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Drying Beads- A Novel Approach in Dry Chain Technology

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SUMMARY

The concept of drying products and maintaining their dryness with hermetic storage is called the "Dry chain". Similar to the cold chain. Appropriately dried and packaged, commodities don't require any additional cost to maintain their quality and safety. Drying beads are modified ceramic materials (aluminium silicates or "zeolites") that specifically absorb and hold water molecules very tightly in their microscopic pores. The beads will continue to absorb water until all of their pores are filled, up to 20 to 25% of their initial weight. Seeds (or other materials) placed or kept in contact with into a container with the beads will lose water due to the low air humidity and will continue to do so until they come to equilibrium. Desiccant-based drying simply transfers the water from the seed to the drying beads through the air without the need for heating. Drying and dehydration is one of the most energy-intensive processes employed within the food processing industry. In fact, these processes account for 15% of the entire energy expenditures within the fruit and vegetable industry. In one way, the drying beads lower energy expenditures by intensifying drying kinetics and removing more water from the air than otherwise possible. It is a suitable technology to small scale farmers and seed companies to store precious seed material for a longer period.

INTRODUCTION

With an increasing population put pressure on food supplies, about one-third of the total food produced for human consumption is wasted, with the majority of loss in developing countries occurring between harvest and the consumer. Controlling product dryness or reducing the moisture content in product is the most critical factor for maintaining quality in stored non-perishable foods and seeds. The high relative humidity prevalent in humid climates elevates the moisture content of dried commodities stored in porous woven bags, enabling fungal and insect infestations. Mycotoxins (e.g., aflatoxin) produced by fungi in insufficiently dried food commodities affect 4.5 billion people worldwide. Elevated moisture content (MC) of stored foods is the primary cause of storage mould growth. Generally, toxigenic moulds can only grow and produce toxins at an equilibrium relative humidity (ERH) above 85%.

Delivering improved seeds to smallholder farmers in the developing world is an efficient and sustainable method of increasing crop yields and quality. Unlike fertilizers, pesticides and equipment, seeds can be produced locally for distribution to farmers or self-saved. Furthermore, improved varieties of horticultural crops often reduce dependence on synthetic pesticides, improve food safety, reduce pre- and post-harvest losses and fetch higher prices in the market. However, the benefits that developing world farmers accrue from improved varieties

can depend on their local systems for seed drying and storage. Without proper storage conditions, seeds can rapidly lose viability, resulting in poor crop establishment, lack of uniformity, reduced yields and poor marketability. Farmers' experience with poor seed performance lowers their incentive to invest in genetically improved seeds and stymies development of breeding and seed marketing systems for more productive horticultural varieties. On the other hand, farmer confidence in the quality of purchased seeds and in their ability to store them safely will strengthen local seed markets and increase yields and incomes. Seed storage can be a major problem because the majority of the world's poor countries are located in the tropics, where the combination of high temperature and high relative humidity causes rapid deterioration of seed quality. In South Asia, seeds harvested before or during the monsoon season need to be dried and stored until the next planting season.

The relative humidity of the air for most of the period between harvest and planting often exceeds 75% and temperatures remain above 30°C, causing seeds to deteriorate rapidly. Seeds absorb water from the ambient air when they are stored in humid environments and lose water when stored in low relative humidity. Generally speaking, a seed's longevity is reduced by approximately half for every 1% increase in seed moisture content (water content as a percent of fresh weight) or 5°C increase in temperature, and the effects are additive. Thus, seeds stored at 10% moisture content and 30°C will last only one-quarter as long as seeds stored at 9% moisture content and 25°C. This principle implies that seed storage life can be enhanced considerably by lowering both moisture and temperature. However, moisture content is the key factor that can be lowered for successful seed storage in tropical countries. Cold storage is expensive and difficult to maintain because electricity supplies are often inconsistent and unreliable. In addition, seeds that are dried to low moisture contents are more tolerant of storage at warm temperatures. However, even prolonged sun drying in high humidity's cannot reduce seed moisture content to the levels low enough to assure long-term viability. These problems can be overcome by drying seeds to low moisture contents using inexpensive hermetic containers and zeolite drying beads, a recently developed desiccant technology. Using drying beads, seeds can be quickly and efficiently dried to safe storage moisture contents, and storing seeds in hermetic containers not only maintains low moisture contents, it also prevents losses to rodents, insects and molds.

Drying beads

Drying beads are modified ceramic materials (aluminium silicates or "zeolites") that specifically absorb and hold water molecules very tightly in their microscopic pores. The beads will continue to absorb water until all of their pores are filled, up to 20 to 25% of their initial weight. Seeds (or other materials) placed into a container with the beads will lose water due to the low air humidity and will continue to do so until they come to equilibrium. Hence, desiccant-based drying simply transfers the water in the seed to the drying beads through the air without the need for heating. Drying Beads only hold water molecules and after reactivation processes keeps the original water-holding capacity overtime. Drying beads are ceramic product with crystalline structure very resistant and durable. These has longer lifetime than any other desiccant. Compared with all other desiccants, drying beads combine better performance, efficiency and long lifetime making it a very economic system.

