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Low-Profile Bins for Grain Drying

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Grain depth is an important factor in grain drying. Extra depth increases airflow resistance, decreasing the drying rate. This extra depth also increases fan power requirements and the cost per bushel of drying grain. Reducing the depth in a low temperature drying bin can speed drying, decrease the risk of grain spoilage and reduce drying cost. Typically, reducing the drying depth by one-fourth will reduce the energy cost per bushel by one-third.

When buying "deep" versus "shallow" or "low-profile" bins, it seems to make sense that the bin cost per bushel will be lower for a deeper bin. After paying for the concrete floor and roof, the cost of an extra ring or two results in cheap storage. However, this doesn't take into consideration the initial cost of a drying fan and motor or the cost of operating the drying fan.

A low-profile bin has a maximum grain depth of 12 to 13 feet, rather than the more typical depth of 17 to 18 feet. In order to hold the same amount of grain, the low-profile bin must have a larger diameter. Due to the larger diameter, the low-profile bin will have a higher initial cost per bushel of capacity due to the extra concrete, larger perforated floor, larger roof, etc. With the low-profile bin, a smaller, less expensive, fan may be used. This may offset the extra cost of the concrete and bin structure is some cases.

This guide examines some of the costs associated with low-profile bins relative to deeper bins commonly used for low-temperature drying. To compare the two, low-temperature drying systems, complete with drying fans and motors, were designed to dry shelled corn.

Figuring bin cost

Fans were sized for bins from 27 to 36 feet in diameter to provide an airflow of 1.5 cubic feet of air per bushel (cfm per bushel.). This airflow is recommended for drying corn to 21-percent moisture or lower in the central half of Missouri on Oct. 1 if filling in one or two days.

Costs for bins, equipment, concrete and labor were provided by bin suppliers. Energy costs were based on an electricity rate of 6 cents per kilowatt-hour. Bin costs included the concrete slab, perforated floor, fans, motor, inside and outside ladders, power grain spreader and 8-inch unloading augers. Costs do not include roof vents, heaters, thermostats or humidistats.

Basic systems for 8,000- and 10,000-bushel bins are shown below. Medium-profile 8,000 and 10,000 bushel bins were also studied, but the costs were similar to the deep bins.

Payback for an 8,000-bushel, low-profile bin

Additional initial cost for a low-profile bin = $0.054 per bushel.

Annual energy saved with a low-profile bin = $0.031 per bushel.

$0.054 per bushel. ÷ $0.031 per bushel. = payback in 1.7 years

Deep bin

17-foot depth, 7 rings; 27-foot diameter; centrifugal 15 hp fan	
Initial cost per bushel.	
Bin construction	$1.080
Fan	$0.189
Total cost per bushel. =	$1.269
Energy cost per bushel. =	$0.066 (30 days per year at $0.06 per kilowatt hour)

Low-profile bin

12.5-foot depth, 5 rings; 33-foot diameter; axial 10 hp fan	
Initial cost per bushel.	
Bin construction	$1.205
Fan	$0.118
Total cost per bushel. =	$1.323
Energy cost per bushel. =	$0.035 (30 days per year at $0.06 per kilowatt hour)

Payback for a 10,000 bushel low-profile bin

Annual energy saved with a low-profile bin = $0.029 per bushel.

$0.094 per bushel. ÷ $0.029 per bushel. = payback in 3.2 years

Deep bin

17-foot depth, 7 rings; 30-foot diameter; centrifugal 20 hp fan	
Initial cost per bushel.	
Bin construction	$1.000
Fan	$0.168
Total cost per bushel. =	$1.168
Energy cost per bushel. =	$0.064 (30 days per year at $0.06 per kilowatt hour)

Low-profile bin

12.5-foot depth, 5 rings; 36-foot diameter; axial 10 hp fan	
Initial cost per bushel.	
Bin construction	$1.160
Fan	$0.102
Total cost per bushel. =	$1.262
Energy cost per bushel. =	$0.035 (30 days per year at $0.06 per kilowatt hour)

For the 10,000-bushel bins, the low-profile bin totaled $1.262 per bushel, 9.4 cents per bushel more than the deep bin. For the 8,000 bushel bins, the low-profile bin totaled $1.323 per bushel, 5.4 cents per bushel more than the deep bin.

The cost per bushel between the deep and low-profile systems is small primarily due to fan costs. The 27-foot bin needs a 15-hp centrifugal fan at a cost of about $1,500, while the 33-foot bin can provide the needed airflow with a 10-hp axial fan at an approximate cost of $1,000. Likewise, for the 10,000 bushel bins, the 30-foot bin needs a 20-hp centrifugal fan at a cost of more than $1,600, while the 36-foot bin uses a 10-hp axial fan at a cost of approximately $1,000.

Figuring the payback

The electrical costs of the fans were calculated on the basis of fan operation for 30 days per year at a cost of 6 cents per kilowatt-hour. At these rates, the low-profile, 8,500-bushel bin would pay the difference in initial cost after 1.7 years of operation, and the low-profile, 10,000-bushel bin would pay back the difference in 3.2 years of operation.

The time required for the low-profile bin to pay for itself depends on many factors including bin capacity, electricity rates and airflow requirements. Some may not payback as soon as the above examples. For smaller diameter bins in the 18- to 30-foot diameter range, low-profile bins may actually have a lower initial cost than their deep counterparts when fans and motors are considered. In the latter case, the payback is immediate and the savings in energy costs from the very first day of operation is profit.

As electricity costs rise, the payback period for low-profile bins will decrease. If the recommended airflow in cfm per bushel. used for matching fans and bins is different from the 1.5 cfm per bushel. used in the examples, the payback period will change. As the airflow rate in cfm per bushel. decreases, the payback period will increase, and as the airflow rate increases, the payback period will decrease. Small grains, such as grain sorghum, have a higher resistance to airflow per unit of depth than shelled corn. Thus, fan performance is more sensitive to increased depths of small grains and low-profile bins will payback sooner than for similar situations involving shelled corn.

It should be noted that the costs shown in this guide are not the total costs for drying a bushel of corn. It is assumed that depreciation, interest, insurance, labor and repair/maintenance costs will be nearly equal for systems of equal capacity.

You can also get some of the benefit discussed from an existing deep bin if you manage it as a low-profile bin. Simply limit the grain depth in the bin to 12 or 13 feet. The benefits will include a higher airflow rate, faster drying time and lower energy cost per bushel. You will also decrease the risk of grain spoilage in the top layers of grain. Since you will be using the same fan as before, no savings in initial fan costs will be realized.

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Related MU Extension publications

- G1305, Estimating Airflow for In-Bin Grain Drying Systems
  http://extension.missouri.edu/publications/DisplayPub.aspx?P=G1305
- G1969, Safe Storage and Handling of Grain
  http://extension.missouri.edu/publications/DisplayPub.aspx?P=G1969

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