DESIGN PROCEDURES FOR CONTROLLED ATMOSPHERE STORAGES

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The most recent trend in storages for apples is by controlling the atmosphere in which the fruit is contained to very fine limits with respect to oxygen, and carbon dioxide.

The technique has been well known to horticulturists for several years but is only gaining true acceptance in Canada at the present time as a practical method of holding apples for an extended period.

Controlled atmosphere storage presents a very interesting and provocative field to the Agricultural Engineer for the challenge to design a structure which is both efficient in operation and containing almost perfectly sealed storage chambers is present in this type of storage.

It should first be explained that controlling the atmospheric conditions in storages where apples are contained actually limits the respiratory rate of the apples to such an extent that the fruit is placed in a state of "suspended animation". This term, while not commonly used with any thing but animal life, can be applied to fruit because even though detached from a tree the fruit is a living object. That is, respiration does go on because fruit sugars are oxidized in the presence of oxygen in the air and as a result carbon dioxide, water vapour, and heat are produced. It has been observed in all types of storages that the more rapid the rate of respiration the quicker fruits break down or deteriorate.

The process of respiration can be retarded by low temperatures which is a standard method of storage. Other principles, such as decreasing oxygen, which is necessary in respiration, and increasing carbon dioxide, may be exployed to assist the refrigeration practices, the summation of these principles being controlled atmosphere storage.

The first requirement in a controlled atmosphere room is gastight construction and by proper design close to 100 per cent tightness should be attained.

It is thus necessary to observe the gas condition in the room periodically and a gas analysis must be made two or three times daily to ensure close control of conditions inside the room. An Orsat analyser is used to observe conditions from outside the chamber since the low content of oxygen will not permit observations inside unless absolutely necessary and even then respirators must be used.

Carbon dioxide is a product of respiration and increases while respiration takes place. If the total percentages of oxygen and carbon dioxide reaches 21 per cent ventilation can be employed but if the atmosphere does not contain a total of 21 per cent but rather quantities such as 3 per cent oxygen and 5 per cent carbon dioxide to operate satisfactorily any quantities of carbon dioxide over 5 per cent must be "washed" out of the air. This is usually done by means of an atmospheric washer using caustic-soda solution as a washing agent.

Since control of temperature and air tightness are essential qualities in the C.A. rooms rigid design and construction procedures must be followed. Insulation of walls and ceilings should be carefully applied using 4 inches of cork board or equivalent in the walls and floor, and 6 inches of cork board or equivalent in the ceiling. Vapour barriers are imperative and heavy kraft paper with asphalt binding has been used successfully.

The seal on the interior of the rooms must be given special consideration to provide a minimum of leaks. The most successful liner thus far is a series of galvanized metal sheets of twenty-eight gauge with overlapper joints each joint being overlapped by 1½ inches and cemented with a high grade caulking compound. Large headed galvanized roofing nails are spaced about 2 inches on centre to give a tight seal but each nail must be finally covered with a good bead of caulking compound.

Normal stud wall construction is permitted if the sealing qualities of the lining is not impaired but at least 2 inches of cork should cover the entire face of the stude while another 2 inches or more should fill the space between the studs. The layers of cork can be fastened together by wood skewers which limits the transfer of heat through the wall.

Cork is an excellent insulation material provided it is not in contact with moisture but readily crumbles and fills the bottom portion of the wall if attacked by water vapour.

The floor is constructed by filling up to platform level with fill and gravel, well tamped, and then topping with a layer of concrete about 3 inches thick. At this point in the construction it is recommended that the galvanized side wall liner be continued so that it covers at least 1 foot of floor, thus giving air tightness at the foot of the walls. A vapour barrier may now be placed on top of the 3 inches of concrete and 4 inches of cork-board placed above this to ensure good insulation. A final 4 inches of reinforced concrete can now be laid to carry the load from the storage product and machinery used within the chambers.

It is good practice to leave a gap of ¾ inch to 1 inch at the perimeter of the top layer of concrete which can be filled with an asphalt compound to allow for expansion and contraction.

Some storages have attached 1 inch by 2 inch material to the walls by means of caulking compound to provide air space around the fruit boxes for proper air circulation. Others have provided a bumper board about the storage rooms to provide ventilation space and also to prevent damage to the metal walls by loading equipment.

The only equipment in the room is an evaporator with blower and duct work and the caustic soda spray chamber.

Each chamber is tested under air pressure to ensure positive seal before loading takes place. This can be done by releasing carbon dioxide from cylinders until the room is pressurized and leaks observed.

Since air escape is critical no floor drains can be installed unless tightly trapped so washing of the floor is not