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Better Ventilation in Grain Storage Bins

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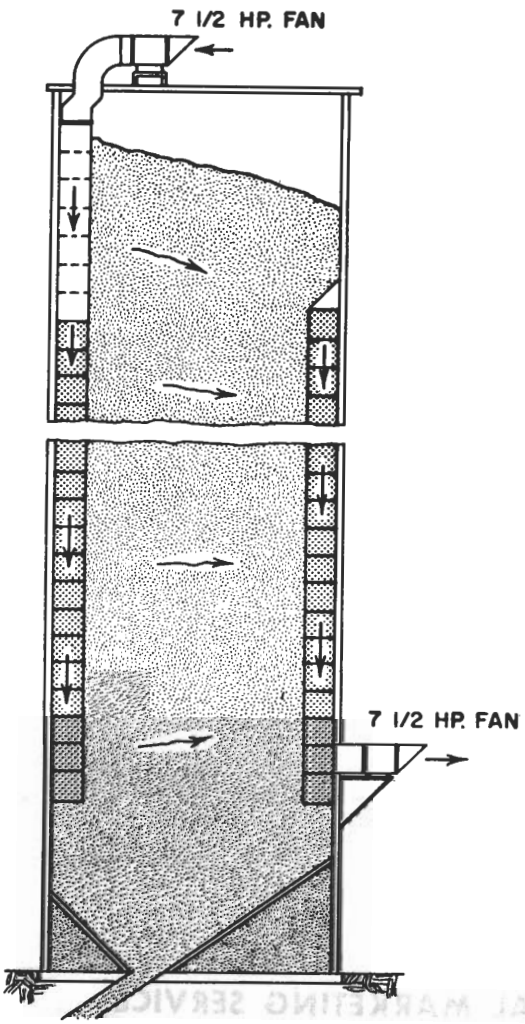


AN EXPERIMENTAL crossflow aeration system reduces the risk of spoilage of moist, newly harvested grain during storage. The new system moves as much as five times more air through the stored grain than do a number of other aeration systems. The improved system is being tested by the U. S. Department of Agriculture at a commercial elevator.

USDA's Agricultural Research Service has developed the new system to provide crossflow ventilation of grain stored in large, upright concrete bins. The new ventilation system has given good results with wheat and grain sorghum in preliminary tests. Equally good results could be expected if the system were used with other small grains, researchers say.

A reduction in moisture content of only 1 to 2 percent is all that is needed, in many cases, to improve the storage quality of newly harvested grain. Although temperature reduction is also important, it does not have to be lowered as fast as the moisture content to maintain the quality of the grain.

The new ventilation system reduced moisture content sufficiently to improve the grade designation in one test with 25,000 bushels of wheat. Grain used in this test graded No. 1 HW Tough, when it went in the bin. When it was loaded out, about 3 weeks later, it graded No. 1 HW.

During the 3-week test, the experimental system's fans were operated during clear, daylight hours (when air is driest) for a total of 120 hours. In this period, the moisture content of the grain went down from an initial average of about 14 percent to about 13 percent. An estimated seven tons of water were removed from the grain in this storage interval.

Newly harvested grain sorghum was used in four other tests. In the best results, moisture content was reduced from an initial 14 percent to slightly below 13 percent. The grain sorghum was ventilated 186 hours in the test in which these results were obtained.

Although moisture reduction is the most important objective of the experimental system, fast results were also obtained in reducing the grain temperature. In one test, the temperature of 25,000 bushels of wheat dropped 15 degrees, from an initial 88° to 72° F., in only 24 hours.

Grain samples, taken at 5-minute intervals as the grain was loaded in, and again when removed from the bin, ranged from 82° to 90° F., initially, and from 65° to 78° F., after continuous ventilation for 24 hours.

This fast drop in temperature was achieved by ventilating the grain with outside air having temperatures below 75° F. Higher air temperatures would do an equally good job, as long as the air temperatures were significantly lower than that of the grain.

Air temperatures as high as 93° F. were used in one test with 25,000 bushels of wheat. The average temperature of the wheat dropped, in 24 hours, from an initial average of 93° to 84° F. —a 9-degree drop. Initial temperatures of the wheat ranged from 82° to 104° F. and, after 24 hours, from 76° to 87° F. Moisture content did not change appreciably in the 24-hour test.

The experimental ventilation system is being tested in a bin with an inside diameter of 17 feet, and a height of 140 feet. Two ducts have been installed in the bin; each duct is connected to a fan outside the bin.

The use of two fans is unique with the experimental ventilation system. Only one fan is used in other crossflow systems.

Crossflow ventilation moves air with less difficulty than vertical air flow from the bottom of the bin, because air passes through only 17 feet of grain (the width of the bin) instead of through 100 feet or more (the height of the bin). Moreover, vertical ventilation systems often achieve an inadequate airflow for drying—about 1/20 or 1/10 cubic foot per minute, per bushel. In contrast, the experimental system moves at least three times more air—1/3 cfm per bushel, or more—through the grain when both fans are operating.

