Using Induction Heating to Dry Sunflower Seed

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Definitions:

An auger is the system that transfers grain, typically with spirals that spin.
A silo is a big container that stores grain.
Induction heating uses electromagnetic waves or electricity as heat.

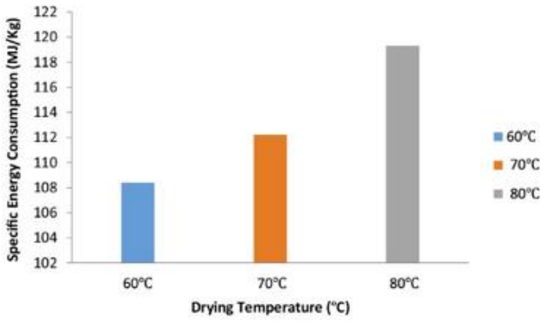
How can grain drying be made more efficient in mixing based dryers?

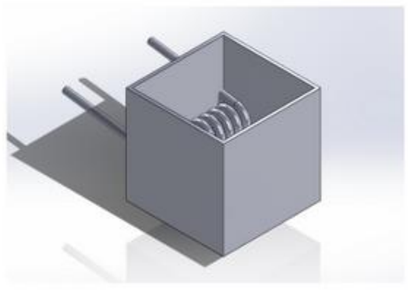
Assumptions:

Grain needs a lower moisture content when being stored so bacteria doesn't grow in the grain and the grain doesn't get moldy. However, it can't get too warm, or the grain will crack, so a cooler is used to cool down the grain. This cycle prevents both mold and cracking, resulting in nice and clean grain to sell.

Background

Farmers and agriculture industries are constantly looking for new ways to keep drying costs down while not sacrificing the efficiency of the grain dryer. For farmers its about saving money, for industries its about getting money, in the form of more business. This research of creating a new dryer can contribute to this issue of farmers paying so much for energy. Researching different methods of grain drying can provide new insight on using less money to dry grain, saving farmers and other consumers money on their harvest, putting more money in their pocket when they sell. There is potential improvements in energy use by removing the auger system and using a method to heat the entire silo. (Atykhanov)





Conclusion

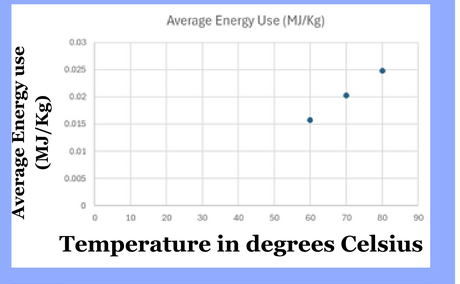
While the data collected was different than the researched data, it is not a significant enough of a difference to confidently say that there is a difference between an induction heater. The different criteria for success were hit to provide a usable grain dryer to suffice for the need of drying sunflower seed. While it was just as efficient, it was not more efficient as desired.

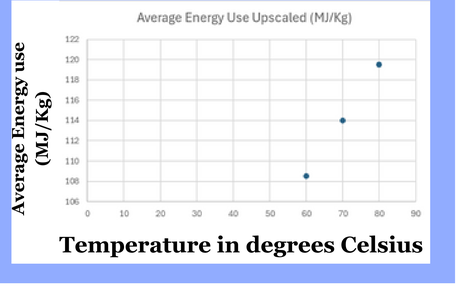
Methods/Materials

Common mixing based dryers use augers to transfer grain at the bottom of the silo to the top, with the entire heating and cooling mechanism at the bottom of the silo. Removing this system requires a new method of heating. To substitute this change, an induction heater is used. An induction heater sits inside the silo and heats the grain entirely. By using a small model of a grain dryer made of metal, using induction heating, data has been taken, compared, and upscaled to the size of other common grain dryers. Using this upscaled data, a comparison has been made to determine which method is better. Sunflower seeds are used because of the availability of it, and the amount of data around it.

Results

After averaging out the raw data, the results came to be 0.01575 MJ/Kg, 0.02025 MJ/Kg, and 0.02475 MJ/Kg for temperatures of 60, 70, and 80 degrees Celsius, respectively. Assuming the traditional size for a grain dryer is 10306 cubic feet, and the model used in this study is 1/27 cubic feet, an upscale of 88,573.5 cubic feet is done to match the traditional dimensions. Using the given formula to upscale the data (0.0932*(10306/(1/27))^(0.75) * (model energy used)) +89.3, the data can be accurately upscaled to provide a rough estimate of how effective the model was compared to a real silo. Including this, results of 108.5, 114, and 119.5 MJ/Kg were achieved.





Acknowledgements

Ndukwu, M. C., Horsfall, I. T., B. Lamrani, Wu, H., & L. Bennamoun. (2022). Moisture evolution, thermal properties and energy consumption of drying spent grain pellets from a blend of some cereals for small-scale bio-energy utilization: modelling and experimental study. Biomass Conversion and Biorefinery, 14(7), 8805–8817. https://doi.org/10.1007/s13399-022-02846-x

Atykhanov, A., & Sagyndikova, A. (2013). Energy savings at the induction method of grain drying. Applied Technologies and Innovations, 17–20. https://doi.org/10.15208/ati.2013.4