Gaining Efficiencies in Feeding & Feed Center Design

Time (Feed Center) vs Shrink (Management)

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What is Shrinkage?

- The percentage of loss of products between manufacture and point of sale is referred to as shrinkage, or sometimes called shrink. The average shrink percentage in the retail industry is about 2% of sales. While this may sound low, shrinkage cost U.S. retailers over $31 billion in 2001 according to the National Retail Security Survey on retail theft. ...

- Note in 2008 it was 1.52% of sales

http://retail.about.com/od/lossprevention/tp/shrink_sources.htm
2013-14 Sources of North America Shrink

- North America Retail Industry Loss ~ $42 billions in 2013-14
- 42.9 % Dishonest Employee Theft
- 37.4 % Shoplifting
- 8.9 % Vendor or Supplier Fraud
- 10.8 % Administrative / Non Crime Losses

Source: Global Retail Theft Barometer 2013-2014
Retail Shrink vs Dairy Shrink

- **DISHONESTY**: Dishonest employee theft vs Scale calibration, inaccurate readings, product delivery
- **INTENTIONAL**: Shoplifting vs Wrong ingredients in TMR mix or storage ingredients in weather
- **FRAUD**: Vendor or Supplier Fraud vs Co Mingling of ingredients, ingredient fraud
- **UNKNOWN**: Administrative / Non Crime Losses vs Unloading, Weather and “good deals”

Source: Global Retail Theft Barometer 2013-2014
What is Feed Shrink?

- Loss of feed ingredients that never have a potential for economic return

- “The percentage of feed on a farm that is not accounted for by the rations by the animals for which it is intended” (Dutton, 1998)

- 8 % Feed Shrink in US Dairy industry cost an estimated $2 billion dollars or about $0.50 /cow/day
Feed Shrinkage

Shrinkage = \frac{W_{int} + Wgt_{pur} - Wgt_{fin}}{Wgt_{used}}

- $W_{int}$ - Initial ingredient weight in storage
- $Wgt_{pur}$ - Weight of ingredients purchased
- $Wgt_{fin}$ - Final ingredient weight in storage
- $Wgt_{used}$ - Actual weight of ingredients used
Challenge with Feed “Shrink”

- Inert material or moisture may mask actual losses
- Normally only an estimate – difficult to measure
- Accounting for refused feed or ORTS
- Scale accuracies and calibrations
- Impossible to know real impact (i.e. cost, cwt)
Feed Cost vs Milk Production at 8 % Shrink

1st 3-4 lbs/cow/dy milk sold pays for daily shrink
Shrink vs Milk Production

- Milk Cost:
  - 15
  - 17.5
  - 20

- Lost Daily Milk Production (lbs/day/cow)
  - 0.0
  - 1.0
  - 2.0
  - 3.0
  - 4.0
  - 5.0
  - 6.0

- Daily Feed Shrink (%)
  - 2%
  - 4%
  - 6%
  - 8%
  - 10%
  - 12%

GOAL vs CURRENT

- Current Milk Cost: 15%-
- Goal Milk Cost: 17.5%-
- Current Milk Cost: 20%-

- Daily Feed Shrink (%):
Shrink Impact on Feed Efficiency

- Ingredient Quality Decline
  - Spoilage
  - Heating
  - Toxins / Fungi

- Ingredient Quantity Loss
  - Wind / Dust
  - Usage / Mixing Error
  - Product Substitution
Feed Center (Time) vs Feed Management (Shrink)

- Feed center – investing resources to construct a new or modify existing feed center to control invisible feed cost with minimal consideration of actual feed cost or labor issues
- Feed management – investing time to understand feed center issues, labor and cost to target investments with high returns in controlling invisible feed cost
# Feed Ingredient Losses

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Uncovered Open Piles</th>
<th>Covered 3-sided Bay</th>
<th>Closed Bin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole Cottonseed</td>
<td>10 – 20 %</td>
<td>5 -15 %</td>
<td>--------</td>
</tr>
<tr>
<td>Dry Meal</td>
<td>5 – 10 %</td>
<td>3 – 8 %</td>
<td>2 – 4 %</td>
</tr>
<tr>
<td>Soybean Hulls</td>
<td>12 – 20 %</td>
<td>5 – 10 %</td>
<td>2 – 5 %</td>
</tr>
<tr>
<td>Dry Distillers</td>
<td>15 -22 %</td>
<td>7 – 10 %</td>
<td>3 – 5 %</td>
</tr>
<tr>
<td>Wet Distillers</td>
<td>15 – 40 %</td>
<td>15 – 40 %</td>
<td>--------</td>
</tr>
</tbody>
</table>
Ingredients Relationship to Finances

