2 Years of Tests

By Our Agricultural Engineers Show That

Insulation With Flax Straw[1] Won't Keep Silo From Freezing

By Arthur H. Schulz[2] and George L. Pratt[3]

One of the major problems in managing upright silos in the cold climate of North Dakota is frozen silage. It is a common experience to find a frozen layer of silage up to one and one-half feet thick around the outer perimeter of the silo. Frequent inquiries have been received from farmers about the possibility of insulating silo walls.

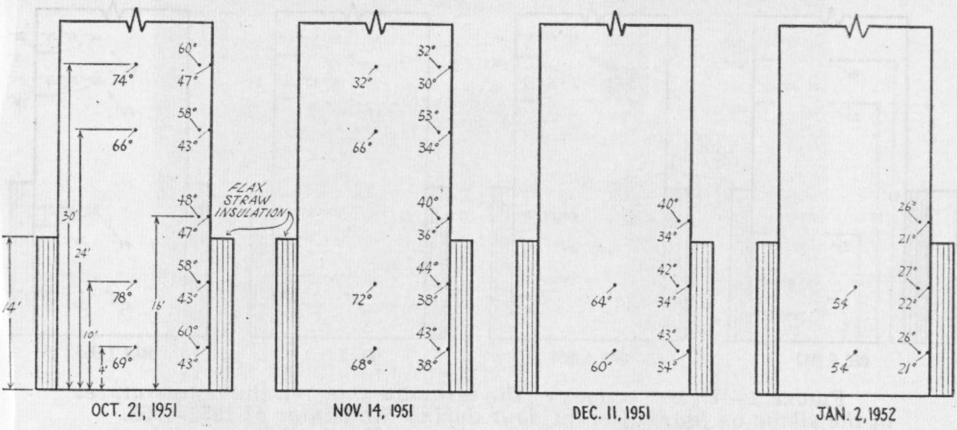

FIGURE 1.—*Cross sections of the test silos showing the temperatures in the silage on four different days during the winter of* 1951-1952. *The location of the flax straw is also shown.*

An investigation was made of the possibility of using flax straw as an insulating material for these silos. Results of two years of tests show that silage froze in the insulated section about as fast as it did in the uninsulated section. The insulation also seemed to slow up thawing on warmer days.

The 1950 census[4] showed that the farmers of North Dakota had five million dollars invested in upright silos. This represented a storage capacity of nearly 800,000 tons of silage. Since this census

[1]From "A Study of the Effect of Silo Wall Insulation on Silage Freezing and of Methods of Thawing Frozen Silage," a thesis submitted by Arthur H. Schulz to the graduate faculty in partial fulfillment of the requirements for the degree of Master of Science. North Dakota Agricultural College. June 1, 1953.
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[4]1950 Census of the United States

many more upright silos have been installed in the state. This would indicate that this method of storing silage is considered desirable by many farmers in the area.

Since frozen silage is one of the major problems encountered in the management of these silos, a study of the problem was started by the Agricultural Experiment Station at Fargo, North Dakota, in 1951.

During the curing period silage produces a large amount of heat. Heat production continues at a much smaller rate during the remainder of the storage period. Previous research indicates that the heat production is a result of the respiration of the silage material, respiration of micro-organisms, and the oxidation of the silage that is exposed to the air[5].

A theory has been considered that it might be possible to conserve this heat and thus reduce the amount of freezing that will occur.

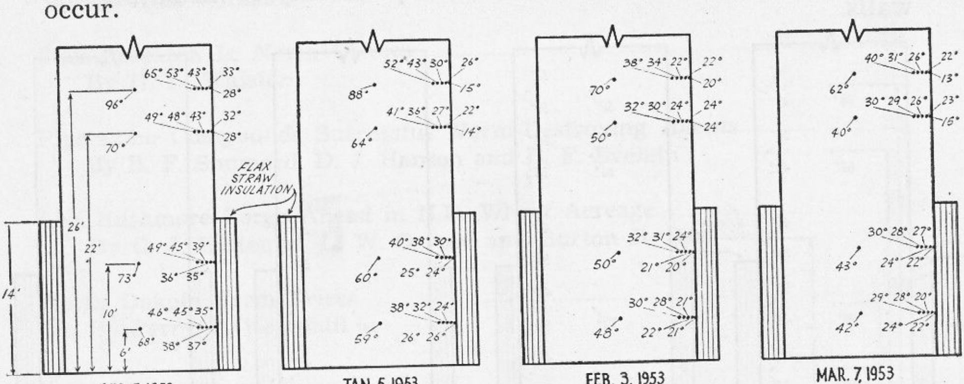

FIGURE 2.—*Cross sections of the test silos showing the temperatures in the silage on four different days during the winter* of 1952-1953.

Procedure

During the winters of 1951-1952 and 1952-1953, tests were set up in a 14 foot by 40 foot silo on the Egge Brothers farm at Wild Rice, North Dakota, to test this theory. Ventilation through silo doors and the roof has been found to be one of the greatest factors in speeding the freezing process at the surface of the silage[6]. The tests were planned so that the silo roof and doors could always be closed to reduce this surface freezing. In addition, the plans included the application of insulation to the lower part of the silo to help reduce the loss of heat.

The silo used in both test years was a concrete stave silo insulated around the outside with a two foot thick layer of well-packed flax straw. This insulation extended 14 feet up the side of the silo.

