Management Techniques To Improve Silage Quality

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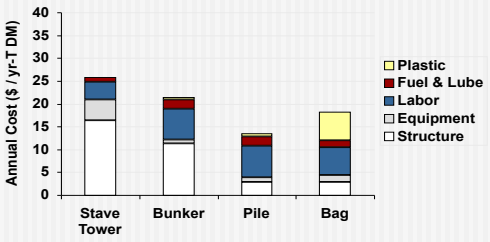
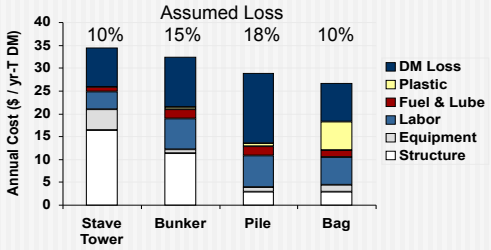
Annual Costs
3100 T DM Stored



Holmes, 1998

Annual Costs Considering Loss
3072 T DM Stored - Good Management



Holmes, 1998

DM Losses From Ensiling:

- Are all digestible
- Reduce the digestibility of the remaining silage

So How Do We Improve Silage Quality?

- Reduce dry matter losses
  - In other words, keep oxygen out!
- Goal-oriented use of silage additives

Scope of Talk

- Packing
- Sealing
- Feed Out
- Additives

PACKING FOR LOW POROSITY

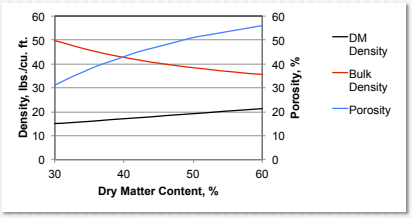
Porosity

- Gas volume surrounding the silage particles
- Oxygen movement into silage proportional to porosity
- So higher the porosity, the faster the rate of spoilage

Factors Related to Density in Bunker or Pile Silos

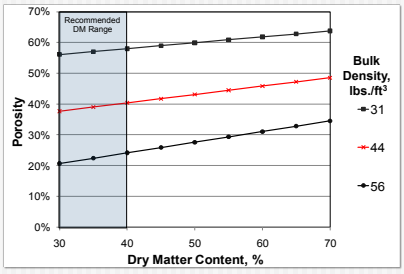
- **Tractor weight**
- **Packing time/ton**
- Layer thickness
- Silage height
- Particle size
- DM content

How Density Changes With DM Content For Identical Packing



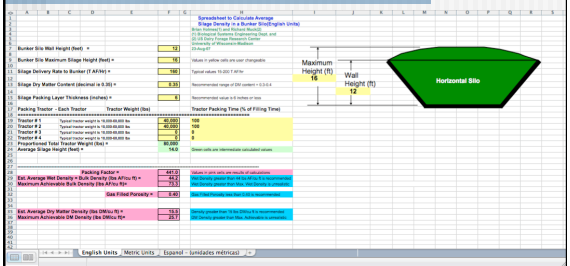
Bottom line: 1) The drier the crop, the more you have to pack to keep porosity low. 2) Bulk density a better target.

Porosity as a Function of DM Content and Bulk Density



Bunker Silo Density Calculator

http://fyi.uwex.edu/forage/harvest/



Goal: Minimum bulk density: 44 lbs./ft.^{3}

Recommendations for Density in Bunkers and Piles

- Minimum bulk density: 44 lbs./ft.^{3}
- Packing tractor(s)
  - Heavy
  - Robust transmission with shuttle shift
  - Blade or bucket
  - Roll-over protection with seat belts
  - 4-Wheel drive or assist
  - Well-lugged tires
- Experienced operators

Recommendations for Density in Bunkers and Piles

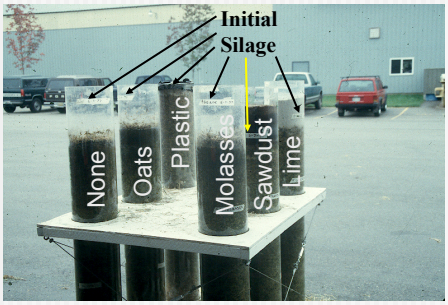
- Progressive wedge
- Thin layers (6 in.)
- Pack continuously
- Uniform coverage
- Drive slowly
- Avoid wheel slip

Packing Operation

With multiple packing tractors, have a plan to work together, avoiding accidents

SEALING

No Good Alternative to Plastic



Types of Plastic

- Polyethylene
  - Varying thicknesses, 4 to 8.5 mil
- Oxygen barrier films
  - Film with 10% or less of the oxygen permeability of polyethylene sandwiched between layers of polyethylene
- Polyethylene cling films, 1 to 2 mil

Polyethylene vs. Oxygen Barrier

- DM losses within 6 in. of the film:
  - 8.5 mil polyethylene ≈ oxygen barrier
  - 6 mil polyethylene: 5 points greater loss
  - 4 mil polyethylene: 10 points greater loss
- Fermentation quality
  - Oxygen barrier better than 8.5 mil poly

Fermentation Products at the Top of Two Bunkers – 8.5 mil White vs. Oxygen Barrier Film

	Depth, in.	pH	Lactic Acid	Acetic Acid	L:A
Haylage					
White	0-6	4.89	2.5	4.0	0.6
Silostop	0-6	4.82	4.5	2.2	2.1
White	6-12	4.82	4.5	1.7	2.6
Silostop	6-12	4.75	3.8	1.4	2.7
Corn					
White	0-6	4.02	3.2	1.6	2.0
Silostop	0-6	3.98	3.0	1.2	2.6
White	6-12	4.00	4.1	1.4	2.9
Silostop	6-12	3.97	3.9	1.2	3.1

Consistently better fermentation quality under Silostop even though no difference in DM loss.

