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# Temporary Silos

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Missouri farmers for some years past have been more or less interested in emergency silos. Previous to 1930 a few had been built in this state, but the dry season of that year caused widespread interest in this method of salvaging the corn crop. Many kinds of existing structures ranging from old cisterns to corn cribs were used in 1930 with varying degrees of success.

Interest in temporary silos has steadily increased in the last four years and thousands of them are now in existence well scattered over the whole state.

The agricultural engineering department of the Missouri College of Agriculture does not advocate the use of temporary silos in preference to the use of permanent silos. It is believed, however, that for some time to come good use will be found on many Missouri farms for some type of temporary silo. Making ensilage is a new venture to many farmers. To such men the temporary silo offers a comparatively inexpensive method of acquiring knowledge of ensiling crops and, in many cases, leads to the construction of permanent silos and winter feeding of silage as a standard practice.

Three kinds of temporary silos are now in common use in Missouri: (1) the trench silo, (2) the paper-lined silo, and (3) the wood plank silo.\* The purpose of this circular is to help in deciding what kind of silo to use and to point out those factors which make for success.

Of 1555 emergency silos reported by county extension agents, 1096 were the trench type, 287 were paper-lined, and 172 were wood plank. Where soil and slope conditions are favorable to the trench type silo it evidently is considered most desirable. Where rocky subsoil makes digging and smooth side walls impractical, as is often the case in the Ozark section, the low cost of native lumber favors the wood plank type. On some of the almost flat lands of the state the absence of low cost lumber favors the paper-lined silo in spite of its more temporary character.

\*Wood Plank Silos described in Station Bulletin 214.

Silo owners have been asked for information based on their experience, and detailed reports have been received on 12 trench silos having a total estimated capacity of 955 tons, and 9 paper sack silos with a total capacity of 562 tons. Only 2 wood plank silos were reported and no estimated capacity of these was included. Construction and upkeep costs for these were given as follows:

	Construction Cost	Upkeep Cost
12 trench	43c per ton	05c per ton
9 paper-lined	72c per ton	21c per ton
2 wood plank	92c per ton	01c per ton

Anyone interested in a study of costs should send for Missouri Station Bulletin 303, "Silo Filling Methods and Costs."

The making of ensilage depends primarily upon the exclusion of air from the ensiled material and the maintenance of proper moisture conditions throughout the mass.

Recently some publicity has been given to the plan of building above ground so-called silos of limited height, with walls of bundled fodder, baled hay or straw, etc. This type of construction seems to have little appeal in this state. No favorable reports on the method have reached the College directly from the field.

### THE TRENCH SILO

**Location.**—A tight soil is desirable, though trench silos are being used in black loam soils, in soils containing lime and in sandy loam soils. They are not suited to sandy soils unless walled on the sides. Good drainage is essential. This applies to subsurface as well as to surface drainage. A south slope, free from seep water and from underlying rocks, is a favorable location for a trench silo. The silo site should be convenient to the barn or feed lots and to a good water supply for filling. It should be easily reached with a wagon at all times. It may not be possible to secure a site possessing all the desired qualifications, in which case good drainage and a firm soil are the essentials to be considered. Unless subsoil conditions are well known the use of a soil auger is recommended when locating the site for a trench silo.

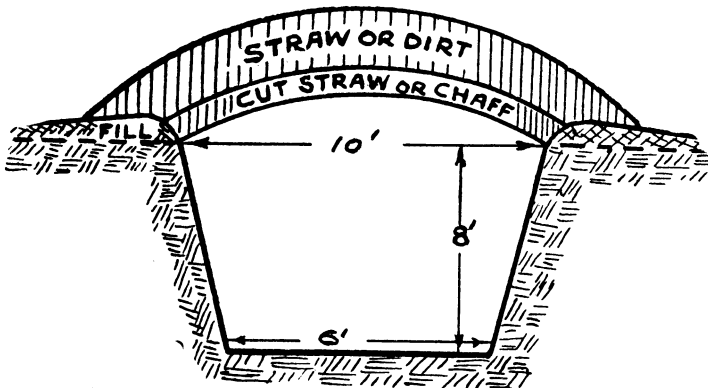
**Size of Trench.**—A definite cross section area of trench suited to the feeding requirements should first be decided upon. A common failing has been to dig the trench too wide. Capacity is secured in length rather than with width. Multiplying the total depth by the width half way up the side walls gives the cross section area. Each foot of length gives the cross section value in cubic feet. Well packed trench silage will weigh 25 to 30 pounds per cubic foot. Knowing the number of head to be fed and the amount to be fed each animal daily, the required cross section area can be determined.

