Management of Tower Silos

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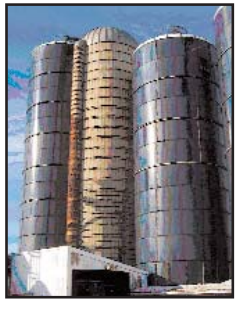
Tower silos have been popular systems to store silage in the Midwest and Northeast regions of the United States. As herd sizes increase, fewer tower units are built, but upright storage can be a logical and economical choice on dairy farms. Storing forages is an important decision for beef and dairy managers, with several systems available for evaluation based on the following factors:.

- Initial and annual costs to store forage
- Herd size
- Feed delivery system
- Optimizing forage quality (harvested and stored)

Storage costs

University of Wisconsin agricultural engineers reported silage storage costs including capital investment and annual costs at various herd sizes. The analysis included hay silage stored in eight different systems (Table 10). Capital costs included structures and equipment used in filling, storing and emptying the hay silage. Transportation, harvesting, or moving feed to the animals were not included. Silos and gravel pads had a life expectancy of 20 years while equipment was assumed to have 10 years of life expectancy. Annual costs include capital costs, labor, plastic coverings, fuel, and Dry Matter (DM) lost during storage. Forage (hay equivalent basis) was valued at $85 a ton. Tractors were assumed to have other uses besides forage management and allocated on a proportional basis to handle forage storage. Table 10 summarizes total capital and annual costs per ton of DM at two different quantities of stored DM (four amounts were calculated in the original report).



Capital cost per ton of silage dry matter was highest for new steel oxygen-limiting structures compared to other systems. If towers or vertical storage units are re-filled (1.5 to 2 times annually), costs will be reduced. Used oxygen limiting and cast in place structures were similar. Silo bags, silage piles, and wrapped bales had the lowest investment. No significant economics of scale occurred above 758 tons of DM (other storage amounts evaluated were 1536 and 3072 tons). Capital cost per ton can be important on farms where capital is limited due to expansion and/or existing debt load.

Table 10: Total Capital Cost and Annual Cost (in parenthesis) per Ton of DM for 384 and 768 tons of Stored DM

	384 tons DM		768 tons DM	
Storage type	$/ton of DM		$/ton of DM	
Steel-glass oxygen limiting (new)	427	(82)	301	(60)
Steel-glass oxygen limiting (used)	268	(55)	187	(41)
Cast-in-place oxygen limiting	285	(58)	186	(41)
Concrete stave	192	(46)	138	(36)
Above ground bunker	152	(45)	103	(37)
Packed silage pile	63	(37)	41	(32)
Bagger	88	(38)	53	(32)
Wrapped bales	64	(36)	38	(32)

Holmes, year

Good management is needed to achieve values in Table 10. Dry matter losses in storage were estimated to be 6% for oxygen-limiting units; 10% for concrete stave and bags, and 13% for piles, bunkers, and wrapped bales.

Herd size factors

After cost, herd size is the next important factor. If a herd size is less than 200 cows plus young stock, large permanent storage structures are viable. Upright silos, bags, and wrapped bales are good choices. If forages are fed in a conventional barn, upright silos minimize weather-related risks and use of tractors to feed cattle. In-line stationary mixers and belt feeders also favor tower structures. Bottom unloading structures can provide a consistent supply of fermented forage to cows, but a layer of low quality forage can occur between

each cutting or filling period. Removing 4-6" of forage a day from the surface in the summer will limit aerobic spoilage. During cool seasons, removing 2-4" will maintain forage quality. Sizing of tower silos is an important consideration when building vertical storage to maintain an adequate feeding rate to maintain palatability and quality (see Capacity Tables Index V).

Forage Quality

Tower storage units (conventional and oxygen-limiting) can be successful if matched to herd size to optimize feed out rates. Harvesting forages with higher moisture contents reduces field losses, but this must be balanced against seepage losses due to excessively wet silage. The guidelines given in Table 11 can be used for target DM levels for different crops in various vertical storage units.

Excessive moisture content can result in an undesirable fermentation and excessive seepage losses of soluble nutrients. Adding a research-proven inoculant will improve fermentation characteristics, lower DM loss, increase digestibility, and optimize desirable VFA pattern (>70% lactic acid of the total VFA produced) in tower structures. Other factors that can improve forage fermentation profile and quality are:

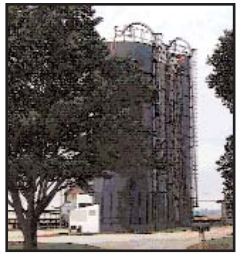
- Rapid harvest and storage (ideally in one day if possible)
- Reduce air exposure by rapid filling and sealing (can be covered with a plastic sheet if feeding will be delayed for several weeks). Check the quality and appearance of the top 6 - 12 inches of the silage before adding more silage or feeding to dairy cattle: discard if it is moldy or low quality
- Increase compaction by adding wetter material on top and covering
- Adding 20-50 pounds of finely ground corn or barley per wet ton of silage can provide a source of fermentable carbohydrate in legume, grass, and small grain silages
- Add a proven silage inoculant to direct, and increase the rateof, fermentation

Table 11: Target Crop DM Levels for Vertical Storage Systems

Oxygen limiting structure	
Legume-grass silage	50-65% DM
Small grain silage	50-65% DM
Corn silage	40-65% DM
Conventional concrete and stave structures	
Legume-grass silage	40-55% DM
Small grain silage	40-55% DM
Corn silage	
Under 60 feet	32-36% DM
Over 60 feet	Increase 2% DM per 10 feet vertical height

Feed Delivery System

With Total Mixed Rations(TMR), the silo or unit unloading equipment must allow for rapid forage removal to meet the manager's expectation on filling the TMR mixer and optimizing feeding time. If herd size is less than 200 cows, or cows are housed inside an insulated or warm housing system, and/or labor wants to work in a favorable environment, tower silos are a logical choice. To increase feed out time or with larger herds, having a series of upright structures unloading at the same time can deliver large amounts of forage and also reduces forage variation as forages from several sources are blended. Another approach to speed up filling time is to run silage unloaders before forage is needed. A skid steer can quickly load larger quantities in to a mobile TMR mixer.



If silage is fed in a bunk or in a confinement barn, blending alfalfa-grass silage with corn silage is recommended on a volume basis. Each silage type can complement the other forage source.

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- Corn silage is high in starch, contains more rumen fermentable carbohydrate, is low in total protein content, is low in calcium, and enhances TMR palatability.
- Legume-grass silage is higher in soluble, degradable, and total protein to improve microbial growth; low in starch and rumen fermentable carbohydrates; and can provide more functional (long) fiber.
- Small grain forage (such as wheat, triticale, oat, and/or barley) can provide an early source of silage in spring that is modestly high in protein and intermediate in energy content. Stage of maturity of small grain forage is critical to match animal needs and balance yield (boot stage for high producing cows, milk stage for growing heifers, and dough stage for dry cows).

Tower storage also provides the opportunity for inventory control if more than one silo or unit is available on the farm. Lower quality forage can be placed in a dedicated structure for growing heifers, dry cows, and lower producing cows.