Is Clinginess a Valuable Trait for Covering Bunkers, Piles?

- I haven't seen good comparisons yet.
- Adding a cling film to a standard polyethylene sheet should reduce losses.

Equal Prevention of Spoilage?

- Left: two layers of white plastic and still pitching about 6 in. of spoiled silage
- Right: one layer of white plastic; no visible mold
- Moral: securing the plastic well is equally as important as choosing a good film.

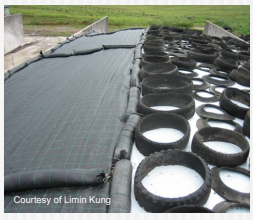
How Many Tires Are Enough?

Enough to keep the plastic from billowing in the wind.

Photos courtesy Brian Holmes, Chuck Grimes

Alternative to Tires

- Woven or mesh tarps anchored with gravel bags
  - At wall
  - At seams in plastic, tarps



Bunker, Pile Covering Problem

- Sides too steep to hold tires in place
- >3:1 (length:height) slope for safe packing and holding tires in place

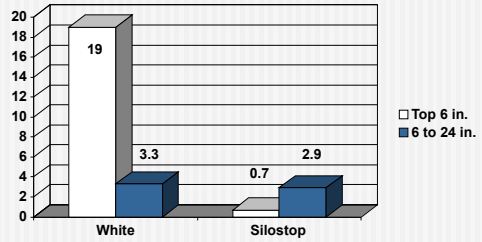
Bunker Covering Problem

- Shoulder spoilage
- For a 100 ft. long, 10 ft. bunker wall: 10 tons dry matter within 12 in. of both walls

Reduced Shoulder Spoilage Using Side-Wall Film

- Side-wall plastic
- Top sheet

Estimated % DM Losses near the Wall - 2 Alfalfa Bunkers



Reduced spoilage near the wall in top 6 in. with Silostop system using side-wall film vs. 8.5 mil white film applied only on the top.

The Plastic's Secure. Can't I Relax?

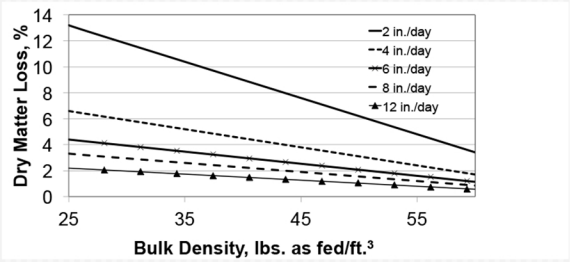
- A major contributor to losses are holes in plastic
- Scout routinely
- Patch with tape made for the plastic

FEED OUT

Goal in Unloading Silos

- Minimize oxygen exposure
- In a well-packed bunker or pile, oxygen moves back approx. 3 feet from face.
- So at 6 in./day removed from the face, silage is exposed to oxygen for 6 days before the cows get the silage.

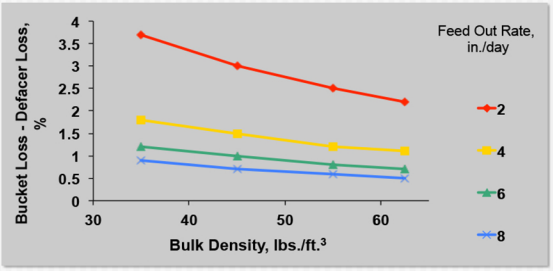
Losses at Feed Out



Feed Out Face

- Smooth
- No loose piles at the bottom to heat overnight

Defacer vs. Bucket: Smooth vs. Rough Face



Muck & Rotz, 1996

Value of a Smooth Face

- Assume:
  - 1% reduction in DM loss (i.e., already good feed out rates)
  - 25 lbs. silage DM/cow/day
  - $200/ton DM
- Savings: ~$9.00/cow/year

Silage Additives

Primary Roles of Additives

- Improve silage fermentation
- Enhance aerobic stability
- Avoid a clostridial fermentation

Homolactic Acid Bacteria

- Shift fermentation to lactic acid
- Lower pH
- Helps avoid clostridial fermentation
- Reduces DM losses
- Some strains have improved milk production more than others but not exactly sure why.

Homolactic Silage Inoculants – ROI

- Improved DM recovery, 2-3% on average
  - Treat 1000 tons as fed: $1000
  - Save 25 tons as fed
  - If each ton saved is worth $60 or more, ROI = 1.5
- Improved animal performance 3-5% when effective
  - Assume 3 lbs. milk/cow/day when effective
  - If effective 50% of the time, 1.5 lbs. milk/cow/day
  - With milk at $16 per 100 lbs., $0.24 extra income/cow/day
  - If cow is eating 60 lbs. silage as fed/day, then inoculant cost is $0.03/cow/day.