At least one foot of silage should be used each five days to prevent spoilage. A cross section drawing of a narrow finish trench silo is shown to make clear some of the details of construction. Note that the

ground surface is left sloping away from the silo. A silo of the dimensions shown, depth (8) times midwidth (8), gives 64 square feet cross section area or 64 cubic feet per foot of length. Sixty-four times 25 (lbs. per cu. ft.) gives 1600 pounds per foot of length, sufficient to feed 10 head 30 pounds each day for five days. If the silo is used for summer feeding the amount fed would need to be doubled or the width and depth reduced to one-half. See Missouri Station Bulletin 214 for further information on sizes.

**Construction.**—Trench silos with sloping walls are more successful than those with vertical walls. They are less subject to caving, easier to excavate, and the silage in settling makes closer contact with the walls and thus prevents air pockets. Smooth walls are also an essential in this connection. A sidewall slope of one foot in four feet of depth is suitable in most soils. Common cross section dimensions are top width 12 feet, bottom width 8 feet, depth 8 feet, which gives a cross section area of 80 square feet or about one ton of silage per foot of length.

When marking the silo site the bottom width dimension should be staked as well as the top width, then a strip is plowed the full length and width of the bottom dimension. The loose soil is removed with



Cross section of Trench Silo

fresno or slip scrapers and piled on three sides of the plowed strip to keep surface water from entering the silo. Later plowings can be taken out at each end, driving back and forth through the silo and dumping at a distance on the sides. Some of this loose soil can be used for covering. It is not advisable to pile the loose dirt close to the silo to increase depth with less digging. The loose earth, being less compact, does not provide proper conditions for ensiling. Instances where logs were used to increase side wall height have shown damage by spoilage due to rats and mice working alongside and under the logs.

The bottom of the trench and the end at which silage will be removed should be left with an easy slope to provide drainage and to

permit ease of backing into with a wagon. Hand work will be necessary to smooth and true the walls so that the silage will pack close with no air pockets along the sides.

**Filling.**—Exclusion of air is the underlying principle in making good silage. Spoiled silage results from (1) poor packing or tramping, (2) insufficient amount of water used at filling time, (3) insufficient amount of covering. Generally some spoilage will occur at the top of the silo because of air penetration. It is ordinarily impossible to pack a trench silo too thoroughly. In an upright silo the depth of the material creates weight which is of considerable help in packing. In the trench silo packing is very necessary because of its shallowness. For packing, the use of a tractor is favored by some; horses or other livestock driven back and forth on the silage at filling time gives good results. If a tractor is used, don't fill the silo half full and then run the tractor off into it. This occurred once and gave much trouble.

It is essential in filling a trench silo to add plenty of water throughout the process. Wetting the edges is of special importance if the silage is put against dry earth. Unless plenty of water is added, the earth will absorb some of the juices from the silage and molding will result. A good plan is to add water to all the silage as it is being placed, then throw generous quantities along the edges at intervals. If an excess of water is used, it will be absorbed by the dry earth and leave the silage just right. One man using a quarter-inch stream of water through a blower reported fair success, another using a half-inch stream reported good results, while another using a one-inch stream reported excellent results.

Silage should be heaped up well above the top of the silo to allow for settling. Unless an extraordinarily good job of packing has been done, it is well to heap it at least three feet above the walls. When the silo has been filled, it should be covered at once. First covering may be a foot or so of wet chaff or straw. The tramping and packing over the wet straw should be continued for several days as occasion offers. As the silage settles, the covering seems to loosen; it is, therefore, best to continue packing for at least a week. After the silage with the wet covering has settled, additional covering is put in place. This final covering may be of straw about three feet deep with logs or poles to weight it down, or it may be of earth from 12 to 15 inches deep. On earth cover oats or other small grain is sometimes sown, since the roots of the grain help to make removal of the covering easier. Soil mixed with silage is not good feed. Any method of final covering which excludes air should prove successful.

