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Abstract

A study on the design and development of a collapsible hermetic silo for organic and chemical-free storage RI GU\ DJULFXOWXUDO FRPPRGLWLHV ZDV FRQGXFWHG WR YHULI\ LWV DSSOLFDW were fabricated with pneumatic posts to facilitate the preparatory assembly for the center top loading of grain. 7KH\ ZHUH ¿OOHG ZLWK GU\ FRUQ DQG LQLWLDO PRLVWXUH FRQWHQWV ZHUH UH material (Grainshade™ ZLWK WKH DELOLW\ WR UHÀHFW RQ DYHUDJH RI VRODU UDGL not covered. Both units passed the pressure decay test (PDT), which was conducted on both models to ensure hermetic condition. Oxygen levels were monitored. A faster reduction of oxygen level was observed in the grain VKDGH FRYHUHG VWRUDJH VLOR ZLWK VDIH R[\JHQ OHYHO DIWHU PRQWKV F

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loaded with grains. e same posts can then be used to assemble other units. Static and dynamic stability of the silo was one of the design considerations. Hence, the model was designed for top-center loading as well as central unloading from the bottom oor. Several loading and unloading mechanisms were considered, including pneumatic loading/unloading, use of augers, and use of gravity. Target unloading capacity was 50 tons/h. e silo with its loading/unloading system must be hermetic. Another design consideration was the e ciency of space utilization, which is a function of the shape of the silo (i.e., circular base, rectangular base, and other geometric shapes). e hermeticity of the model was checked using the PDT. Protocol that has been tested and validated in actual assemblies of hermetic cocoons. An outdoor experiment was conducted with two treatments i.e. CHS models with and without Grain shade™, to determine which one will have faster rate of oxygen level reduction in the stored grain. e CHS model treatment with the faster oxygen level reduction rate was chosen as reference for the design and development of the CHS prototype.

Results and Discussion

e validation of hermeticity using a CHS model with hermetic zipper proved positive. A 1-ton CHS model with pneumatic posts and rings was made (Figure 2a & 2b) and subjected for outdoor validation experiment with two treatments: 1) with and 2) without Grain Shade™. (Figure 3) e Grain Shade™ re ected on average 75% of solar radiation. Oxygen levels were monitored and the data recorded. e

long-term storage condition. It is then logical to assume that higher capacity CHS can be developed on the basis of this study. Short- and long-term storage of other grains such as paddy, wheat, chia seeds, and others can be done using the CHS without the use of toxic chemicals. [9,10].However, as per product design and development protocol, the higher capacity CHS must be subjected to actual performance testing, evaluation, and validation under di erent environmental conditions, including high day and night cyclic temperatures and normal and freezing temperatures.

is study has proven the applicability of hermetic principle in the GrainPro cocoon to bulk storage technology. e following conclusions were made:

1. e results of the model and CHS prototype study have validated the feasibility of short- and long-term storage of grains under an outdoor environment without the use of chemicals to control storage infestation and without building a warehouse.

2. Low oxygen level and moisture content stability were maintained (as necessary conditions that must be maintained for short- and long-term storage of agricultural commodities in CHS).

3. Provision of Grain Shade™ is a must to attain the required conditions for outdoor grain storage in the CHS.

Recommendations

Collapsible organic and hermetic silo can be used for short and long term storage of dry agricultural commodities. However, due to the di erent physical and chemical properties of grains, an actual performance validation of storing a particular grain using CHS must be done to insure the safety of the stored product.

Hermeticity or gas tightness of CHS must be veri ed using the pressure decay test protocol to insure that it is hermetic enough to warrant safe product storage, and that short and long term storage conditions (right product moisture content and oxygen level) are met.

References

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