

Eco-Friendly Zero Energy Cool Chamber: Demonstrations

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The Zero Energy Cool Chamber (ZECC) is an eco-friendly on-farm storage system developed to preserve food in a hot, arid climate also for fresh fruits, vegetables and flowers to extend their marketability. Zero energy cool chambers (ZECC) is such a device designed and developed at IARI New Delhi for on-farm rural oriented storage structure which operates on the principle of evaporative cooling and is constructed using locally available raw materials. The ZECC an alternative of common refrigerator. India is a tropical country having Storage of fresh horticultural produce after harvest is one of the most pressing problems. The ZECC also called Evaporative cool chamber (ECC), which are simple and inexpensive ways to keep vegetables fresh without the use of electricity. Lack of transportation facility, shortage of energy supply and lack of investment on storage, lower price of vegetables during the harvesting season, farmers in the rural areas often sell their products to the middleman or in the local market at low prices. They are not even able to get the return of invested money of cultivating vegetables or fruits. As a result, higher percentage of poverty level remains in farmer's community. There is therefore, the need of a low cost storage system such as zero energy storage system which doesn't require electricity for operating to store the agricultural produces in a small scale at farmer's level. Evaporation of water from a surface removes heat, creating a cooling effect, which can improve vegetable storage shelf life. The high moisture content of fruits and vegetables have very short life and are liable to spoil. The spoilage of fruits and vegetables can be controlled by reducing the storage temperature. Refrigerated cool storage is not only energy intensive and expensive, but also involves large initial capital investment.

The final year students of Rural Agricultural work Experience (RAWE) programme demonstrated the Eco-friendly Zero Energy Cool Chamber in their programmes and demonstrated this technology to farmers. The zero-energy cool chamber can be constructed easily with materials like brick, sand, bamboo, straw, gunny bag etc. A ZECC can reduce the temperature by 10-15°C but it keeps humidity high. These are perfect conditions to store produce. Traders can also use ZECCs to store produce at markets so that the produce doesn't waste away under the sun all day.

Multilocal studies at different agroclimatic zones have been found it to be very useful. It is most effective during the dry season.

Materials Needed

Size: 1.5 m wide x 2.15 m long (interior dimensions about 0.7 m wide x 1.40 m long)

Capacity: A ZECC this size can store 6 crates of Vegetables or up to 120 kg of produce

- 800 to 1000 bricks (should be burnt bricks (even local or farm bricks will work)

- 4 m³ coarse sand (or two handcarts)

- **Tools:** Hoe, rake, shovel, watering can, measuring tape

Site Preparation

1. The site needs to be on flat ground, under shade and near a water source.
2. Level it with a rake and clear away any debris.
3. Add a layer of sand, raked flat. This is the foundation and helps with drainage.
4. Make a frame of top cover with baboo frame and straw or dry grass etc.
5. Keep the sand, bricks and top cover of the chamber wet with water.
6. Water twice daily in order to achieve temperature and relative humidity.

Application of ZECC

- Short term storage of fresh vegetables, fruits and flowers
- Growing of white button mushroom
- Ripening of tomato and banana
- Plant propagation
- Storage of processed fruit products

Advantages of ZECC

- Avoid distress sale of fresh fruits, vegetables and flowers.
- Better marketability of fresh horticultural produce than ambient
- Retain nutritive value
- Environment friendly storage system with no pollution

Suitability of ZECC

ZECCs provide the most benefits when they are used in low humidity climates (less than 40% relative humidity), the temperature is relatively hot



(maximum daily temperature greater than 25 °C), water is available to add to the device between one and three times per day. The device should be located in a shady and well-ventilated area.

Additionally, storage conditions must meet users' needs for scale of storage needed and optimal conditions for different vegetables throughout the year. The cost of the ECC must be affordable and justified by the benefits be realized due to its improved storage.

The size of a ZECC can be chosen to meet a range of user storage needs; however, the cost can vary significantly based on desired size and local cost of materials. Because ZECCs can be constructed over a range of sizes, it is important to select an appropriate

size according to the need, to avoid over-building and spending more money than is needed.

Inside the ZECC, food is placed in unsealed plastic containers, which keep the vegetables off the ZECC's floor and allows them to breathe and be exposed to the cool, humid air inside the device.

It is important that ZECCs is correctly used to ensure maximum cooling performance benefit for the user. Improper use decreases the potential benefits and results in a lower cost-benefit ratio. The vegetables that need storage should be carefully considered, since not all produce can be stored together because some release ethylene, which can accelerate ripening or reduce post-harvest quality.

Before starting to build an ZECC, a location should be chosen that is close to water, exposed to wind/breeze, and if possible, where there is shade to avoid the need of a cover. ZECCs should be reinstalled every 3 years with new bricks. The cover of the ECC should be opened as infrequently as possible to keep the cool air in. The sand between the bricks must be kept wet, installing an irrigation system can make this process simpler. Additionally, water should be sprinkled on the cover 1-3 times per day.

ZECC had a maximum efficiency during the summer season. The rise in relative humidity (90% or more) and fall in temperature from the ambient condition could be achieved by watering the chamber twice a day.