Lactobacillus buchneri

- Heterolactic acid bacteria
- Ferments lactic acid to acetic acid
- Improves aerobic stability
- Alternative to the long-standing chemical approaches: propionic acid, acetic acid, potassium sorbate, sodium benzoate

L. buchneri Inoculants – ROI

- Improved DM recovery, 1-2% on average
  - Treat 1000 tons as fed: $1500
  - Save 15 tons as fed
  - If each ton saved is worth $60, DM recovery alone won't pay for using the product: $900 benefit at a cost of $1500.
- Improved animal performance
  - If silage would be cool normally, **no** animal benefit to using
  - If silage would be heating normally, assume a 4 lbs. DM reduction in TMR intake and a 3 lbs. loss milk/cow/day
  - Avoidance of heating gives $0.48 more milk income/cow/day with $16 milk at a cost of ~$0.045/cow/day, for a cow eating 60 lbs. as fed silage.

Combination Inoculants

- L. buchneri or L. brevis plus homolactic acid bacteria
- Improve silage fermentation and aerobic stability
- However, not for avoiding a clostridial fermentation

Combination Silage Inoculants - ROI

- Most expensive inoculants, ~ twice that of standard homolactic inoculants
- So DM recovery won't be enough to cover the cost of these products
- A positive ROI depends on getting more milk.

Which Additive Should You Use, If Any?

Which Additive Should You Use?

Choice of additive depends on:

- Crop to be ensiled
- Goals

Goals An Additive May Address

- Aerobic stability problems
- Making a good silage better
- Avoiding a clostridial (butyric acid) silage

Aerobic Stability Problems

- Is the problem a management problem that can be solved without an additive? – density, feed out rate, sealing
- Corn Silage:
  - *L. buchneri* is a good alternative to propionic acid or other chemicals
    - Safer to handle
    - Competitive cost
    - Similar effects on DM recovery, animal performance
    - If you have multiple silos, use only on the silage to be fed in warm weather

Aerobic Stability Problems

- High Moisture Corn:
  - *L. buchneri* is a good alternative to propionic acid
  - However, if HMC is <25% moisture, inoculants less likely to succeed; propionic acid would be a better choice

Aerobic Stability Problems

- Alfalfa:
  - Below 45% DM, stability problems are almost always related to management issues
  - Above 45% DM, you have a number of options:
    - Feed out in winter
    - Homolactic inoculants for sporadic warm weather issues should make small improvements in stability
    - *L. buchneri* or combination products for more consistent warm weather issues

Issues with L. buchneri

- However, slow grower that takes 45-60 days storage time before having much effect
- So, not an answer to heating problems with immature silage; propionic acid is the best solution for this case
- Not a solution at feeding time

Make a Good Silage Better

Homolactic inoculants are the best route to improve DM recovery, animal performance

- Good fit for hay crop silages, HMC
- Best success under:
  - Good harvesting conditions
  - Very good silo management

Make a Good Silage Better

- Corn Silage:
  - Homolactic inoculants can reduce aerobic stability
  - Inconsistent success rate
  - Best fit: silage to be fed in cool weather
- HMC:
  - Much higher success rate than corn silage
  - Best fit: HMC to be fed in cool weather

Avoid a Clostridial Fermentation

- Typical situations where a clostridial fermentation is possible:
  - Rain-damaged hay crop
  - Ensiling hay crop on the wet side to avoid rain damage

Steps to Avoid Clostridial Silage

1. Use a homolactic bacterial inoculant to get pH as low as possible
2. Ensile separately in a pile or bag
3. Feed out early. Start 2-4 weeks after ensiling before clostridia become established.

Issues with Any Additive

- Application rates below the recommended level compromise the effectiveness of the product.

Issues with Any Inoculant

- These products work only if the bacteria go on the crop alive!
  - Store them properly: generally cool and dry
  - Don't use chlorinated water to dilute unless the chlorine level is less than 1 ppm
  - Watch out for high temperatures (> 100°F) in inoculant tank on chopper
- These bacteria cannot move around; they depend on you to spread them uniformly

Summary of Keys to Improve Silage Quality

- Packing
  - Minimum bulk density of 44 lbs./ft.^{3}
- Sealing
  - High quality film held tightly to crop, patched regularly.
- Feeding
  - Design silos/piles for feed out rates of 12 in./day
  - Defacer improves DM recovery by 1 or more percentage points by making a smooth face.

Summary of Keys to Improve Silage Quality

- Steps to avoid heating silage
  - Review silage management first and correct.
  - Use chemical additive or L. buchneri inoculant.
- Making a good silage better
  - Use a homolactic inoculant except for corn silage, HMC to be fed in summer.
- Steps to avoid clostridial silage if ensiling too wet
  - Ensile separately using a homolactic inoculant.
  - Begin feed out within a month of ensiling.

Questions?

U.S. Dairy Forage Research Center