SUMMARY OF CA STORAGE IN CHINA

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The principles of CA storage have been applied in China for many years. It has only been since the sixties that this technology has been studied in theoretical research. There has been tremendous development during the last 10 years. Today various types of research set-ups have been established with comparatively good testing facilities. Some optimum storage data has been obtained. Different types of CA equipment have been designed and manufactured in China with good and reliable performance. In February 1978, a 20-ton testing CA store that could be automatically controlled and data recorded was built which was the first of its kind in our country (1, 2). Yali, a very popular kind of pear grown in Hebei province, was preserved in this CA store. After storage it met with the quality requirements in the international market and thus sold at a better price. On the basis of this experience gained from the testing CA store, a number of small-sized CA stores have been built or rebuilt since then.

Due to the situation that the country suffered over the past decade, the bigger part of fruits produced in our country are stored in conventional warehouses, underground storehouses, and cavehouses relying upon the natural conditions. The shelf-life is usually limited and the quality cannot be guaranteed. Apples are exported to Hongkong from July to the following April and citruses from October to next April. Every year there is a big decrease in the sale of fresh fruits in the domestic market after October. Currently, China cannot preserve the fruits all the year round for the international market nor the domestic market.

Existing conventional coldstores with plastic tents covering them have been used for CA storage of apples (3). This method cannot be popularized due to its lower volume utility (only one-half to one-third of that of conventional coldstores), inconvenience in the management of the tent, and easy damage to the tent. The gas composition is unstable and the tent has to be replaced after being used for no more than 2 or 3 years.

With the growth of foreign trade and a continuous increase in the living standards of the people, there is an increasing need for fresh fruits in the home market. China is urgently in need of research and development of the advanced technology in the field of fruit storage and looks forward to a bright future in this area.

How a Modern CA Store is Built in China

Enclosure Structure

The way of building the modern CA store is similar to that of the conventional coldstore. Its enclosure wall is made of masonry construction, precast construction or cast-in-site reinforced concrete construction. The vapor barrier, insulation and gas seal are respectively applied on the inner side of the wall. Usually the gas seal is placed directly upon the surface of the interior wall. Generally, one layer of asphalt felt with two layers of bitumen are used as vapor barrier, and polystyrene sandwich panels, cork or rice husk used as insulation. The floor is constructed from bottom to top as follows: concrete, vapor barrier made of two layers of asphalt felt, insulation, gas seal, and reinforced concrete slab finishing. The materials for the gas seal previously used are galvanized steel sheets, rubber boards, hard polyvinyl chloride plastic sheet and polythylene film. Recently a kind of coating material to be painted directly on the surface of the enclosure wall has been tested. It is likely to be used in the near future due to ease of application and cheaper building cost.

The prefabricated CA room has a number of advantages, such as its lower initial investment, simpler assembly, shorter construction period, economic artistry and it is in good keeping with the sanitation standard. We are planning to build a CA room with the prefabricated sandwich panels, which are used to build the conventional fish, meat and fruit cold stores.

Gas Sealed Door

One type of door used is a removable one made of plastic film or aluminum alloy sheets, which is fixed on the door frame. The door threshold is removable. The gap all around between the door and the threshold is sealed with sealing compound.

Another type of door that is used is gas tight and insulated completely. The gas chargeable rubber tube is placed all around the door. Angle steel is fixed around the doorframe and is pressed to the other angle steel fixed on the door skeleton. The sealed rubber tube is gas charged to a certain pressure.

Gas Generators

Gas-flushed type high temperature burning generator. The compressed air is charged into the burner, which is equipped with flame controller and kerosene is used as a burning source. The burning results in a mixed gas with the levels of N_2 85% and CO_2 14%, which is used to replace the air in the cooled CA store.

Recycle type catalytic burning generator. Liquified gas, propane, or gasoline is used as fuel. The gas in the CA room is drawn and burnt and then returned back after being cooled. This equipment runs with a high level of automatic control and simple operation, and results in wide applications in the commercial fruit stores.

Research work has been done on catalytic beds with a comparison between various reactors such as multi-pipe reactor, adiabatic reactor with preheating feed, etc. (4). At present, research work on a new reactor is being carried out. Composite chromium is used as a catalyzer which is superior to the platium catalyzer in cost, supply and anti-sulphration (5).

Coke molecular sieve type device. Based on the principle of boost adsorption, negative pressure desorption and evacuation, the gas can be purified to a high level of nitrogen 94-99%. As the device does not require any fuel where there is electricity, it can be put into operation easily. Moreover, as the gas supplied by this device does not contain any moisture, the device finds a comparatively wide application, especially for the storage of grain, Chinese herbal medicine, etc. which require a lower level of relative humidity. Furthermore, this device has an ability of removing ethylene during the absorbing process. The device is employed in the CA storage of tomatoes without the help of any other CA equipment such as a CO_2 absorber. Excellent results have been obtained (6). Further research work is being carried out to change the vacuum desorption over to a normal pressure desorption, to simplify the device and lower its cost.

CO_2 Absorbers

Lime absorber. Lime was directly spread over the floor of the CA storage room to absorb CO_2 in proportions of 100 kg apples per kilogram of lime. This method is no longer being used due to its low absorptivity and high labor requirements.

Carbon absorber (7). This unit consists of two cylinders filled with activated carbon, equipped with three sets of connecting pipes and valves. One cylinder operates on the stage of CO_2 absorption from the gas drawn from the CA room and the other operates on the stage of blowing in fresh air for regeneration. If the change-over from adsorption to regeneration and vice-versa occurs continuously, the level of CO_2 in the CA room can be decreased to less than 0.5%.

Pressure Relief

Breather bags and water traps. Both have been commonly used. The level of the water in the trap is maintained at less than 10 mm water column, which is subjected to both positive and negative pressures in CA room. Generally the CA room is only equipped with a water trap. In some cases, both water trap and breather bag are installed together.

Humidification

Humidifiers are used to keep a high relative humidity in the CA storage. The methods of humidification used are:

1. Sprinkle the floor with water before produce are stacked into the CA room.

2. Electrical steaming humidifier

3. Water spraying humidifier

Water spray is superior to an electrical steaming humidifier. The water spray devices used at present spray water particles that are too big. These particles cannot be completely vaporized before reaching the produce and hold to the surface of the produce containers. As a result the containers become damp and cause the stack to be toppled if carton boxes are used.

If the storage room needs a high level of relative humidity, it is important to have the proper refrigeration system and air cooler. At present, a ceiling extrusion air cooler with a large coil surface and minimized power consumption is being adapted for use in fruit storage rooms.

Removal of Ethylene

Foam material fully absorbed with a saturated solution of potassium permanganate is placed in containers filled with fruit to remove ethylene. This method can be used successfully but is labor intensive, inconvenient and it is difficult to control the absorption rate. Therefore, an ethylene removing device is being developed for commercial application.

Gas Analyzer

Polarogram type O_2 analysis apparatus and CO_2 conductometers are used for routine analyses. Orsat gas analyzers are utilized periodically for analysis at the CA room.

The polarogram type O_2 analysis apparatus works on the principle that the electric current is proportional to the O_2 concentration in the gas as it diffuses over the diaphragm and into the cathode. This generates electrolytic current which is amplified and the level of O_2 is indicated on the display panel.

As the gas sample from the CA room is pumped through the CO_2 conductometer, the CO_2 is absorbed by basic asbestos. The level of CO_2 is displayed on the panel directly through the differentiator.

The ethylene level in the CA room is usually not tested because of complicated testing procedures. Samples can be sent to a research institute for analysis with a gas-chromatograph if necessary.

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