- Inclusion of ingredients (excess or too much) which have no economic advantage,
- Inclusion of excess ingredients which negatively impact the NMP (i.e. phosphorus)
- Exclusion of ingredients (not enough) which limit economic potential
- Losses of ingredients for which there is no economic potential
- Inclusion of ingredients without full nutritional value due to decline in quality
Feed Center Management Goals

- Feed cheapest diet each day
- Get the cows fed each day
- Keep feed at the feed bunk / in front of cows
- Drive by and wave at feeders each day
- To deliver each day an economical balanced nutritional diet to maximize the genetic potential of cows
- ????????????????????????????????????
Managing the Feed Center

- Same management level as milk center
  - Employee monitoring
  - Ingredient quality
  - Knowledge of resources
- Targeted investment with high ROI’s
- Measure & Monitor
- Utilize “2X” % of existing data available
- Develop education program for feeders
Feed Center Communication

- Why are ingredients important?
- Why are correct amounts important?
- What are the goals of the diet formulations?
- What are the cost of individual ingredients?
  - $ /cow / day or $ / cwt
- Feeders vs milkers?
- Efficiency & accuracy vs rodeo & time event
- How are records used to monitor performance?
- Buyer & feeder interactions
Step to Consider

- What are the cost of individual ingredients?
  - $/cow/day or $/cwt

- How are records being utilized?
  - When was last time data was really analyzed to make a decision or evaluate the operation

- Begin to focus on top 5 ingredient cost –

- Set a goal to reduce ingredients purchase 2 to 3% assuming stable cow numbers

- Spend time understanding feeder activities
  - Time motion study, data entry, etc.
### 2,000 Cow Dairy Annual Cost of Losses

<table>
<thead>
<tr>
<th></th>
<th>lbs/dy/cow</th>
<th>$/ton</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alfalfa Hay</td>
<td>12</td>
<td>180</td>
</tr>
<tr>
<td>Corn Silage</td>
<td>35</td>
<td>75</td>
</tr>
<tr>
<td>Cottonseed</td>
<td>3</td>
<td>250</td>
</tr>
<tr>
<td>Soybean Meal</td>
<td>4.5</td>
<td>425</td>
</tr>
<tr>
<td>Almond Hulls</td>
<td>6</td>
<td>185</td>
</tr>
</tbody>
</table>
## Causes of Shrink

<table>
<thead>
<tr>
<th>Shrink Issues</th>
<th>Responsible</th>
<th>Problem</th>
<th>Consideration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rainfall</td>
<td>Owner</td>
<td>Spoilage 1 % moisture increase = 1.1 % decrease in dry matter</td>
<td>Store in commodity bay or storage bin</td>
</tr>
<tr>
<td>Solar Radiation</td>
<td>Owner</td>
<td>Drying 1 % moisture reduction = 1.1 % increase in dry matter</td>
<td>Decrease surface area to weight ratio, add bays</td>
</tr>
<tr>
<td>Co Mingling</td>
<td>Owner/Feeder/Buyer/Trucker</td>
<td>Dry matter in ration that does not meet nutritionist's spec</td>
<td>Commodity bays, ingredients in wrong bay, improper handling</td>
</tr>
<tr>
<td>Excessive Purchases</td>
<td>Buyer</td>
<td>Higher shrink / feeder error</td>
<td>Increase storage capacity</td>
</tr>
<tr>
<td>Feed Center</td>
<td>Owner/Feeder</td>
<td>Too small facility / not enough storage and bays / handling</td>
<td>Add bays, direct placement into storage, loader operator</td>
</tr>
<tr>
<td>Mixer Error</td>
<td>Owner/Feeder</td>
<td>Feeder or feed equipment</td>
<td>Scales not calibrated, repairs not made, level site, overloading</td>
</tr>
<tr>
<td>Expansion</td>
<td>Owner</td>
<td>Adding cows without consideration of feed center</td>
<td>Overstocking / expansion, feed center size /equipment stagnant</td>
</tr>
<tr>
<td>Delivery</td>
<td>Trucker</td>
<td>Placement of ingredients, time of day</td>
<td>Unsupervised unloading of trucks, bays not emptied, slab unloading</td>
</tr>
<tr>
<td>Wrong Ingredient</td>
<td>Feeder</td>
<td>TMR mix does not contain appropriate ingredients</td>
<td>Adequate time to load mixer, proper storage location</td>
</tr>
</tbody>
</table>
Focus on Top 5

