STORAGE DISORDERS OF APPLES

EXTERNAL CO2 INJURY
- Rough brown or bronze lesions on the skin, often puffy, sunken, with well-defined edges; more common on the non-blushed areas.
- Injury occurs slowly during the CA storage period.
- Susceptibility varies with rapid establishment of CA, especially involving CO2 levels before 800 ppm or lower.
- Low O2 concentrations, (less than 5% O2) treatment, poor ventilation, fence assistance on the skin, and innate factors.

INTERNAL CO2 INJURY
- Sometimes called Brown Sugar, brown sugar injuries on or in many tissues, which is firm or firm but lately becomes dry as ammonia is lost to the surrounding healthy tissue; varies from a discolored center to a dark brown dry-to-fine forming the walls of the sections; external appearance often in green.
- Injury occurs when fruit are allowed to cool during storage.
- Immature fruits with low O2 concentrations, delayed cooling, low storage temperature, and internal fruit.

LOW O2 INJURY
- Possible purple discoloration of the skin, abscission color, and flavor, fruit splitting, large brown, water-soaked lesions on the skin, especially after extended periods of storage.
- Immature fruits with low O2 concentrations, delayed cooling, low storage temperatures, and internal fruit.

CORE BROWNING
- Delayed browning of flesh around the core and carpel, with very no clear distinction between healthy and affected tissue.
- Develops after several months of cold storage and becomes more extensive at lower temperatures.
- Many predispositions to frost that are harvested after extended period of cloudy, cool, or wet weather; incidence is reduced with advanced maturity, delayed cooling, and storage; and lower O2 atmospheres less than 2%.

FLESH BROWNING
- Diffuse browning or the flesh, with a definite radius of the injured area may affect water cores or core tissue, or in some areas, when deficient in vitamin E and some nutraceuticals, the affected areas are less defined.
- Immature fruits with low O2 concentrations, delayed cooling, and storage; and lower O2 atmospheres less than 2%.

LENTICEL BREAKDOWN
- Darkened or black lenticels, or superficial brown tumors, spots surrounding lenticels, may cause vascular system and affect areas of carotenoids.
- Oranges develop following fruit packing in warm storage, the spots grow in depth and diameter and treatment is more consistent.
- High coloration in fruit with normal anthocyanin, harvested with advanced maturity; and stored too long; may be aggravated by being stuck in cold storage, and cooled and O2 concentrations; may be aggravated by being stuck in cold storage, and cooled and O2 concentrations.

VASCULAR BREAKDOWN
- Browning of micro vascular bundle and some adjacent tissue, with inner radiating extension into the flesh in coarser areas.
- Finally develops during the storage period (after 6 months).
- Associated with cool growth seasons, incidence and severity varies with chilling and stress.

ADHERING TO LOCAL CA RECOMMENDATIONS FOR SPECIFIC APPLE CULTIVARS AND HAVING ACCURATE GAS CONTROL WITH LITTLE ATMOSPHERIC AND TEMPERATURE FLUCTUATION GREATLY REDUCES THE LIKELIHOOD OF DEVELOPING THESE DISORDERS

SUPERFICIAL SCALD
- Diffuse browning or bruising of the skin, often confined to the non-blushed areas and cultivars.
- Develops after several months of cold storage and becomes more extensive at lower temperatures.
- Aggravated by fruit maturity, delayed cold storage and CA establishment, high storage temperature, and O2 concentration, and restricted ventilation.

WATER CORE
- Liquid-soaked tissue around the vascular bundle and needly flesh, due to the accumulation of a starch solution in the mesophyll tissue.
- Small areas of water core tissue often recover in cold storage, but may cause flesh browning and breakdown in severe cases.
- Fruit maturity and the extent of water core, with harvested or advanced maturity promoting water core development.

HONEYCRISP
- Simply defined, completely shaped, smooth, brown leaves of the skin, which may damage the underlying flesh tissue, leaves unusually secondary infections, e.g., Alternaria or Glomerispora, resulting in darkish color.
- Induced by low water potential; is basically a horticultural cultivar that is stored newly higher incidence in apples near the cold air of temperature codes, development steps when fruit retained from cold storage.
- Associated with advanced fruit maturation in the form of brown, growing blemishes and climate, (dry, cool, wet summers), light spots, large fruit, vigorous trees on heavy soils, and fruit maturity.

CO2 INJURY
- Characterized internally by defined areas of brown flesh tissue, which develop cosmetic as it becomes dry and moisture is lost.
- External CO2 injury may also develop in CA-stored Honeycrisp.
- Immature fruit with very low CA establishment; increasing CO2 levels before apples are cooled and low O2 concentrations; may be aggravated by being stuck in cold storage (5-15% O2) treatment.

CO2 INJURY
- Characterized internally by defined areas of brown flesh tissue, which develop cosmetic as it becomes dry and moisture is lost.
- External CO2 injury may also develop in CA-stored Honeycrisp.
- Immature fruit with very low CA establishment; increasing CO2 levels before apples are cooled and low O2 concentrations; may be aggravated by being stuck in cold storage (5-15% O2) treatment.

SENSCENB T BROWNING
- Slices in american breakdown, but fruit remains very firm and it does not always develop directly the skin.
- More prevalent with extended storage duration and warmer storage temperatures.
- Advanced fruit maturity at harvest time is a major factor.