**Maintenance.**—If the trench silo when empty is allowed to stand unprotected from the weather for some considerable time, reworking of walls, etc., will be necessary. This will change the dimensions and may result in abandoning the trench in a comparatively short time. Keeping the trench covered with a roof, preventing runoff from entering, and fencing livestock out will greatly prolong the useful life of a trench silo.

Where rock is plentiful some owners who have had good success ensiling with this type structure are making them much more permanent in character by lining the trench with rock set in cement mortar. Where rock is not plentiful to keep costs low, a few are providing concrete side walls, using light weight, small mesh wire for reinforcing.

### THE PAPER-LINED SILO\*

The so-called paper sack silo is in reality a slat-fence silo lined with heavy building paper or tar paper and reinforced on the outside by poles set deeply in the ground. Many however have secured very satisfactory results without the use of poles. When poles are not used each section of fencing is allowed to settle with the silage. Extreme care must be taken in building and filling a silo without poles in order that it will settle straight.

**Location and Size.**—The advantage of locating the paper sack silo where it is most convenient to the barn or the feed lot and the ease of feeding from it are items in its favor.

The following table gives the capacity in tons of the various paper sack silo sizes that are most often used and also the material required to build them:

Diameter in feet	Height in feet	Approximate Capacity in Tons	Feet of 48 inch fencing	Feet of 48 inch paper
10	12	11	95	104
10	16	17	126	138
12	12	16	113	124
12	20	33	189	207
16	12	29	150	166
16	16	43	200	220
16	20	58	250	276
16	24	75	300	332
16	28	94	350	387
20	16	67	250	276
20	20	91	314	346
24	20	136	377	515
24	28	190	528	580

To determine the size of a round silo it should be realized that to avoid spoilage it is necessary to feed at least two inches of silage a day in winter and three inches a day in summer. The small diameter silo is generally favored in the permanent type and the same holds true for temporary types.

When inside diameter of silo is	Weight of 2 inches of silage will be
10 feet	510 pounds
12 feet	735 pounds
14 feet	1000 pounds

With the above information the desirable height and diameter of a silo can be determined when the number of head to be fed and the number

\*Henry W. Hamilton, County Extension Agent, Saline County, has contributed much of the material in the section of this circular dealing with the paper-lined silo.

of days it is desirable to feed silage are known. As an example, 2 inches a day from a 10-foot silo will feed 30 pounds each to 17 head.

**Construction Details.**—When the location for the silo and its diameter have been decided, to lay out the required circle on the ground drive a stake in the center of the area to be covered by the silo and tie a string to this stake. With the string just one-half the length of the proposed diameter mark off a circle on the ground which will show the position of the sidewalls. Posts are set outside of this circle and should be long enough to reach the full height of the proposed silo. If they are all long enough to reach to the top, the structure will be just so much stronger. In order to make the walls as straight as possible the posts should be reasonably straight and should be set in the ground at least 3 feet for the average height silo so that they will not later have a tendency to lean. It is very important that the ground be level in order that the silo may stand up straight.

Two-by-fours are sometimes used in place of posts on silos which are not more than 12 or 16 feet high. This practice is not satisfactory as the two-by-four is so narrow that it easily cuts sideways through the soil and allows the silo to lean.

Posts should not be spaced farther apart around the circle than 6 to 8 feet, and two of the posts may be set somewhat closer together so that cross pieces may be nailed to them to form a ladder. This ladder will be found a great convenience when putting up the blower pipe if it is on the side from which the cutter will fill. The space between the posts is frequently used as the door by placing the steps of the ladder far enough apart so that silage may be thrown through. To make such a door possible the fencing is spliced behind the ladder.

Twisted wire cables, steel rods or bands are placed around the outside of the posts and drawn up snugly to act as hoops and prevent bulging.

Number 9 wire makes quite satisfactory hoops and it may be obtained at any hardware store. Cables with turn buckles, however, will make a stronger and neater job. A five-strand cable spaced at 4-foot intervals is usually sufficient for silos that are not more than 12 feet tall and 16 feet in diameter. The taller and larger sizes can be wired in proportion.

It will be easier to put the wire around the silo before filling is completed as the strands at this time will not need to be drawn as tight as would be necessary if the inside pressure were already on the walls and posts.

The sides of the silo should be plumb and it should be the same diameter from top to bottom. It is a mistake to draw in the top of the structure for in so doing the top silage draws away from the walls as it settles to a lower part of the silo and allows air spaces.

