

Hermetic Technology

A new beginning for grains storage and farmers benefit

Sandeep Mann¹, Nileshwari Yeole², Kishore Swine³ and Sachin Mittal⁴

ICAR-Central Institute of Post-Harvest Engineering and Technology, Ludhiana, Punjab 141 004

In India, insect pests cause serious post-harvest losses during storage of cereal grains and pulses. These losses can be prevented by using hermetic preservation technique. In this technique, the flow of oxygen and water from external environment is fully examined. The hermetic bag is a triple-layer plastic bag that serves as an air-tight (hermetic) way of storage for grains such as (maize, paddy, milled rice, pulses, wheat, millet, beans, coffee, soyabeans etc.). Hermetic bags help in controlling insects and pests without use of any pesticides. It is a cost effective, easy, environment friendly technique for crop protection and larger number of people are understanding and using this newer method of hermetic storage.

Key words: Grains, Hermetic, Insect, Pests, Storage

HERMETIC storage technique prevents losses due to insects pests during storage of food grains and therefore, helps in maintaining their quality for extended periods. Hermetic bags work on the principle of hermetic storage where flow of oxygen and water from outer environment is completely checked. This method prevents the damage and proliferation caused by storage insect pests. Additionally, it greatly helps in preserving the quality, germination and vigour of the seeds. It can be used to store a wide range of commodities such as maize, paddy, milled rice, pulses, wheat, millet, beans, coffee, soybeans etc. Hermetic plastic packaging material used in this preservation technique is PICS (Purdue improved cowpea storage) bag, grain pro super bag, save grain bag, ecotech hermetic bag. The hermetic bags provide a safe and convenient method for farmers to preserve agricultural commodities. Hence, the adoption of hermetic bags must be encouraged in India. Hermetic storage is a sustainable, cost effective, user-friendly and environmentally benign technology that makes the use of pesticide and

fumigants unnecessary in post-harvest and seed storage. This technology has already been adapted for protection of many different commodities in quantities ranging from conventional grain bag size to many thousands of tonnes. Applications of hermetic storage are very likely to expand even more rapidly in the future, as the available forms of hermetic storage continue to increase and more users are experiencing and understanding the advantages of this green technology.

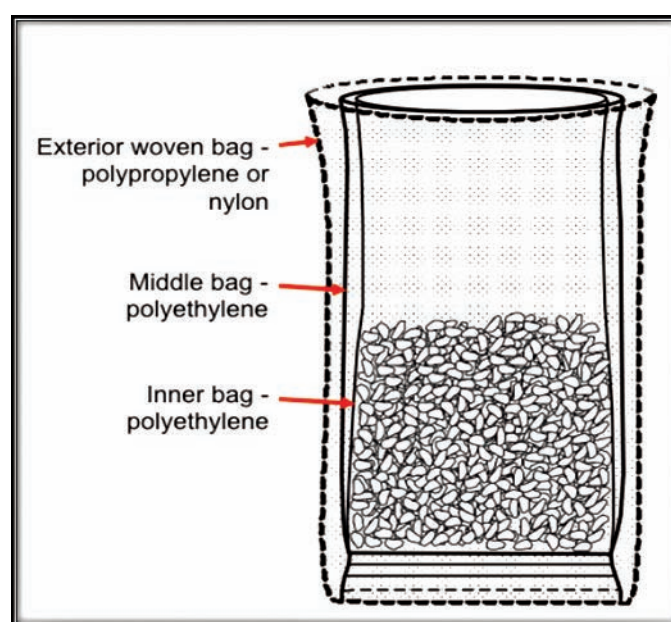
Hermetic technology

The hermetic bag is a triple-layer plastic bag that serves as an air-tight (hermetic) way for storage. Triple layer is composed of two inner bags of low-density polyethylene

(LDPE) fitted inside and outer sack composed of woven polypropylene (PP). The inner LDPE liners are composed of wall thickness of 80 microns. They greatly hinder the movement of oxygen across the wall of the bag. The tough outer woven enables easy handling of bag.

Mode of action of hermetic bags

Hermetic storage bags when filled



Hermetic bag

with the grains and closed completely, act as strong barrier to oxygen. No more oxygen passes inside the bag while the remaining oxygen inside is depleted by both the grains and insects through their normal respiration (consume oxygen and reject carbon dioxide). This oxygen depletion kills insects and other pests. Hermetic bags have the lowest OTR (oxygen transmission rate) than any other bags currently available in the market. They are fully organic solution for preservation and storage of grains and pulses.

Steps in using hermetic bag



Step: 1

Make sure that the grains are properly dried (<14 % moisture content). Shell all the grains. Place the hermetic bag inside another bag i.e jute bag or polypropylene bag.



Step: 2

Fill the hermetic bag with dried seed or grain.



Step: 3

Remove air from the bag completely. To remove air, press from the side of the bags to expel out air from the bag. Then twist the free plastic to fold it two times.



Step: 4

Tie off the twist with a strong rubber band or an adhesive tape.