[5]Micro-organisms and Heat Production in Silage Fermentation. O. W. Hunter, Bibliography Journal of Ag. Research, Vol. 10, pp. 75-83, July 19, 1917.
[6]Will Silage Freeze? Bower, Hoards Dairyman, p. 578. November 16, 1917.

The purpose of this part of the experiment was to determine whether the insulation would conserve enough heat from the silage to move the frost point in the silo out of the silage and into the insulation, thus reducing or preventing freezing in the silage. The silo was filled both years with corn silage of good quality. The first year of the tests, three-fourth inch pipes were installed vertically in the silage as the silo was filled. Standard copper-constantan thermocouple wires were installed in these pipes at points four feet, 10 feet, 16 feet, 24 feet, and 30 feet from the bottom of the silo. These thermocouple wires are devices that can be used in combination with an electrical instrument to determine the temperatures at the points where the ends of the two wires are joined. The pipes were installed on a diameter extending from the northwest to the southeast side of the silo. Pipes were installed at the southeast end of the diameter, at 14 inches from the southeast wall along the diameter, and at the center of the silo.

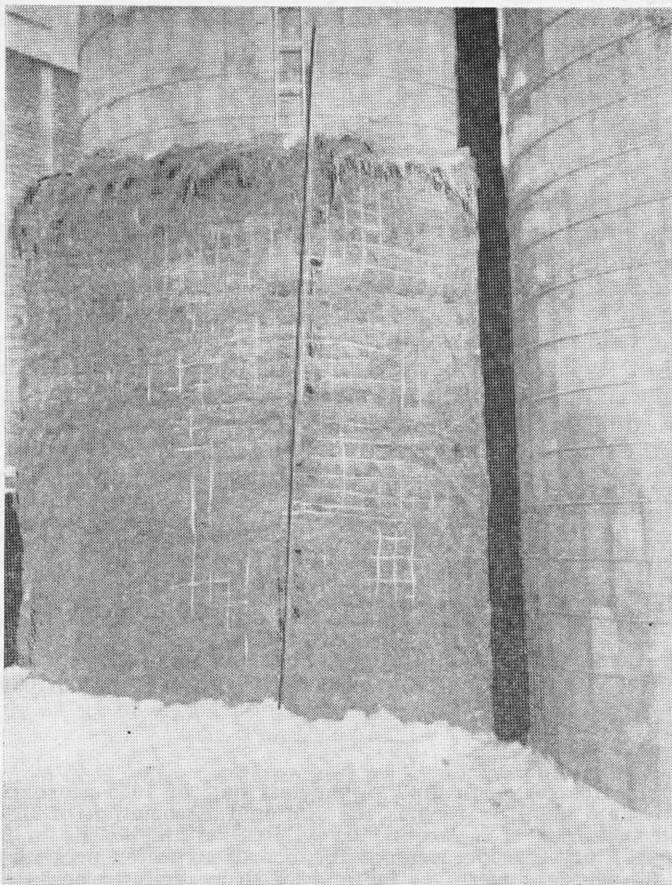

FIGURE 3.—*Flax straw insulation in place around the lower 14 feet of the upright concrete stave silo.*

A framework of four two-inch by four-inch studdings was erected around the silo. A 42 inch high woven wire netting was attached to this framework so that a space of at least two feet was left between the wire netting and the silo wall. This space was filled with well-packed flax straw as it was delivered from a spike-toothed combine cylinder.

The same method of insulating was used during the second season of the test. The method of installing the thermocouples was changed. Special copper-constantan wire was used which had a covering that was resistant to silage acids. This thermocouple wire was installed without the use of the pipe. A series of thermocouple wires was located at levels six feet, 10 feet, 22 feet, and 26 feet from the ground. At each of these levels, thermocouple junctions were located on a diameter from 20 degrees west of south to 20 degrees east of north. The thermocouple junctions were located on the southwest end of the diameter at the silo wall, six inches, 10 inches, 14 inches, and 18 inches from the silo wall and in the center of the silo. A record of the temperature at each of these points was taken the second year. Sample temperatures that existed in the silo at four different times during each year are recorded in Figures 1 and 2. The diagrams also illustrate the location of the insulation.

Findings

The practical results of these tests were unsatisfactory, if measured from the standpoint of the ability of the insulation to eliminate freezing in the silo. The silage froze to a thickness of approximately 14 inches around the perimeter of the silo. The insulation seemed to slow up the freezing action to a very small degree, but it was so small it was difficult to measure. About the same amount of silage froze to about the same degree in both the insulated and uninsulated sections of the silo. It was observed that little or no thawing occurred in the insulated part of the silo on warm days. On the same days, considerable thawing could be observed in neighboring silos that were uninsulated. These facts seem to indicate that it would be undesirable to use insulation on upright silos. A statistical analysis of the data indicated that there was not a significant difference in the temperatures in the silage in the part that was insulated, as against that which was uninsulated.

Other methods of managing frozen silage were tested in the project. These results will be reported in the Bimonthly Bulletin at a later date.

Steady prices for farm land in the last half of 1955 are expected by most real estate men. So reports the National Association of Real Estate Boards on the basis of a recent survey. Real estate boards in 217 areas participated. Sixty-four per cent of the boards expected present prices to continue; 23 per cent were set for a price drop on farm acreage; 13 per cent looked for higher prices. The survey also found that desirable residential and industrial land near cities is increasingly scarce, with prices steady to rising.