IJFEAT
INTERNATIONAL JOURNAL FOR ENGINEERING APPLICATIONS AND TECHNOLOGY

HERMETIC STORAGE

Vaishali Sawant[1], Shyamkant Munje[2] and Pradip Borkar[3].

1. Ph.D. Scholar, Department of Entomology, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.). and Author for correspondence: Email: vaishalisawant254@gmail.com.
2. Assistant Professor, Regional Research Centre, Amaravati (M.S.).
3. Professor, Department of Post Harvest Engineering and Technology, College of Agrilcultural Engineering, Akola (M.S.)

ABSTRACT:

Hermetic storage or Organic-Hermetic storage is a storage system which is sealed with a modified atmosphere. In hermetic storage, sealed, airtight units are used to control the quantity of oxygen for controlling the store insect for dry agricultural commodities. Under the sealed air-tight conditions, the respiration of grains and insects present in the storage bags continues which results in reducing the oxygen level and increasing carbon dioxide. Because of reduced oxygen and increased carbon dioxide levels, the insects inside stored grains dies. It is also a very effective means of controlling grain moisture content because of the low permeability. Hence there is reduced cracking of grains which results in high grain recovery. Hermetic storage is suitable for many commodities and seeds/ grains, particularly in hot, humid, tropical regions. The hermetic storage is a way to reduce the attack of insects and fungi on the stored food. In hermetic storage, there is no use of chemical pesticides it is complete environmentally safe and sound method of storage.

1. INTRODUCTION :

In hermetic storage, an impenetrable obstacle is placed between the grain and the outside atmosphere. Because of impermeability to moisture from outside, the moisture content of the stored grain is remain same when the storage was sealed. Due to respiration of insects and grains inside the sealed container, the remaining oxygen is consumed and hence reduced oxygen and increased carbon dioxide level. Because of the reduction in oxygen causes unfavourable to most insects and insects die. Hermetic storage is important as it provides insect control without using pesticides[1].

Most of the times, in storage, there is always the problem of fungi and bacteria. If the environmental humidity is high, then the infection of these microorganisms increases by increasing the respiration processes within the stored commodities. These microorganisms are mostly aerobic in nature and hence they need oxygen for their development. The relative humidity ranging between 65% to 85% is suitable for development of most of the microflora. Hermetic storage helps in keeping the moisture content at stabilised level as it is when the

grains or seeds are stored after proper drying. In continents like Africa, Asia, South and Central America, hermetic storage systems are commonly used for storing agricultural commodities[2]. There are different types of hermetic storage systems which helps in reducing insect pests organically.

Types of hermetic storage systems:

There are various types of hermetic storage systems which can be made from specially designed PVC containers. They are as follows:

Cocoons :

Cocoons are commercially available hermetic storage structure and manufactured by GrainPro. It consists of two plastic halves which are joined together with an air-tight zipper. In these two plastic halves the grain sacks which are to be stored are loaded and then these halves are joined together by an airtight zipper. As compared to traditional storage systems, in cocoons the germination life of seeds can be extended. In cocoons, insect pests in grains/ seeds can be controlled without using chemical pesticides. These structures improve the head rice recovery of stored paddy[3].

In this structure, the flow of oxygen and water is reduced between the stored grains / seeds and the outside atmosphere. Generally, due to the respiration of grains and insects inside the bag, the oxygen levels reduce from 21% to 5% in properly sealed containers or cocoons. Because of reduced level of oxygen inside cocoon, the insects present in the sealed bags get died and the live insects reduces to less than 1 insect/kg of grain without using insecticides often within 10 days of sealing. As the moisture content inside the cocoon do not increase or decrease, hence it prevents wetting and drying of grains. This reduces the extent of grain cracking and hence head rice recoveries are higher upon milling[3].

General guidelines regarding storing grains in the cocoon:

1. Before storing the grains in the cocoon, clean the seeds or grains and dry to the correct moisture content. For seeds, moisture content should be 12% and for grains, it should be 14%). It is better to use analog moisture meter to take readings.
2. The Cocoon should be cleaned and undamaged.
3. The Cocoon should be sealed according to the recommendation of manufactures.
4. The containers should be stored under shade or cover.
5. Usually an oxygen meter must be used to measure oxygen content inside the cocoon daily, and once the oxygen has dropped, the oxygen content can be measured using oxygen meter weekly to monitor that the cocoon is properly sealed.

But sometimes, due to poor management, the oxygen levels are higher than expected in the cocoons. Hence to avoid this, the following points should be considered:

1. Due to frequent, opening and closing of cocoons, the oxygen re-enter in the stored seed/ grain bags. And because of this, the rapid re-infestation of some insects such as lesser grain borer can observed which can pierce plastic liners.

2. If cocoons are not placed properly or managed correctly, they can be damaged by rodents. Hence to avoid this, pull plastic liners tightly and keep the space around the containers.
3. Mechanical damage or cuts on the cocoon can also allow the entry of oxygen and moisture causing re-infestation of insect pests.

Super bags :

The super bags are also used for hermetic storage of grains/ seeds. These super bags are available in 50 and 100 kg sizes also. Super bags are used as liners to conventional jute or woven polypropylene bags. In IRRI Super Bags, farmers can store sorghum, wheat, pulses, corn and rice and other expensive commodities such as spices, cocoa, coffee and various hybrid seeds safely for longer period[4].