Precautions when using a bag

Make sure that you:

- do not over fill the super bag.
- do not puncture or damage the bag.
- never carry the grain by holding on to the hermetic bag, always use the outer bag for carrying.
- seal the bag properly.
- do not use hooks to hang the bags.
- Clean, dry, fold bags (undamaged)



Step: 5

Close the outer bag by tying or sewing. Make sure not to puncture the hermetic bag, pull the middle bag up over the first one so that it completely surrounds it. Twist the lip shut, fold over and tie, as before. Follow the same steps for the outer/ woven bag.

hermetic bags can be reused)

- check regularly- for leaks and re-seal.

Benefits of using hermetic bags

- help in preventing losses to bruchids (weevils).
- no insecticide or other chemical is needed.
- convenient for small-scale farmers and organic grain producers to use.
- reusable as long as they do not have holes.
- cost is little more as compared to any other storage methods and are thus affordable.



No insect damage on grains stored in hermetic bags



Serious damage in traditional storage system

Table 1. Target pests and crops

Crops	Pulses	Grain
Insects	Bruchids <i>Callosobruchus</i> spp <i>Acanthoscelides</i> spp	Main pests Moths (Indian meal moth) Beetles (<i>Tribolium</i>) Weevils (<i>Sitophilus</i> spp)

Table 2. Main additional benefits of Hermetic bag

Insects control	Yes
Prevention of mold development	Yes
Reduction of aflatoxin risk	Yes
Grain quality preservation	Yes
Protection against ambient humidity (water drops)	Yes
Protection against household animals (cats etc.)	Yes
Protection against rodent	No
No need for pesticide treatment of the grain	Yes
Prevention of weight loss	Yes
Preserve seed viability	Yes

produce into silage. This would result in deterioration of produce quality.

Target pests and crops

Hermetic bags should be used for the storage of grains and pulses. They are not recommended to store maize because of serious infestation of the larger grain borer (LGB) adults, which are well adapted with chewing through both wood and plastic. LGB adults can perforate the liner and break the hermetic seal. The details on the specific pests that can be

- Purchase price of green gram per kg was ₹ 56/kg.
- Selling price of green gram was ₹ 60/kg.

In traditional storage bags, the bags are low cost and grains loss is approximately 8% during storage due to insect infestation, weight loss etc. and therefore farmers suffers from the loss of ₹ 60-130/100 kg of green gram. Since, the price of hermetic bags is relatively high but the grains can be stored for 1 year with only 2% storage losses. Therefore, the quality of grains in hermetic bags is relatively higher than traditional storage systems and can be used economically in grain storage systems.

CONCLUSION

Hermetic bags are used for storage and preservation of grains and pulses for a long time. These bags help in extending germination of seeds, maintain stable seed weight and moisture content for extended periods. Most importantly, they control insect pest without use of any insecticides. Live insects in the bags have been observed to be dead after 1-2 weeks of storage. These bags are

Table 3. Cost of packaging material for 12 month of pulses storage

Packaging material	Cost of greengram ₹/100 kg	Price per bag(₹)	Fumigation charges annually, (₹/bag)	Storage loss (%)	Product Weight after storing 1 year	Final value of greengram ₹/100 kg	Advantage of intervention (profit/loss)
Purdue improved crop storage (PICS)	5,600	155	Not Required	2	98	5880	₹ 125 Profit
Grain pro super hermetic bags	5,600	80	Not Required	2	98	5880	₹ 200 Profit
Save grains bag	5,600	90	Not Required	2	98	5880	₹ 190 Profit
Ecotect hermetic bags	5,600	85	Not Required	2	98	5880	₹ 195 Profit
White woven bag	5,600	30	10	7	93	5580	₹ 60 Loss
Jute bag	5,600	40	10	8	92	5520	₹ 130 Loss

- Investment in hermetic bags pays high returns – therefore, their use is profitable.
- technology is easy to learn and use.
- grain can be stored safely in hermetic bags for a year or more.

Condition of use

Hermetic storage bags should be used with the grains, which have been dried to the recommended moisture content (13-14%). If grains stored in hermetic storage bags are not properly dried (e.g. over 16%) then, there is risk of conversion of

controlled are given in Table 1 and additional benefits of hermetic bags are given in Table 2.

Cost economics of packaging

The cost economics of the pulse storage was done by considering the actual cost incurred and making certain assumptions.

Assumptions: The unit cost of packaging material for storage capacity of 50-90 kg was taken as per the actual (Table 3).

- Moong/green gram as raw material.

not much expensive than conventionally used bags. Hence, this technique would be one of the most effective and economical tool in reducing storage losses at the household and commercial levels as compared to traditional storage systems.

¹Principal Scientist, ²PhD Research Scholar, ³Assistant Professor, ⁴SRF, ^{1,4}ICAR-Central Institute of Post-Harvest Engineering and Technology, Ludhiana (Punjab) and ^{2,3}Visva-Bharati Central University, Kolkata (West Bengal)