CO2 INJURY
- Characterized internally by defined areas of brown flesh tissue, which develop cosmetic as it becomes dry and moisture is lost.
- External CO2 injury may also develop in CA-stored Honeycrisp.
- Immature fruit with very low CA establishment; increasing CO2 levels before apples are cooled and low O2 concentrations; may be aggravated by being stuck in cold storage (5-15% O2) treatment.

SENSCENB T BROWNING
- Slices in american breakdown, but fruit remains very firm and it does not always develop directly the skin.
- More prevalent with extended storage duration and warmer storage temperatures.
- Advanced fruit maturity at harvest time is a major factor.

SENSCENB T BROWNING
- Slices in american breakdown, but fruit remains very firm and it does not always develop directly the skin.
- More prevalent with extended storage duration and warmer storage temperatures.
- Advanced fruit maturity at harvest time is a major factor.

DPA INJURY
- Black lesions on the skin, which may penetrate into underlying tissue.
- Inoculated with high DPA concentrations, freeze moisture on the skin, or when DPA dissolution occurs on the fruit at extended periods of time.

BITTER PIT
- Dye, sourness lesions on or beneath the fruit surface may be present at harvest but most commonly become evident during storage.
- Caused by low levels of calcium, more pronounced in large apple cultivars, fruit from light crops, with excessive vegetative growth, storage temperature below 0.5°F, reduced sugar, less starch, brown, and heavy donutting present.
- Maximized by postharvest dips containing calcium, grinding fingers, low storage temperature, high ethylene balance, and CA conditions.

Photos and Descriptions Courtesy of Dr. JENNIFER R. DeELL
Fresh Market Quality Program Lead Ontario Ministry of Agriculture, Food and Rural Affairs Vancouer, Ontario, Canada
CA STORAGE SAFETY

BY J. BREHTON

The oxygen content inside a sealed CA storage room will not support human life. This fact should be clearly displayed on the CA room entry point. Occasionally persons must enter rooms to gather sample or make repairs and it is imperative that they understand the hazards of these tasks. No one should enter or even place their head inside an opening room. Persons have passed out, fell into the rooms and died just a few feet from the doorway. Never enter alone, and never open a window or door without having at least one other person who is familiar with CA storage hazards nearby. Make sure all employees and co-workers recognize the hazard and understand the meaning of all alarm systems and danger signs. Also study all personal medical and understand the symptoms of asphyxia in general terms before entering.

CA STORAGE CONTAINS LESS THAN 5% OXYGEN

STORAGE LEAKAGE SPECIFICATIONS

BY DAVID BISHOP

Many people not familiar with CA storage assume that the amount of leaking gas required in a CA room. A leakage rate should be included in new specification and continue to building a CA room and to test for form to be used for the establishment of the process. These tests should then be carried out every or any problems notified before leading with products.

This test is carried out by recording the room pressure and measuring the rate of decay. The pressure used is the maximum room pressure, which is usually 20 inches (51 cm).

This should be measured on a sensitive indicator, which can be included in the room, an electronic instrument, or a gas detector. It is essential that the indicator is accurate enough to easily measure the maximum pressure and calculate the decay.

The room is then prepared for testing by sealing of all doors, latches, drains, valves and pipes lower closed. The approved pressure is increased by charging the vessel and recording the volume. The air volume must be recorded at a specified point for the duration of the test. The pressure has reached the required level, then the blower on and the blower is started. The pressure should be allowed to increase until a limit on the test is achieved and recorded.

The rate at which the pressure is maintained is the indication of the air leakage rate. In Europe, the time taken for the pressure to fall from 205 psi to 15 psi is measured. In a blower door test for 20 inches, the equivalent of 20 inches are assumed to be required. The time required to reach 15 psi is recorded. The blower door test is taken as 7 minutes. For severe rooms in 5% oxygen, 15 minutes should be allowed. The blower door test is considered to be complete when the pressure falls to 10% or a decrease in 25 psi within 20 minutes or 10% of the initial reading.

North American operations define the facility accordingly, and the time taken is used in the calculation of the carbon dioxide rate.

Another method of testing used in some areas requires the use of a test area width to adjust on all floor rates to achieve required pressure. The airflow is then the rate of the last rate.

If a room does not meet the leakage specification, remedial action is required. The leaks are often difficult to find and some of the best method is to locate the test area until the final test is complete. However, this means investigating the entire structure. It is possible that leaks are introduced by the testing process. Use carbon monoxide to test the leak and carbon dioxide to test the seal.

Storage Control Systems, Inc., while preparing 80 years of providing CA systems, the captive industry, widely presents the second location of their captive decades ago. S. Brehten’s family partner with an average and bring the best materials to our clients in any day and style. We advise our clients under the worst circumstances. We agree with this policy of not seeking additional information from our own personal ability. As a total service, we have included installation, maintenance, and service and we stand behind our products. Storage Control Systems, Inc. has been a leader in the industry since 1990. We take pride in our work and stand behind our products. For additional information, please contact our sales department at 800-487-7994, or visit our website at www.storagecontrol.com. We are a proud member of the Storage Industry Association of America (SIA) and follow all guidelines and best practices to ensure the safety and reliability of our systems. 300 Applewood Drive, Sparta, Michigan 49345 USA storagecontrol.com - 800-487-7994 - info@storagecontrol.com

STORAGE CONTROL SYSTEMS, INC.

300 Applewood Drive Sparta, Michigan 49345 USA