- Identify non human potential problems
  - Rain, wind, solar, excess purchases, commingling, storage, mixer calibration, loading area

- Identify human potential problems
  - Time to perform task, unloading trucks, carelessness, records utilization

- Sigma Six STEPS
3 – Sided Buildings
Commodity Bays

- Number of bays
- Bay construction
- Improper size
- Weather concerns
Unloading Slabs

- Poor drainage
- Product movement
- Vehicle contamination
- Weather exposure
Understand Terms

- Accuracy is degree of closeness an object’s displayed weight is to actual weight – most TMR scales are +/- 1 %
- Precision is measure of repeatability from multiple weightings of the same object – +/- 1 lb
- Resolution is the smallest increment in applied weight that is detected or displayed on the scale
- Example – 60,000 lb portable truck scale
  - Accuracy – 50 lbs/10,000 lbs – 0.5 %
  - Resolution – 10 lbs
Mixer Accuracy – most are +/- 1%

<table>
<thead>
<tr>
<th>Mixer Capacity (tons)</th>
<th>Scale Accuracy (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
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<tr>
<td>10</td>
<td>10</td>
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<td>20</td>
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<tr>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>400</td>
<td>400</td>
</tr>
</tbody>
</table>

10 out 10 TMR brands did not have (at least not easy to find) information on accuracy, precision or resolution based on trade literature or website resources.
Scale Accuracy – Vita Plus
Rasmussen and Templeton (2015)
https://hoards.com/print-article-17191-permaent.html

- 22 farms - ~50% of mixer scales were accurate

Examples of scale accuracy
- 2 mixers scales had never been calibrated for mixer load cells
  - Large errors in overall weight and dry matter intakes incorrect
  - 6 mixers – binding or load cells not working properly

Recommended TMR system checks
- Frame clean of debris from mud and feed
- Support arms rusted or broken
- Shifts in frame mounts (collars, bolts, bearings, etc)
- Binding - mixer rides on frame and does not allow load cells to flex
- Performance of individual load cells
- Specific to load cell configuration
26 California Dairies with FeedWatch 7
- Five dairies had high accuracy
- Three dairies had poor accuracy

Deviations of target weights for individual ingredient weights ranged from 78.7 % to 21.9 %
- Alfalfa hay, corn silage, canola – poor precision & accuracy
- Rolled corn and almond hulls – high precision & accuracy

Tolerance level deviation of > 2 % in 46 % of ingredients
- 75 % of ingredients loads below targeted weight
Del Rio (2017) recommendations
https://www.progressivedairy.com/topics/feed-nutrition/6-tips-to-improve-feeding-accuracy

- Set goals
- Re-evaluate the use of tolerance levels
- Communication
- Listen to your feeders
- Consider premix
- Check the mixer scale
Mixing Concerns – Ration Composition

- Individual ingredients range from 0.1 to 50% of the diet
  - i.e. corn silage is 50% of ration while soybean meal is 8%
- The higher percentage inclusion rate – the better the weigh accuracy
- Low inclusions ingredients are any ingredients which are less than 10% of the ration (J.P. Harner definition)
- Low inclusion ingredients tend to have higher cost/unit weight
- May be individual or multiple ingredients (i.e. mineral premix)
Trends in Dairy Feed Center Design.

- **Traditional**
  - TMR mix
    - Ingredient 1
    - Ingredient 2
    - Ingredient 3, etc
  - Mineral Pack
  - Liquids
  - Forages
  - Silages

- **Trend**
  - Premix (on or off site)
    - Ingredient 1
    - Ingredient 2
    - Ingredient 3, etc
    - Mineral Pack
  - TMR mix
    - Premix
    - Liquids
    - Forages
    - Silages

- **Future**
  - Micro Mix
    - Mineral 1
    - Mineral 2
    - Mineral 3, etc
  - Premix
    - Ingredient 1
    - Ingredient 2
    - Ingredient 3, etc
    - Micro mix
  - TMR mix
    - Premix
    - Liquids
    - Forages
    - Silages

Must work with nutritionist and mixer company to determine order of adding feed ingredients.
Traditional Dairy Feed Center

TMR Mobile Mixer
Or
Stationery Mixer & Feed Delivery Truck

Soybean Meal
Wheat Bran
Ground Corn
Canola Meal
Salt White
Sodium Biocarb
Limestone
Megalac
Lactation VTM
Grass Silage
Corn Silage

