

Carbon Dioxide Control in Apple CA Storages Using Hydrated Lime

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Freshly hydrated, high calcium lime ($\text{Ca}(\text{OH})_2$) may be utilized to remove carbon dioxide from CA storage rooms. Bags of hydrated lime placed inside the room will supplement existing scrubbing methods or a dedicated lime scrubber may be used for CO_2 regulation during the storage period.

The amount of lime needed depends on the length of the storage period, the apple variety, storage temperature, atmosphere composition and use of Nitrogen generators, etc. In the past, lime use was based on a half pound of lime per bushel of apples for a three-month storage period. This works out to be 10 fifty-pound bags per 1,000 bushels of fruit. The exact amount needed for a specific set of storage conditions will need to be determined from experience.

Either "chemical" or "agricultural" hydrated lime can be used. Each type is suitable if it is fresh, high in calcium, and of adequate fineness. Particle size is indicated on the bag; at least 95 percent should pass a 100-mesh sieve. Chemical grade is usually finer and more expensive than agricultural grade.

"High calcium" hydrate is more reactive than lime containing large amounts of magnesium. The calcium and magnesium content is stated on the bag in terms of percent calcium oxide (CaO) and magnesium oxide (MgO) contained in the original limestone. For efficient CO_2 removal, the assay should show "70% to 75% CaO " and "less than 2% MgO ."

Only fresh hydrated lime is effective in removing carbon dioxide, and lime will gradually lose its freshness over time because it continuously absorbs CO_2 from the air. The 50-pound bags of hydrated lime will weigh approximately 68 pounds when they have absorbed the maximum quantity of carbon dioxide. If the new bags of hydrated lime weigh more than 55 pounds at the time of

delivery, reject the shipment and order new lime. The bags may have plastic liners that must be punctured before the lime inside is effective for rapid CO_2 uptake. A board with several nails driven through it can be used to punch a number of holes in the side and ends of each bag as it sits on a shipping pallet.

The use of SmartFresh (1-MCP) has made the control of carbon dioxide levels in CA storage rooms more critical than ever. 1-MCP appears to increase fruit susceptibility to external carbon dioxide injury. The critical time for exposure of fruit to high carbon dioxide is in the first month or so of storage.

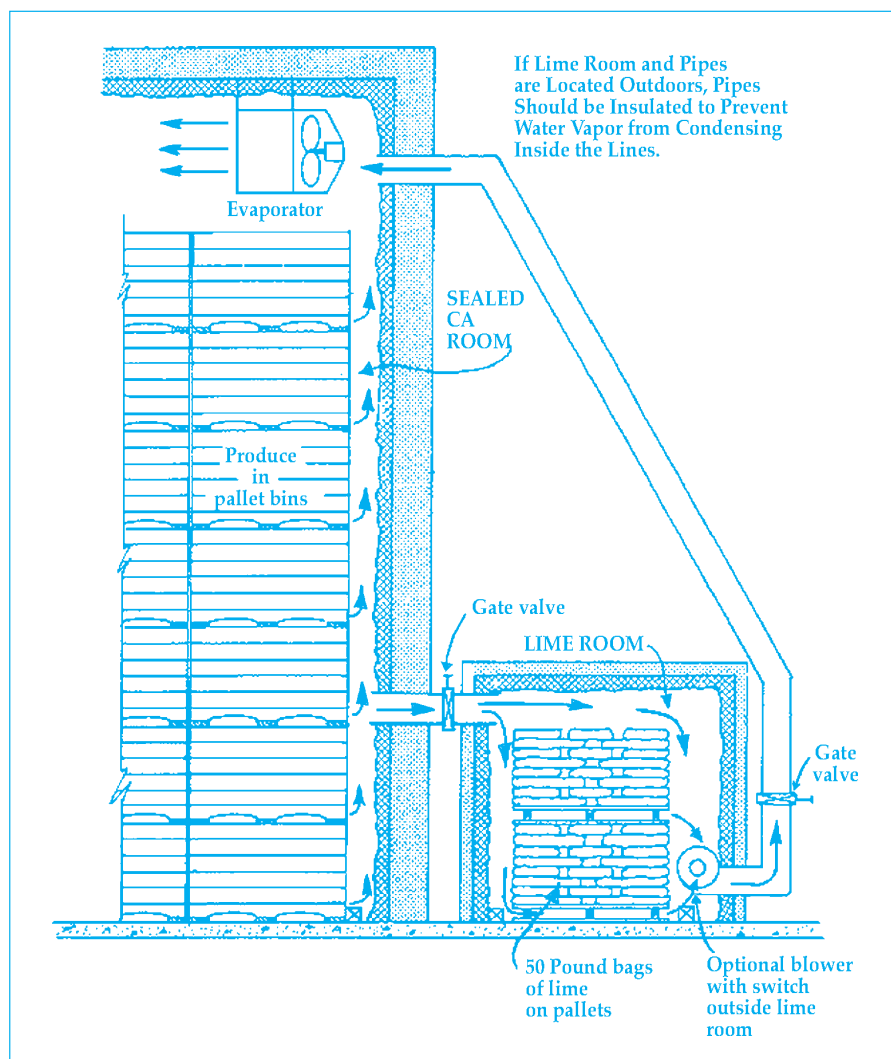


Figure 1. Lime Box Schematic.

If hydrated lime is used to supplement other scrubbing methods, it may be placed directly in the CA room under the evaporator, inside the door, or on a pallet on top of a stack of bins where it does not disrupt the atmosphere circulation in the room. Some heat will be given off as the lime absorbs carbon dioxide, so locate the lime in an area with good air movement away from the room thermometer and refrigeration thermostat sensors.

If lime is used as the only method to remove CO₂ it is usually placed in an airtight box or "scrubber" outside the CA room, adjacent to the wall where the evaporator is located (Figure 1). The lime box may be constructed of plywood or metal, fitted with an airtight door and insulated with urethane foam. Size the scrubber to hold 10 bags of lime per 1,000 bushels of fruit and allow approximately 3.5 cubic feet of internal volume for each 50 pounds of lime. Make sure the box is large enough to provide clearance space for atmosphere circulation around and across bags stacked on a shipping pallet. The lime box door should be large

enough to permit loading and removal of pallets of lime with a forklift.

Replace the lime when the CO₂ level in the room can no longer be held to the desired level. Spent lime (calcium carbonate, CaCO₃) will be a solid lump, but still good for soil application if it is broken up and spread on fields.

Use a 4-6 inch diameter PVC pipe to connect the lime box to the CA room as shown in Figure 1. Connect a similar size pipe to the base of the lime box and extend it overhead and through the wall of the CA room in the vicinity of the evaporator fan intake. The low pressure developed by the evaporator fans is usually sufficient to draw the room atmosphere into the top of the lime box, downward through the stacks of lime where CO₂ is removed, and back into the storeroom. If circulation is not adequate, or if smaller diameter scrubber lines are used, install a small externally controlled centrifugal blower inside the lime room to assist with circulation. Gate valves in the scrubber lines are necessary to regulate scrubbing action or isolate the lime box when lime is changed. If the lime

room is located outdoors, it may be necessary to insulate the lines or place the vertical pipe inside the CA room to prevent condensation or ice buildup inside the pipe in winter. The lime box should be leak tested each time the CA room is leak tested.

References

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