Managing Forage in Tower Silos

Brian J. Holmes
Biological Systems Engineering Department
College of Agricultural and Life Sciences
University of Wisconsin-Madison
March 10, 2000

Many tower silos are more than ten years old and beginning to show some signs of age. Before a silo is refilled, it should be inspected for conditions which could result in entry of air and water as well as structural integrity. Annually check the condition of the concrete walls and liners when the silo is empty. Cracks in the wall and doors should be sealed to exclude air. Holes in the roof should be repaired to exclude precipitation. Hoops should be checked for corrosion and tightness, and the integrity of the concrete should be evaluated by a qualified silo company representative. Annually check to assure the following.

- Doors are in good repair and seal well to help exclude air. Hardware should be sound and properly attached to doors.
- Ladders and cages should be sound and properly attached.
- Floor drains are open and debris is removed from outside the silo to allow seepage to move away from silo walls.
- Silo unloader cables and lifting equipment are checked for soundness.

One way to reduce the number of trips up the silo during feed out is to perform preventive maintenance or replacement of the unloader before the silo is filled. Inspect bearings, drives, and other moving parts for wear. Consult the owner's manual for routine maintenance including lubrication and adjustment settings. More detailed recommendations for tower silos and unloaders can be obtained from your owners manual and from the International Silo Association.

A distributor, located at the discharge of the filler pipe gooseneck, should produce a level fill of the silo. Uniform distribution reduces particle size separation and enhances uniform packing of the forage, resulting in higher density silage and reduced air entrapment and infiltration. Higher silage density also increases the capacity of the silo. A good distributor can increase silo capacity up to 30%. Uniform distribution provides uniform loading on silo walls, thus reducing the risk of structural problems. It also improves the silo unloader operation. Consult your silo equipment supplier if you observe forage filling faster on one side of the silo, a mound of silage in the center, a mound of forage in a doughnut shape, or some other pattern where forage fills faster in one location than in others.

Forage should be harvested at the correct maturity to assure desired feed quality and to assure proper sugar content for good fermentation. Optimal relative feed value is achieved when alfalfa is cut at 35-40% neutral detergent fiber (Sulc et al., 1999) or 170-180 relative feed value (Rankin, 1997). Small forage particles improve fermentation and are easier for silo unloaders to remove. However, longer fibers are needed to produce good rumen function. Chop alfalfa at 3/8-inch theoretical length of cut with 15-20% of the particles exceeding 1.5 inches long (Shaver, 1990). Use Table 1 to select the proper chop length for the stage of maturity for corn silage.

Fermentation proceeds best at 60-70% moisture content. However, larger silos have a greater silage density with increased likelihood of juice expression at higher moisture content. Use Table 2 to determine optimum forage moisture content based on silo size and location of forage in the silo. Use drier forage near the silo bottom.

Rapid silo filling reduces exposure of the forage to the effects of weather in the field, increases the uniformity of forage moisture and maturity in the silo, and reduces exposure of the forage to air during filling. Rapid silo filing is accomplished by having sufficient capacity for harvesting, transporting and filling equipment and adequate labor to operate the equipment. Bottlenecks to rapid filling should be identified and eliminated.

Tower silos rely on gravity to achieve good packing. Forage at the top of the silo has low density. Air can penetrate this low density silage to a great depth (5-10 ft). To reduce spoilage in this top layer, cover the forage immediately after filling. If there is a delay in covering, run the blower for 30 minutes before entering the silo and operate the blower while covering. To properly cover the forage, distribute the forage manually to create a level top surface and walk on the silage until the surface is tightly packed. Then dig a 2-ft deep trench in the forage around the circumference of the silo, place a 4-6 mil thick plastic cover over the forage, and weight the plastic down uniformly with more than 12 inches of wet straw, sawdust, or other low-quality material.

The fermentation phase requires 7-21 days. During this time, the forage quality varies from day-to-day, and dangerous silo gas can be present in and around the silo. Overall silage stabilization takes 30-40 days. The additional weeks of stabilization reduce the number of spoilage organisms. Cows perform best when presented a uniform quality of forage from day-to-day. To obtain maximum performance from cows, avoid contact with silo gas and maximize feed bunk life, do not feed out of the silo during the fermentation and stabilization period.

The unloading face is always exposed to air. Oxygen in the air allows aerobic organisms to consume dry matter in the silage, releasing heat and moisture. A minimum face removal rate must be maintained to minimize the effects of this spoilage. Table 3 provides minimum removal rates. If you experience silage heating, increase the removal rate to stay ahead of the spoilage. An increased removal rate implies reformulating the ration or increasing the number of animals fed from this forage source. If you anticipate the removal rate will not be adequate, propionic acid can be added to the forage during the harvest/filling process.

TABLE 1. Recommended Theoretical Length of Cut as Affected by Maturity and Kernel Processing for Whole Plant Corn

Kernel Processing	**Stage of Maturity**	**Theoretical Length of Cut** (inches)
None	1/3 to 1/2 milk line	3/8
Yes	1/3 to 1/2 milk line	1/2 to 3/4
None	1/2 milk line to black layer	1/4
Yes	1/2 milk line to black layer	1/2 to 3/4

TABLE 2. Recommended Maximum Moisture Content to Prevent Seepage from Tower Silos

	Silo Diameter (ft)				
Silo Height (ft)	10	15	20	25	30
20	78	76	74	74	74
30	76	72	71	70	69
40	74	70	68	66	65
50	- - -	68	66	63	62
60	- - -	67	63	61	60
70	- - -	- - -	- - -	59	57
80	- - -	- - -	- - -	57	54

Source: Pitt and Parlange (1987).

TABLE 3. Recommended Minimum Removal Rate for Tower Silos

	Minimum Removal Rate (in/day)	
Unloading Season	**Alfalfa**	**Corn Silage**
cold	2	2
warm	3 to 4	4 to 6

Source: Bates et al. (1985)

References

Bates, D.W., et al. 1985. Dairy Housing and Equipment Handbook (MWPS-7). MidWest Plan Service, Ames, IA.

International Silo Association. 1993. Silo Operator's Manual. International Silo Association Lafayette, IN.

Pitt, R.E. 1990. Silage and Hay Preservation (NRAES-5). Northeast Regional Agricultural Engineering Service, Ithaca, NY.

Pitt, R.E. and J.Y. Parlange. 1987. Effluent production from silage with application to tower silos. Transactions of ASAE 30:1198.

Rankin, M. 1997. Some reflections on alfalfa cutting management. www.uwex.edu/ces/ crops/alfcut.htm.

Shaver, R.D. 1990. Forage particle length in dairy rations. Dairy Feeding Systems (NRAES-38). Northeast Regional Agricultural Engineering Service, Ithaca, NY.

Sulc, R.M., K.A. Albrecht, V.N. Owens, J.H. Cherney. 1999. Update on predicting harvest time for alfalfa. www.uwex.edu/ces/ crops/alfqualest.pdf. Originally as Proc. of Tri-State Nutrition Conference, The Ohio State University.