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Introduction

Direct energy expenses (diesel, gasoline, propane, electricity) total nearly $1 billion annually for Iowa's farmers. When it's required, drying energy can be a significant cost for corn production. This study measured propane and electrical energy used in high-temperature bin drying of corn on the farm.

Materials and Methods

Corn was dried either as recirculating-batch or continuous-counterflow in a 4 to 6 ft layer in the 30-ft diameter bin at the farm. Load cells under the propane tank measured weight of propane consumed and current transducers measured electricity used for fans and augers.

Corn harvest was relatively slow from small plot areas. Measurements were recorded from six bin batches of about 2,000 to 4,000 bushels each at 140°F and 180°F drying temperature during 2013-14. Corn harvested near the end of the season was dried with natural air.

Results and Discussion

Most of the drying energy used (95%) was from propane, with the remainder as electricity used for the fans and augers. Propane use averaged 0.018 gallon/point of grain moisture content removed/bushel dried (Table 1). Electricity used averaged 0.016 kWh/point of grain moisture removed/bushel. Total energy used for drying/pound of water removed from grain is a measure of energy efficiency and ranged from 2,010 to 2,760 Btu/pound of water removed. Unheated, natural air drying with electricity only used 1,390 Btu/pound of water removed.

Grain drying energy also was measured at locations in central and northeast Iowa. Considering all locations, energy used for drying increased somewhat as outdoor air temperatures decreased (Figure 1).

Conclusions

Propane was the predominant energy expense for high-temperature drying. About 150 gallons of propane were used per 1,000 bushels dried with incoming moisture content of 23 percent, and about 75 gallons per 1,000 bushels with initial moisture content of 18 percent. This energy use was consistent with published estimates of high temperature drying efficiency. Energy use tended to increase with colder air temperatures. Energy required for natural air drying is lower, however the drying period is much longer, requiring adequate airflow and bin space.

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Table 1. Conditions and energy used for corn drying during 2013-15 at the ISU Armstrong Farm, Lewis, IA.

		Temperature						
		Dryer	Outside air	Moisture content (%)		Energy per water removed	Propane	Electricity
Dryer mode	Bushels	°F	°F	Initial	Final	Btu/lb	Gal/pt/bu[c]	kWh/pt/bu[d]
Batch[a]	2,430	180	43.6	20.2	14.5	2,500	0.018	0.012
Batch	2,470	140	41.9	18.6	14.8	2,450	0.017	0.015
Continuous flow[b]	2,190	140	40.9	18.9	14.6	2,010	0.015	0.013
Continuous flow	1,900	180	44.6	17.2	14.4	2,540	0.019	0.020
Continuous flow	1,990	140	43.4	21.4	14.9	2,760	0.019	0.020
Batch	3,883	180	50.8	19.9	14.7	2,590	0.018	0.015
Natural air	7,500		44.5	16.5	15.2	1,390	0.000	0.263

[a]Counterflow recirculating batch.
[b]Continuous counterflow.
[c]Gallons propane/percentage point moisture removed/bushel dried.
[d]Kilowatt hours/percentage point moisture removed/bushel dried.

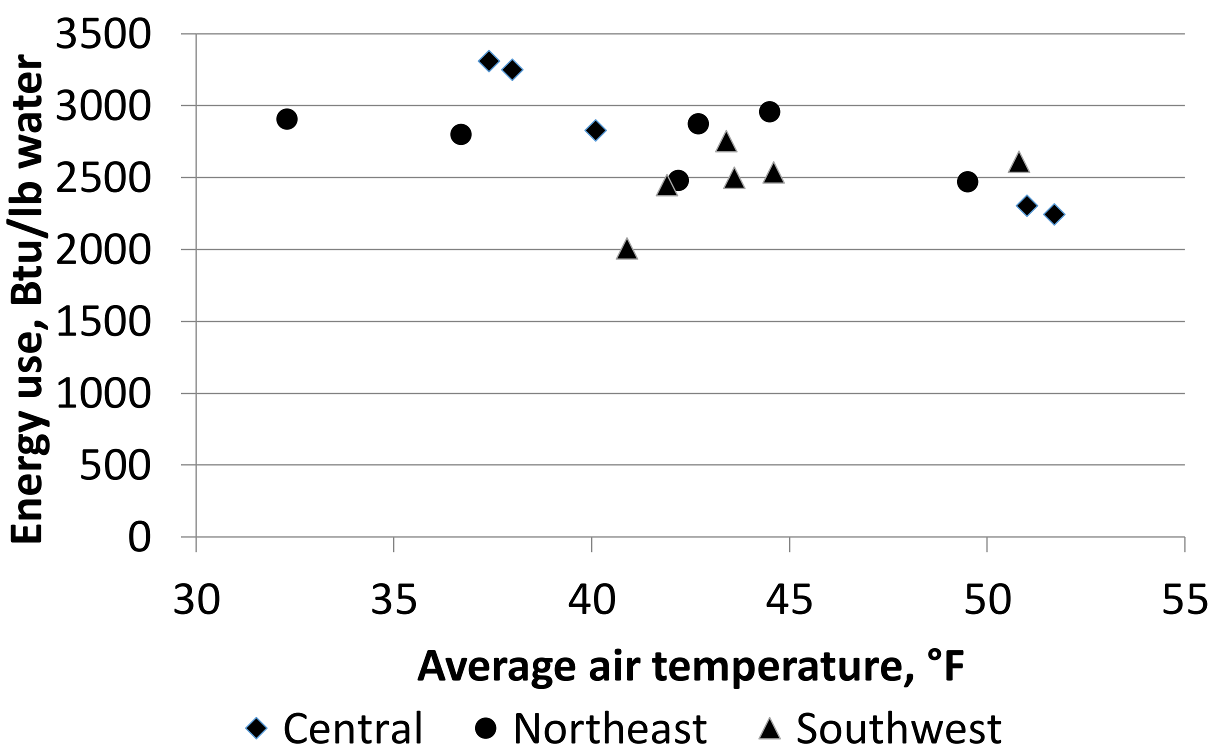

Figure 1. Energy used/pound of water removed during high-temperature grain drying vs. outside air temperature at the Ag 450 Farm, Ames (Central), Northeast Research Farm, Nashua (Northeast), and Armstrong Research Farm, Lewis (Southwest).