Ethylene in Cold Stores

Ethylene is a naturally produced gas that is the ripening trigger for most fruit, vegetables, flowers and ornamentals. It is therefore an important factor to be considered in the management strategy when storing these products.

The production rate and sensitivity is very dependant on the product and can become a particular problem in mixed storage areas. The significant levels of ethylene can be very small and is usually stated in parts per million (ppm). 1000ppm is the same as 0.1% volume.

As an example of the differences in ethylene levels, the typical level to be found in an apple storage room would be 100 ppm whereas Kiwifruit need to be kept in levels as low as 0.01 ppm.

Ethylene accelerates the ripening and senescence process and it control will improve the storage quality of most products and the table below indicate some products that are particularly sensitive.

Leafy vegetables	Turn Yellow, leaf spotting
Cucumbers	Softening and turn yellow
Unripe fruits	Ripening accelerated
Cut flowers	Wilt and petal drop

The fruits that are most sensitive to ethylene include : Avocado, Green Bananas, Cherimoya, Honeydew Melon, Kiwifruit, Mango, Papaya and Tomato.

Ethylene measurement.

Because of the very low levels, Ethylene is not easy to measure. High accuracy is not necessary but sensitivity is and an indication of a potential storage problem would be very useful. For scientists a chromatograph can provide accurate measurements down to very low levels but it is not a practical tool for everyday use. Portable equipment that draw a sample through a glass tube containing crystals that change colour are useful and can be used to detect down to about 0.1ppm. The tubes are not reusable and are expensive and time consuming for regular use.

The Instrument division of International Controlled Atmosphere Ltd of Tonbridge Kent have recently developed and introduced a new instrument based on electrochemical sensor technology. The ICA56 is an affordable, battery-powered instrument with a built in pump that gives a digital readout of ethylene over the range of 0.5 to 100 ppm.

Professor Adel Kader from the University of California Davis has recently tested this instrument and recommended that:

> *"……all produce quality control personnel of distribution centers use such an ethylene detector to monitor ethylene concentrations in various parts of the distribution center on a daily basis and take corrective action if the ethylene concentration exceeds 1ppm in areas where vegetables and flowers are kept. Corrective action may include elimination of the sources of ethylene, increased fresh air exchange, and use of ethylene absorbers."*

The same sensor is also available in the ICA512E instrument for permanent installation in the area of concern and can be used for the automatic control of ethylene removal equipment.

Ethylene removal.

High ventilation rates can keep Ethylene under check and that is the technique commonly used is the shipment of Bananas and Kiwifruit. This can significantly affect the refrigeration load and humidification requirements and should be considered as part of the overall cold store design.

A Catalytic Ethylene scrubber uses a precious metal catalyst at high temperature to convert the ethylene to Carbon Dioxide and can be run continuously in produce cold rooms. The 'Swingcat' is the most widely used commercial machine with many successful installations.

For a much lower capital investment, ethylene removal systems based on chemical adsorbent using natural clays coated with potassium permanganate and other materials can be used. The downside of this system is the need to periodically renew the adsorbent. This frequency will depend on use and is typically every 12 weeks. The 'Ethylclean' system using 'Bi-on' granules is being installed in many produce rooms.

Both of these systems remove other harmful micro-organisms and pollutants from the storage atmosphere improving the quality of the stored fruit.

International Controlled Atmosphere Ltd can help in specifying and installing the most appropriate equipment for each project.

Ethylene Addition

Where fruits require ripening before sale, ethylene can be injected into a ripening room to provide consistent and rapid ripening. This system is commonly used in Banana ripening but also useful for products such as Avocados and Tomato's.

Ethylene can be introduced from cylinders in pre-prepared mixtures or can be generated on site by converting liquid fuels to ethylene gas on a heated catalyst.

These machines can now be purchased rather than hired and are now available with separate fuel tanks and automatic control.

With the introduction of the new ICA512E Ethylene detector, the Ethylene in the room can be measured and the generator controlled to achieve a more repeatable and economic use of the injected gas. ICA can provide the complete ripening system including the rooms, ethylene generators and control systems.

Other Gases.

Carbon Dioxide is produced by product respiration and can build up to harmful levels in unventilated rooms. The safe level for 8 hour human occupational exposure is 0.5% CO2 and this is also considered a safe level for most fruit and vegetables.

The ventilation level to achieve this is not excessive and one way of limiting the ventilation load on the refrigeration plant is to measure the CO2 and ventilate only when it exceeds a set value. The instrument division of ICA can design and supply suitable systems for this purpose.

Ammonia is being used in more large refrigeration systems and small leakage can cause damaged to the stored product. The ICA512A includes a new generation ammonia sensor to give reliable detection of small ammonia leaks.

The Instrument division of International Controlled Atmosphere Ltd manufacture measuring and control equipment for all produce storage applications and the company can provide a complete solution for all produce cold storage.

David Bishop, ICA's Technical director testing the ethylene level with the new ICA56 Ethylene analyser in a cold store constructed by ICA in Kent.