Characteristics of drying beads

- Micro porous materials
- Uniform pore dimensions
- Thermally and mechanically very stable
- No polymerization during heating
- Adsorption at high temperatures
- Non-toxic, food grade
- Absorbs about 20-25 weight % water

Procedure for using of drying beads

Beads can be mixed with the seeds for fast drying, and can be easily screened out from the seeds for reuse (beads can be produced in different sizes to be easily separated from various types of seeds). And also, the beads can be enclosed in a porous bag or container within the hermetic container for convenience. The

requirement is that beads and seeds be in contact with the same atmosphere that is sealed from the external atmosphere. Wet seeds, such as fresh tomato or brinjal seeds, should be surface dried by the sun or other method before mixing directly with seed drying beads (Ashok *et al*., 2017).

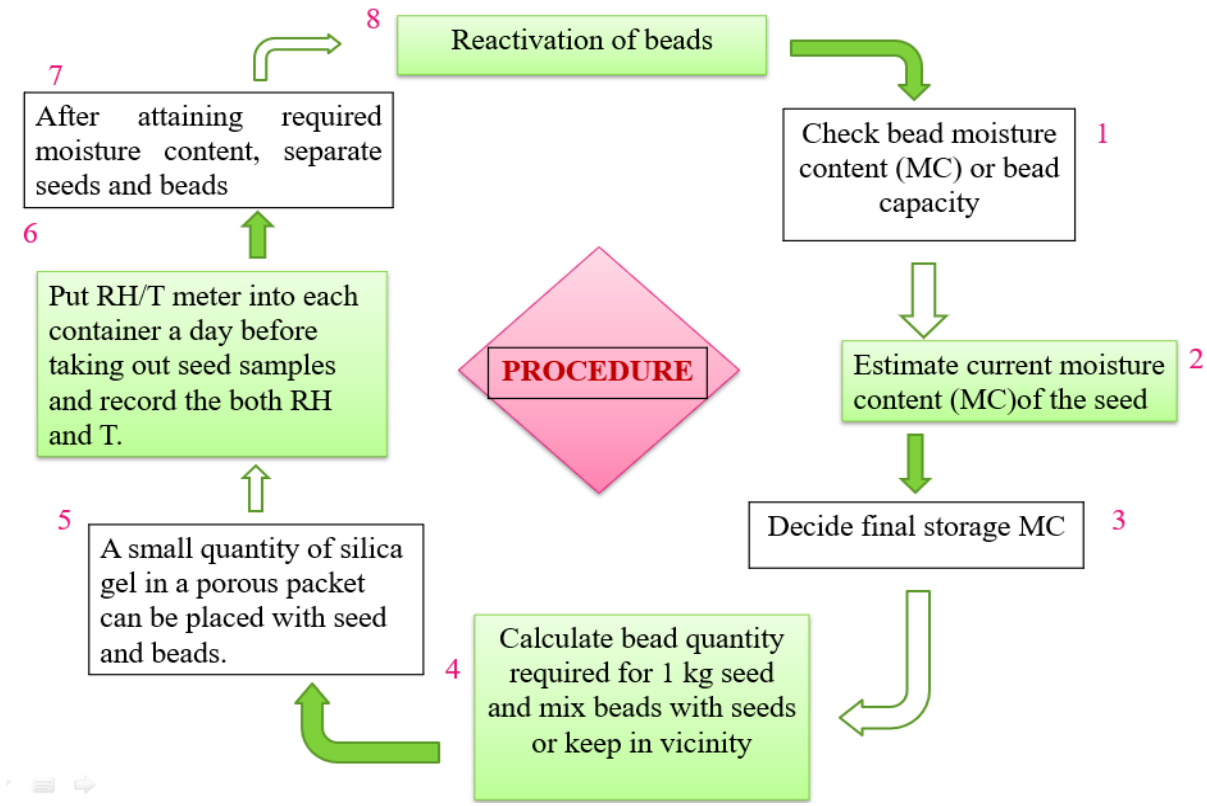

Fig: Procedure for using of drying beads

Reactivation of drying beads

- To regenerate the beads for reuse with an oven or other heat source. This can be any type of oven capable of heating to 200°C. For example, an oven for baking bread could be used to regenerate the beads.
- Heat the beads for 2hrs at 200°C

Advantages

- Can dry seeds to a specific and low MC (2-3 %)
- Protects from molds, insects and rodents
- Can re-use desiccants
- Seed quality is preserved for several years
- It further delays ageing by absorbing toxic gasses – Ethylene
- Used in Humid regions
- Conservation of germplasm for longer period
- Used for the post-harvest drying and processing industry
- No need for cold storage to maintain seed viability

Disadvantages

- Initial Investment cost is very high.
- Separation of desiccants from the seeds is difficult, again it requires labour to separate.
- If the color indicators are not used for ultra-drying may cause overheating and desiccation problem will occur so that the germination percentage of seed will be decreased (Arjun and Paudel Pratima, 2014).

CONCLUSION

High seed moisture is more injurious to seed as increases the metabolism and favors the growth of microorganism at higher temperature. Recently, Zeolite beads have been developed which can be used as drying desiccant. The Zeolite beads have an extremely high capacity to adsorb water, even at very low air humidity, making it feasible to efficiently dry and store seeds at low RH. It is a suitable technology to small scale farmers and seed companies to store precious seed material for a longer period.

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