A New Way Of Looking At Bunker Silage Density

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Why Care About Bunker Silage Density?

Density affects:

- How much you can get in your bunker
- How much loss during storage
- Profitability



Bunker Capacity: 180' x 40' x 12'





Bunker DM Losses As Affected By Density – 180 days storage





Based on Ruppel, 1992

Benefits of Improved Bunker/Pile Silo Packing

Assume:

500 Cow Herd 50% Corn Silage 5% Opportunity Cost Layer Thickness 6" Extra Storage Pad=\$0.75/sq ft

Harvest Rate 80 T AF/Hr Feed Value= \$0.042/lb DM

Achieved Density (lbs DM/cu f	t) 16	14	12
Packing Tractor Weight (lbs)	50,000	36,000	25,000
Tractor Initial Cost (\$)	163,000	149,000	119,500
Init. Cost Additional Storage (\$)	0	6,840	10,650
Extra Storage Cost (20 yr)(\$/Yr) 0	549	855
Feed Value Lost Cost (\$/Yr)	14,061	15,924	17,788
Tractor Annual Cost(10 yr)(\$/Yr) 5,324	3,622	2,905
Total Annual Cost (\$/Yr)	19,385	20,096	21,548
Cost Reduction (\$/Yr)	2,163	1,452	0

Holmes, 2007

The Old Target: Improving Dry Matter Density



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WI Study of Silage Densities in Bunker Silos

- 19 extension agents collecting samples
- 87 hay crop silages
- 81 corn silages
- Surveyed the packing practices





Dry Matter Density in Bunkers Based on WI Survey

Affected by:

- Tractor weight
- Layer thickness
- Packing time
- Silage height
- DM content





How to Improve Silage Density

Spreadsheet tools:

- Bunker Silo Density Calculator
- Silage Pile Density Calculator
- http://www.uwex.edu/ces/crops/uwforage/ storage.htm





Bunker Silo Density Calculator

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2						Silage Density in a Bunker Silo(English	Units)												
3						Brian Holmes(1) and Richard Muck(2)													
4		_				(1) Biological Systems Engineering Dept. and													
2					-	(2) US Dairy Forage Research Center						-							
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18																			
19	Tractor # 1	Typical tractor we	ight is 10,000-60,000 lbs		40.000	100													
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21	Tractor # 3	Typical tractor we	ight is 10,000-60,000 lbs		0	0													
22	Tractor # 4	Typical tractor we	ight is 10,000-60,000 lbs		0	0													
23	Proportioned Tot	al Tractor Weigh	ht (lbs) =		80.000														
24	Average Silage H	eight (feet) =			14.0	Green cells are intermediate calculated values													
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28		Pac	king Factor =		441.0	Values in pink cells are results of calculations													
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So, What Is The Problem With Dry Matter Density?





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Problem 1 With DM Density

How do you estimate how you are doing during the packing process?





Problem 2 With DM Density

- Porosity gas filled voids around the silage particles
- Losses increase proportionally as porosity increases
- What happens to porosity at fixed DM density when DM content changes?





Porosity as a Function of DM Content and DM Density



The New Target: Improving Bulk Density



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Porosity as a Function of DM Content and Bulk Density



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Benefits Of Bulk Density

- Porosity is relatively insensitive to the DM content of the crop
- Easier to estimate density on the fly while filling
 - Weight of forage put in the silo divided by the volume filled



Estimating Volume



Estimating Volume



Minimum Bulk Density Target

44 lbs./cu. ft.

700 kg/cu. m



How to Improve Silage Bulk Density

Same spreadsheet tools as for DM density:

- Silage Pile Density Calculator
- Bunker Silo Density Calculator

http://www.uwex.edu/ces/crops/uwforage/ storage.htm





Bunker Silo Density Calculator

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How Density Changes With DM Content For Identical Packing



Bottom line: The drier the crop, the more you have to do to get above the target bulk density.

Packing Operation

- Progressive wedge
- Thin layers (6 in.)
- Uniform coverage: two directions, multiple passes
- Continuous
- Drive slowly, avoiding wheel slip



Packing Vehicle

- Heavy tractor(s), weighted within specs
- Robust transmission with shuttle shift
- Blade or bucket
- Roll over protection with seat belts
- 4-Wheel drive or assist
- Wheels: well-lugged, high tire pressure
- Experienced operator(s)



Packing Operation

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



2

Summary

- High bunker density is a profitable goal that minimizes losses, reduces storage costs
- New target of increasing bulk density
- Minimum bulk density of 44 lbs./cu. ft.
- Still use a combination of heavy packing tractors, thin layers and packing time per ton to achieve high density



Questions?

Presentation will be posted on the U.S. Dairy Forage Research Center web site

www.ars.usda.gov/mwa/madison/dfrc

Or "google" dairy forage research



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