The perforated ducts in the experimental system extend about 130 feet down opposite sides of the bin. A fan on the roof of the bin forces air into the first duct, horizontally across the grain. Ductwork closest to the fan is unperforated, to force air downward into the duct before it passes into the grain.

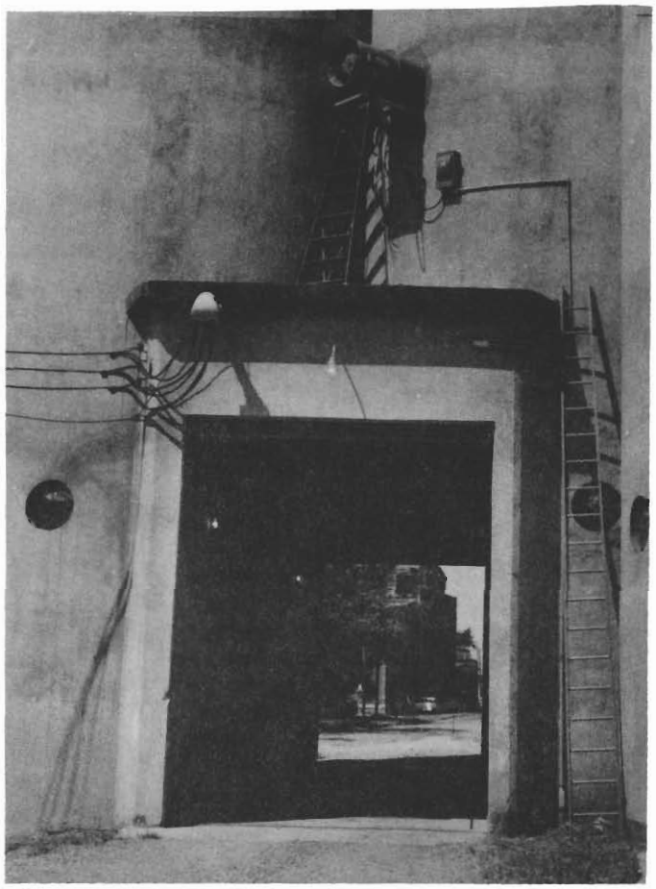
The second duct is attached to the wall opposite the first duct. An outlet leads to the second fan, which exhausts air from the duct.

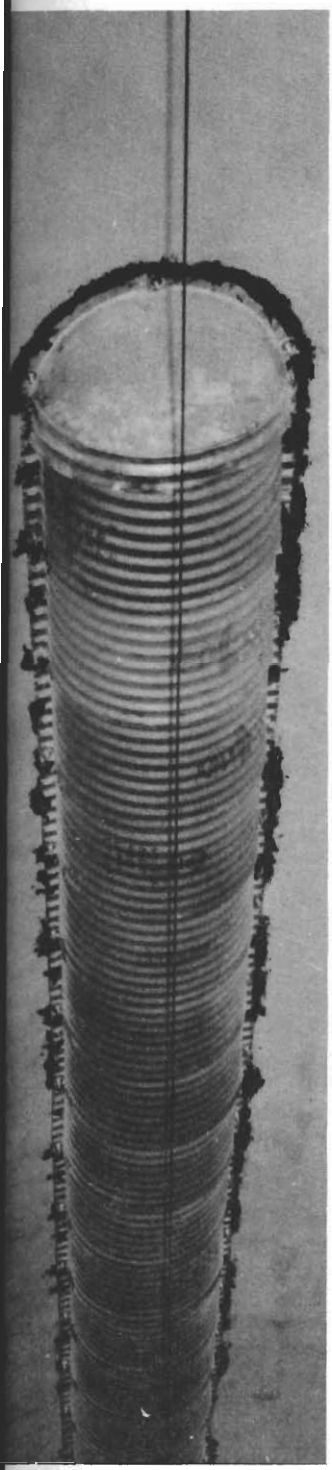
Both half-round ducts consist of overlapping sections of corrugated metal sheeting, about 35 inches wide, 26 inches long, and with a radius of 17 inches.

Results of further tests will be published when tests are completed.

(*The author is a member of the Transportation and Facilities Research Division, ARS, stationed at Manhattan, Kansas.*)

Five times more air circulates through grain in bins equipped with the new crossflow ventilation than through those equipped with other kinds of ventilation systems. Bin is 140 feet tall, 17 feet in diameter, and is being used in tests with 25,000-bushel lots of wheat and grain sorghum. The 7½ h.p. fan below draws air out of the bin.





Above, an interior view of the bin showing the exhaust duct. Black marks are calking; the cable is connected to research instruments. Arrows in diagram at left indicate airflow pattern.