Title Use of liquid nitrogen in CA storage: Theoretical analysis and experimental validation

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Abstract

Liquid nitrogen (LN_2) is a colorless, odorless, low boiling cryogenic liquid. Due to its inertness and high expansion ratio (646 between liquid and gaseous N_2 at 0 °C), it is an excellent material for rapid purging of the initial O_2 gas from the space of the controlled atmosphere (CA) storage. The present study establishes a relationship for predicting the amount of LN_2 required for reducing O_2 concentration in the CA storage. Simulations were carried out for predicting the amount of LN_2 required for flushing at different conditions such as purity level of LN_2, O_2 set point of the CA storage and flow rate of LN_2. The simulation results were validated using the laboratory scale CA storage system having a storage capacity that could hold 10 kg of apples. It was found that higher the purity level lower was the consumption of LN_2. At O_2 set point of 3%, the consumption of LN_2 was found to increase from 0.12 to 0.21 kg when the purity level decreased from 100% to 97.5%. Higher level of O_2 set point was found to consume less amount of LN_2 at a given purity level. Flushing of LN_2 at flow rate of 1.51×10^{-6} m^3/s reduced O_2 concentration more efficiently and also avoided the freezing temperature inside the CA storage.