**Sidewalls.**—Slat fencing, such as is used for temporary corn cribs and sometimes for snow fence is good sidewall material. This fencing usually comes in rolls of 50 feet which will make a silo of slightly more than 16 feet in diameter without cutting. The slats are 4 feet tall. New fencing should be stretched with a woven wire stretcher or a tractor before it is used.

After the posts are set, the fencing is unrolled on edge inside of the posts and wired to them.

In wiring the fencing to the posts care must be taken to leave all twisted ends on the outside of the fencing so that they will not later tear the paper lining. After filling is completed it may be advantageous to remove the wires that hold the fencing to the posts so that the sidewalls may settle within the ring of posts and with the silage.

Since slat fencing will stretch under pressure of the silage, to obtain a good circle after the silo is full, the slack left between posts should be not quite enough to form a circle before filling. The second and each succeeding round of fencing should lap the lower round down from the top three or four inches with the upper round on the inside.

After the first and second rings of fencing have been put in place it will usually be found more convenient to put up the succeeding rings as the silo is being filled. This gives an opportunity for the work to be done while standing on the ensilage.

Woven wire fencing is not satisfactory for walls since it helps develop breaks and tears in the paper lining and consequent spoilage.

**Sidewall Lining.**—The silo is lined with some sort of tar paper or a good grade of especially prepared building paper. This lining should be strong enough not to tear easily and should withstand weather conditions.

A building paper made of two layers of tar treated paper with fibers imbedded in tar between the two has been found very satisfactory. The paper containing the sisal fibers will withstand tearing to a marked degree.

The paper is applied directly to the inside of the ring of fencing going around the circle inside in the same manner as in applying the fencing.

The bottom ring of paper should be placed at such a height that about two inches of the bottom edge will flatten out on the ground. If this edge is turned to the inside the silage will rest upon it and form an almost airtight joint against the soil at the ground line. The paper may be held in place, while filling, by fastening the upper edge to the snowfence at 4-foot intervals with spring clothes line clips or by hair-pin shaped pieces of No. 9 wire about a foot long. The paper should not be fastened permanently to the snowfencing as it must be free to move with the silage during settling in order to avoid tearing.

The principal point to keep in mind in applying the paper is to leave enough slack all the way around the wall so that the paper will

not be broken by the stretching of the walls from the pressure of the silage. At least 2 inches of slack should be left in every 4 feet of wall covered, and slightly more would be better.

At least 4 inches of lap should be left between the rings of paper as the silage in settling has a tendency to take the paper down with it. This sometimes leaves openings of considerable length in the paper. The spoilage will not go deep, however, as the silage has a tendency to seal itself and only a strip against the opening will be unfit for use.

After the first ring of paper is almost filled the clothes pins or wire fasteners should be removed and used to hold the next ring of paper in place. The silage may be allowed to build up somewhat in the center of the silo, leaving the level about 4 inches from the top edge of the paper around the outside edge. The second ring of paper can then be unrolled around the wall and the silage from the center thrown against its lower edge to hold it in place. One must be sure to leave sufficient slack in the paper as it is placed around the wall.

Both slat fencing and lining material may be bought at lumber yards. Some of the linings come in both 3 and 4-foot widths. As the slat fencing is 4 feet wide an advantage may be found in using a lining of the same width.

**Filling the Silo.**—It is a good policy to place a few inches of straw in the bottom of the silo after the first ring of paper has been applied, so as to keep the silage off the ground. The straw will not only prevent any loss of material at the bottom of the silo but will make it possible to fork up all the silage without picking up any of the dirt.

### GENERAL INFORMATION

It is more necessary to do a thorough job of tramping in temporary structures than in the permanent silos as the latter have sidewalls that are more nearly airtight. The finer the silage is cut the better it will pack and keep. Therefore, the knives must be kept sharp. Silage that looks like shredded fodder may prove a disappointment when feeding starts.

Silage also requires a certain amount of moisture to keep well. Unless the greater part of the corn plant is still green when cut for silage, more water should be added. This is especially true in a year of drouth.

Various methods of preventing top spoilage, such as covering with straw, sowing oats, or covering with building paper on which several inches of silage are placed to hold the paper down tightly, have been tried, and found quite satisfactory.

Where both temporary and permanent type silos are available it is best to use the latter for late feeding since the former are not considered as long-time storage structures.



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