Optimum CO_2 levels can considerably lengthen the shelf life of fruit and vegetables.

PHOTO COURTESY: KESKO, FINLAND

Carbon dioxide is an inert and relatively inexpensive gas, commonly available and quite easy to handle. Inert gases are used to displace oxygen e.g. in process and packing industries. For instance fires and explosions can be prevented by carbon dioxide enveloping.

Potential safety hazards

CO_2 can be a safety hazard. When the concentration of carbon dioxide rises, people start to feel tired and listless and have trouble concentrating. With further increases, CO_2 begins to act as an asphyxiant. Carbon dioxide which is an odorless, colorless gas, displaces air and oxygen in it. CO_2 is denser than air, and high concentrations can occur in open pits and other areas below ground level. Exposure to very high concentrations of carbon dioxide results in unconsciousness or even death.

As high concentrations of CO_2 are clearly hazardous, most countries have set exposure limits in the workplace. In Great Britain, for instance, the weighted average exposure limit for an eight hour working day is 5,000 parts per million (ppm). A higher limit of 15,000 ppm is applied to exposures of up to ten minutes.

Occupations where carbon dioxide can rise to dangerous levels include the brewing and carbonated drink industries, the freezing of food with dry ice, cold storage, cargo ships, and of course plants where CO_2 or dry ice is produced or handled.

Beneficial effects in greenhouses

On the positive side, carbon dioxide can enhance plant growth. In greenhouses, the growth rate and development of plants, ranging from tomatoes and cucumbers to the most luxurious roses, can be improved by controlling the concentration of carbon dioxide. This raises the productivity and quality of the crops.

To reduce the carbon dioxide consumption and to maximize the productivity, the CO_2 level is typically monitored and measured. If the carbon dioxide level rises too high, the plants can be damaged and their growth stunted. ■

PHOTO COURTESY: VR COMPANY, FINLAND

If the concentration of carbon dioxide rises, people start to feel tired and listless.

More chicks, better chicks from

Carbon Dioxide

Buckeye International Ltd. in the UK is today one of world's leading incubator manufacturers. Building on more than 100 years of experience, a striving for excellence and a willingness to innovate, the company has been responsible for many revolutionary advances in the history of commercial incubation. One such advance involves the routine use of Vaisala's GMD20 carbon dioxide transmitters in its incubators to give precise control of the gaseous environment of the eggs. As a result, the hatching rate has been boosted by up to 3–4 per cent.

Brian Hodgetts
Technical Consultant
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United Kingdom

Buckeye International Ltd. has its head office and factory in Somerset in the UK, and is served by a network of offices and agents throughout the world.

Importance of carbon dioxide

The humble brooding hen, sitting tight on a clutch of eggs in the nest, may not be too aware of the concentration of carbon dioxide around them. But, by keeping the eggs close together under her wings, she is not only providing the correct temperature, but also creating a level of carbon dioxide about ten times that of fresh air.

Researchers have known about this for nearly one hundred years, but could not use this information in the design and construction of artificial incubators as there was no way to measure carbon dioxide accurately.

Vaisala's transmitters for CO_2 monitoring

That is, until the Vaisala GMD20 carbon dioxide transmitters came along. Now Buckeye International, an incubator manufacturer since 1881, routinely uses the GMD20 units in its incubators to give precise control of the gaseous environ-

Control in Buckeye's Incubators

PHOTOS COURTESY: BUCKEYE

More chicks and better chicks in the hatchery.

ment of the eggs. As a result, the hatching rate has been boosted by up to 3–4 per cent.

Carbon dioxide plays an important role in converting insoluble calcium carbonate ($CaCO_3$) in the egg shell into soluble calcium oxide (CaO) which is used to build the skeleton of the developing embryo. The growth of embryos is stimulated during the first few days by the presence of 0.3–0.4 per cent of carbon dioxide in the air surrounding the egg. But very high levels (in excess of 1 per cent) are likely to inhibit growth.

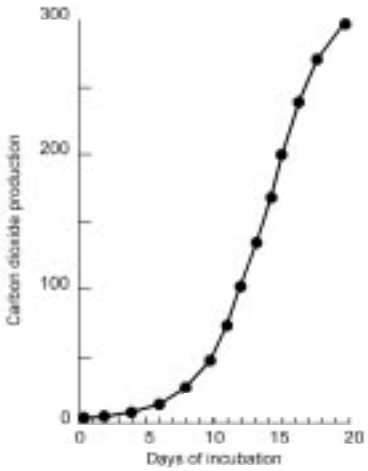
If we examine unhatched eggs, we find that incorrect levels of carbon dioxide produce a greater proportion of embryos with physical abnormalities or embryos which are incorrectly positioned within the egg – both of which have a negative effect upon hatchability.

As the embryo grows, however, it progressively uses more oxygen and liberates more carbon dioxide and heat. For this reason, single stage incubators (i.e. those with eggs all of one age) have conventionally operated with low levels of carbon dioxide up to about day ten of incubation period. From this point on until hatching, the embryo has grown rapidly and produced significant amounts of carbon dioxide, heat and water vapor.

New technique allows higher CO_2 concentration

More specifically, the conventional wisdom has been to ventilate the incubator to maintain quite a low level of carbon dioxide – about 0.1 per cent. In contrast, the new technique allows a higher concentration much earlier. This is done by linking the signal from the GMD20 probe to the ventilation system, so that the quantity of air allowed through the incubator is controlled directly by the carbon dioxide probe. As the level builds up, the damper opens to maintain the preset level.

More chicks and better chicks are the result. Buckeye customers report an improvement of up to 3 per cent. Considering that about 1,000,000,000 eggs are set each year in the UK alone, this level of improvement means big money for Buckeye customers. ■



Carbon dioxide production of the developing chick embryo, data from Romanoff (1967).

Brian Hodgett, Buckeye's Technical Consultant inspects the trolley turning system.

Vaisala's GMD20 CO_2 transmitter is used in Buckeye's incubators to give precise control of the gaseous environment of the eggs.