Super Bags have the following benefits over the traditional storage systems[4]:

1. Super bags help to maintain high level of germination and vigour of seeds. They help to extend the germination life of seeds from 6 to 12 months.
2. Storing the grains in super bags, controls the insect pests without using chemical pesticides in ware houses.
3. Because of storing the grains in super bags, it avoids entry of moisture from outside environment in the storage bags. Because of that the grain cracking is reduced which improves the head rice recovery of stored grain typically by 10% higher than traditional system.
4. Super bags are useful during the transportation and distribution of seeds/ grains.
5. Storing the grains in super bags helps to sell seed and grain over a longer period and to get better price.
6. Super bags helps in reducing physical losses.

Super bags also deplete the flow of oxygen and water between the stored grains / seeds and the outside atmosphere. Like cocoons, when super bags are properly sealed, the oxygen levels inside super bags exhaust from 21% to 5% due to respiration of grains and insects inside the bag. Because of the reduced level of oxygen to lethal level, the insects present inside storage bags reduces to less than 1 insect/kg of grain without using chemical insecticides. And this happens generally within 10 days of sealing.

The grains/ seeds can be stored inside the super bags by following these steps.

1. The super bag is placed inside an existing type of storage bag of woven polypropylene or jute bag.
2. Fill the super bag with dried seeds or grains.
3. Grains should be dried to less than 14 per cent moisture content and seeds should be dried to less than 12 per cent moisture content.
4. Before sealing the bag, as much as possible air should be removed from the bag. The mouth of the bag should be closed by twisting the upper plastic portion above the grain and it should be folded in two.
5. Then the twist should be tie off with a strong rubber band or adhesive tape.
6. After that the outer jute or woven polypropylene bag should be closed. It is important that there should not be any puncture or damage in the super bag.

While using the super bags, following precautions should be taken :

1. The bag should not be over filled with grains, seeds or other commodities.
2. The super bag should not be punctured or damaged.
3. The grains should never be carried only in the super bag, but the super bag should always be covered with the outer bag while carrying.
4. Proper sealing of bag is necessary. .
5. After certain period, checking is required. If there are insects inside the bag it is not sealed properly. Checking for leakages and re-sealing is also important.

Locally available containers :

They are useful in rural areas and also useful for household purpose. The locally available containers can be easily converted into hermetic storage systems.

The commonly available containers may include water bottles, vegetable oil containers, etc. In African countries, about 5 to 20 litre vegetable oil containers are commonly used in villages to store beverages[5].

In Champaran, Bihar, beri is an outdoor structure used for storing grains hermetically. The structure is prepared with bamboo strips or locally available reeds. Beri is generally round in shape and always plastered with mud. This structure is constructed on reeds or on stone slabs or bricks. This helps to protect grain from rodent damage and also prevents taking up moisture from the ground. The roof of beri is made from straw[6].

Advantages of hermetic storage[2][7] :

1. Hermetic storage system is largely used to store rice, jowar, maize and wheat. Storing rice in hot humid climate for longer period is difficult task because of the problem of insect infestation, fungal infection, rodents attack in storage which affect the quality of seeds and grains. But hermetic storage of rice helps in reducing insects, fungi and also keeping moisture content stable, storing the rice for longer period without affecting quality of grains and seeds.

2. Hermetic storage of maize, sorghum, beans and wheat in cocoons is also done on large scale in many countries. Storing these seeds/ grains in cocoons help in reducing the insects initially present in storage bags due to death as oxygen level reduced and no re-infestation observed. It also helps in preserving the germination potential of the seed.

3. The agricultural commodities can be stored qualitatively without using chemical pesticides.

4. The seeds can be stored for longer period without much affecting the germination rate and vigour of seeds.

Precautions to be taken in hermetic storage[8]:

1. Frequent opening and closing of containers should be avoided because it may lead to re-infestation of insect pests and also infection of microflora.

2. In case of super bags, the plastic liners should be pulled tightly so that maximum air should be removed from the bag.

3. The containers should be kept little away from each other so as to avoid the problem of rodents.

4. The containers should not be punctured or damaged.

References:

1. https://en.wikipedia.org/wiki/Hermetic_storage. 21/06/2018.
2. Villers, P., de Bruin, T. and Navarro, S. (2006) Development and applications of the hermetic storage technology. 9th International Working Conference on Stored Product Protection. 719-729.
3. http://www.knowledgebank.irri.org/step-by-step-production/postharvest/storage/grain-storage-systems/hermetic-storage-systems/cocoon. 21/06/2018.
4. http://www.knowledgebank.irri.org/step-by-step-production/postharvest/storage/grain-storage-systems/hermetic-storage-systems/irri-super-bag. 21/06/2018.
5. https://www.researchgate.net/publication/316379137_Hermetic_Seed_Storage_Technology. 21/06/2018.
6. http://www.iskconvarnasrama.com/home/traditional-ways-of-storing-grains. 27/06/2018
7. http://www.knowledgebank.irri.org/postproductioncourse/index.php/storage/advantages-of-hermetic-storage-systems. 21/06/2018
8. http://www.knowledgebank.irri.org/step-by-step-production/postharvest/storage/grain-storage-systems/hermetic-storage-systems. 21/06/2018.