were recommended to be loaded at 85% to 95% capacity, and horizontal mixers at 70% to 80% capacity (Tegeler, 2011).

Mixer capacity needs can be calculated by using the bulk density of a ration. A typical 60 Mcal NE_g/cwt finishing diet has a density of 26 lb/ft^3 (Table 6). Dividing batch size by 26 lb will yield cubic feet requirements for TMR mixer. When determining effective TMR mixer size, this value must be, on average, 85% of the overall capacity to maintain proper diet mixing characteristics.

Table 6. Typical Minnesota finishing diet bulk density

	Diet DM, %	Density, lb/ft^3	DM, %
Alfalfa, chopped	8	12	88
Corn silage	12	35	35
Corn distillers, modified	35	40	48
Corn, cracked	41.5	17	88
Supplement, dry	3.5	70	97
Total		26.2	59.8

Inclusion rates. Diets containing extremely low inclusion rates for certain ingredients, particularly dry ingredients, may be difficult to mix properly. Feed additives, vitamins, and mineral mixes must be included in sufficiently large concentrations for the mixer capacity. Ingredient inclusion at amounts less than five times the scale accuracy should simply be avoided (example: If scale accuracy rating is to within 10 lb the smallest inclusion rate for an ingredient would be 50 lb). Simple carriers such as finely processed corn can be used to pre-mix small-inclusion ingredients prior to adding them to the final diet. This will allow for small-inclusion ingredients to be properly mixed into the TMR mixer.

Roughage processing. Roughage processing should also be evaluated closely when using a TMR mixer. Depending on the type of TMR mixer available (horizontal vs vertical), processing hay, straw or cornstalks to desired length before they are loaded into the TMR mixer is critical. The amount of hay that can be incorporated and properly fed is a function of the type of mixer (Salfer, 2001). Vertical mixers are designed to process forage whole using a round or square bale; horizontal mixers are not designed for this. Most auger type mixers can handle a small amount of long hay, less than 5 to 8% of DM (Barmore, 2002). On horizontal mixers unprocessed hay that is loaded into the TMR mixer tends to increase horsepower needs and exerts excess torque on augers and gears as forage balls in and around the augers. Balled forage can lead a diet having imbalanced nutrient supply.

Even though vertical mixers are designed to process roughage without the need of a bale grinder it can be beneficial to have the forage processed prior to loading the TMR mixer. This simple step allows for blending roughages from multiple bales. This is expected to reduce variation and time needed to process a bale in a TMR mixer before adding additional ingredients. Samples from 10 alfalfa bales to be fed sequentially in a dairy operation were analyzed to determine variation between bales (Table 7). Variation above a CV of 5% was observed for NDF (5.8%), ADF (5.6%), K (5.3%), S (7.4%), and Mg (6.0%). Variation for Ca, P, and CP was within 5% CV (J. Jaderborg unpublished data).

Table 7. Average, standard deviation and CV for nutrients analyzed (NIR spectroscopy) from 10 bales designated to be fed at a dairy farm.

	Average	SD	CV
CP	22.87	1.08	4.70%
ADF	28.91	1.62	5.61%
NDF	36.85	2.12	5.77%
Ca	1.56	0.06	3.84%
P	0.36	0.02	4.65%
Mg	0.29	0.02	6.00%
K	2.58	0.14	5.30%
S	0.31	0.02	7.42%

Feed Delivery

At feeding time (actual loading, mixing and delivering) it is important to prevent distractions caused by other time-consuming chores better left to non-feeding times so that all cattle are fed in shortest time using the most consistent method. Checking scales, cleaning magnets, bringing feed from piles to stage near TMR mixer loading area, processing hay or pre-mixing small-inclusion ingredients are examples of other feeding related chores that are better left to be carried out when mixing and delivering feed are the central activity.

Feed delivery approaches must be evaluated to retain cost efficiency and preventing excessive fuel or labor use, or wear and tear on equipment. Regularly while visiting large operations, one finds TMR mixer operators backing up to finish a delivery from the end of a bunk. Every time TMR mixers are backed up to deliver the last remaining weight for a particular pen, time, fuel, and equipment wear increase. In some instances, this may be unavoidable. For larger operations an alternative exists to do a straight pass without backing, and, if the load corresponding to that pen for that feeding time was not fully delivered, adding this amount at a later feeding is also possible. There are other benefits associated with this approach, especially when feeding bulky diets or when bunk capacity is limited.

Planning. Being prepared ahead before the next feeding period is important. This will reduce preparation time and forewarn potential breakdowns, which could delay diet deliveries. Prepare ahead by delivering sufficiently large ingredient piles near TMR mixing areas at least 6 h before needing to mix diets. Grinding roughage ahead of time will reduce feeding time and variability.

Conducting daily inventory checks so ingredients are stocked ahead of time seems obvious, but it gets over looked often. Many ingredients take a few days to receive; therefore, observing feedstuff disappearance is a simple way to prevent loss of continuity in feedstuff supply.

Other items beyond ingredient procurement such as having equipment full of fuel and maintained are supportive of efficient feed preparation. These pre-feeding preparations allow time to resolve issues before the next feeding time rather than during feeding time, which will enhance the bottom-line and reduce stress on operators and their cattle.

Generation a backup plan for emergencies must be a part of the preparatory steps in a feeding operation. Taking the time to think through potential situations such as running out of an ingredient, equipment breakdown, and bad weather, so when they happen a backup plan is immediately set in motion to complete feeding with minimum upset to the normal schedule.

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