Carbon dioxide fumigation technique to control insect pests in stored products

Fumigation is the main insect control procedure for stored products in Thailand. Methyl bromide and phosphine are among the widely used fumigants. In Thailand, the technique of using carbon dioxide treatment to control insects in milled rice storage was initiated many years ago.

Carbon dioxide (CO_2) is a fumigant that produces no harmful residues and is relatively safe to use. It is effective in killing insects in all stages of their life cycles and could be used for long-term storage of products. Nowadays, CO_2 is the only fumigant that can be used to control insect pests in organic product storage. CO_2 fumigation should be practiced under completely sealed storage, and concentration must be maintained at 35% or higher during the first 15 days.

The study on using carbon dioxide fumigation to control insect in milled rice in sealed plastic enclosures used the *Suggested recommendations for the fumigation of grain in the ASEAN Region: Carbon dioxide fumigation of bag-stacks sealed in plastic enclosure*. PVC plastic sheets of 0.2, 0.25, and 0.3 mm thickness were used for the efficacy test of maintaining carbon dioxide gas during 2-6 months storage. Results showed that 0.25 and 0.30 mm thickness of plastic sheets have the same level of effectiveness in maintaining carbon dioxide gas. Both thickness can maintain carbon dioxide concentration of more than 35% for 15 days after fumigation. Results also revealed that the size and the height of rice stack and the folding of the plastic sheets at the corner of the stack have some effects in maintaining the carbon dioxide concentration and also in the survival of the insects.

Stacking

The stack should be built based on good storage practice condition (Fig. 1). The floor sheet should be at least 0.5 mm thickness and should be longer and wider than the base of the proposed stack. The floor should be inspected for holes, tears, weak spots, and manufacturing faults before the stack is built.

Sealing

Seal the cover sheet and floor sheet together with solvent-based PVC glue (Fig. 2). Silicone mastics can be used to completely seal gaps or small holes.

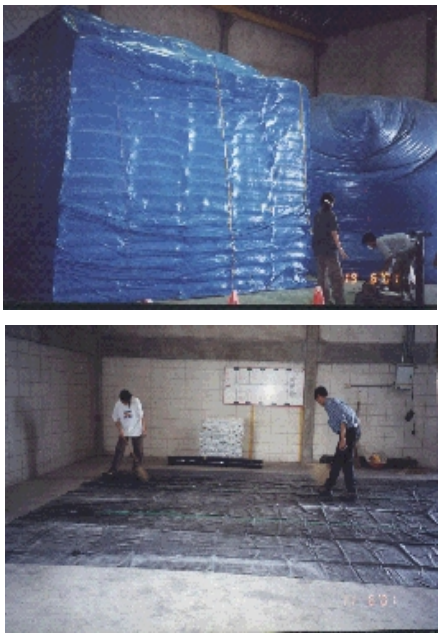

Fig. 1. Stacking

Fig. 2. Sealing

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Inlet Port

Set the inlet port for filling the gas near the floor at the bottom of the stack (Fig. 3).

Outlet Port

Set the outlet port on top of the stack (Fig. 4).

Pressure Test Standard

The tightness of the gas enclosure is measured by the time required for negative pressure of 500 Pascals (5 cm of water gauge) to fall to 250 Pascals (2 cm of water gauge) (Fig. 5).

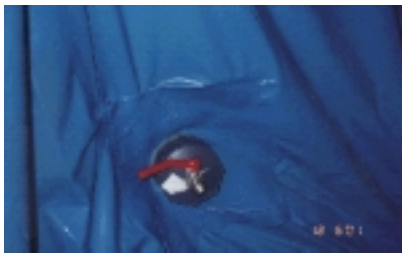

Fig. 3. Inlet port

Fig. 4. Outlet port

Fig. 5. Pressure test standard

Gas Introduction

Filling gas into the sealed stack must be done quickly. Invert the cylinder and connect it to the inlet pipe (Figs. 6 and 7). As the gas is released, the pressure inside the cylinder falls rapidly, causing the temperature to fall substantially and the carbon dioxide to freeze.

Dosage Required

The required dosage is determined by monitoring the concentration of carbon dioxide at the top of the stack (outlet). Gas filling should stop when the concentration exceeds 75%. The concentration of carbon dioxide must be monitored during the first 15 days of exposure period. It must remain at or above 35%.

Benefits

Carbon dioxide treatment is effective for controlling pests of stored products, especially organic commodities. It is also an efficient method for long -term storage.

Fig. 6. Gas introduction

Fig. 7. Gas-filled stack