Dairy / Heifer Feed Center
Current Trend in Dairy Feed Center

Centralized Premix Facility

Dairy / Heifer Feed Center

Stationery Mixer

Mill

Whole Corn

Soybean Meal
Wheat Bran
Ground Corn
Canola Meal
Salt White
Sodium Biocarb
Limestone
Megalac
Lactation VTM

Premix
Grass Silage
Corn Silage

TMR Mixer
Future Trend in Dairy Feed Center

Centralized Premix Facility

Dairy / Heifer Feed Center

1. Minimize daily haul distance
2. Space availability for storage
3. Regional cooperators / growers
4. Biosecurity – once silage / forage at dairy only concern is premix delivery truck
Overview of Design Considerations

- Total time to load, mix and unload stationery mixer – 15 -- 20 minutes
- Total time to load, transport and unload feed trucks – 15 -- 30 minutes
- 3,000 cows at 120 lbs/cow/day (as fed) equals 180 tons per day
- Assuming 8 hours per day for feed center
  - Then must average ~ 24 tons / hour from commodity bays to feed bunks
  - Or 2 - 12 T loads per hour
  - Or 30 minutes/(load-mix-deliver-transport)
- Water added to mix influences time requirements

Adapted from D. Greene
Ways to Gain Efficiency

- Have all ingredients in the feed center when making “30 minute loads”
  - Make loads in 8 - 10 minutes
  - 25 – 30 minute turn time
- Use stationary mixers and delivery boxes when distance is an issue
- Use weigh boxes and mobile mixers with high volume and short distance
- Have loading area lower than loader travel area

Adapted from D. Greene
Additional Ways to Gain Efficiency

- Make on farm premixes
- Size your mixer to match your needs
- Mix and deliver full loads when possible
- Use your feeding software to it fullest
- Size your loader bucket to best address your operation

Adapted from D. Greene
4 Zones in Feed Center for Efficiency

- **Zone 1** – TMR mixed in this area –
  - only equipment is loader used to fill stationery or mobile mixer
- **Zone 2** - Ingredient delivery trucks & commodity bays
  - Trucks should not hinder TMR loader from accessing any ingredients
- **Zone 3** – Mobile TMR mixer or feed delivery trucks
  - Non stop travel from feed center to the feed bunks
- **Zone 4** – Exterior access to feed center
  - Ability of ingredient delivery trucks to move from scale to feed center (commodity bays) without compromising bio security protocols

Adapted from D. Greene
Many dairies are able to mix feed 25% faster on the weekend than Monday through Friday due to congestions on Zones 1, 2 and 4.
Centralized Premix Facility

- Isolate delivery trucks from dairy & heifer feed centers
  - i.e. control traffic to minimize off dairy disease transmission
- Inventory control of individual ingredients at one site
  - One set of truck scales and weigh / inventory tickets
- Premix low inclusion ingredients & deliver to multiple sites
- Less complex feed centers at dairies and heifer yard
  - Mixing fewer ingredients - less chance for error
- Specialized feed crew (mix and delivery)
- Micro machine, grain bins & hammer mill added in future
- Flexibility built into the design
  - Changes made at one site with extra flex bays rather than multiple sites

Adapted from D. Greene
Redundancy Plan

- **Traditional**
  - Extra TMR mixer available as back up to TMR mixer
    - Extra could be at nearby equipment dealer, neighboring dairy or on-site

- **Current Trend**
  - Extra TMR mixer serve as back up to TMR mixer & stationery mixer
  - If only one TMR mixer – TMR mixer serves as back up to stationery or vice versa during off hours

- **Multiple Site Feed Centers**
  - One extra TMR mixer is available as back up for other sites
  - Two small stationery mixers at premix center (one operating all times)
    - Initial design 8 to 16 hours per day operation to provide some flex time
  - One small stationery mixer can serve as back up to micro machines
    - Labor intensive to handle bags

Adapted from D. Greene
New Designs: Time Considerations:
1. Exterior access to unloading forages
2. Limit deliveries – 4 to 6 uninterrupted hours
3. 24-30’ wide bays – unload truck & loader access
4. Mixer size based on pen size (100 % loads)
5. Feed splits based on pen sizes / grouping
6. Reduce low inclusion / number ingredients
Every 25 ft of additional travel distance adds 500 ft of travel distance per load (10 ingredients/load)
THANK YOU!