Guide to gases - Carbon dioxide (CO_2)

Nowadays CO_2 (carbon dioxide) has acquired a "bad" reputation because of its Global Warming Potential. However, CO_2 (usually used in gas form) has many very useful applications.

Carbon dioxide is an essential ingredient for life on earth. Despite the fact that there is only about 400 ppm CO_2 in the atmosphere around us, this is still enough for all green plants to live on. They convert CO2, water and sunlight into carbohydrates and oxygen and grow to feed animals and humans.

Production

Production of CO_2 on industrial scale is done mainly by combustion of fossil fuels, conversion of natural gas into hydrogen and CO_2, fermentation of sugar (breweries) and decomposition of limestone ($CaCO_3$) during the manufacturing of lime (CaO). Carbon dioxide is widely used throughout industry. Because of its inert and non-flammable properties, and its relative low price, many of the applications are related to this.

Applications on vessels

Although many applications exist, not all of these are used onboard ships. The most common uses are listed below.

- **Fire fighting.** This is a well known application because the gas is inert. It extinguishes flames because it replaces oxygen needed for combustion.

Because it forms liquid when compressed above 5 bars, much more gas can be contained in a cylinder compared with normal compressed air. Onboard most vessels we find numerous small extinguishers but also large fixed systems for protection of the cargo holds and the engine rooms. These large systems can contain several tons of CO_2.

- **Water treatment (pH-control)** onboard of modern cruise ships is a recent development. These ships have high demand for fresh (potable) water and cannot rely on taking on water in each port they visit: the consumption is too high. The production of water onboard is done onboard by two methods; reverse osmosis or using evaporators. The osmosis process depends on semi permeable membranes to separate the pure water from the salts and other minerals found in seawater. The evaporators basically boil the seawater after which the vapour is condensed.

  In both cases very pure water is produced. This pure water is however very corrosive. By running the water over limestone, the water absorbs calcium ions and thus increasing the hardness of the water, reducing its corrosiveness. Finaly the acidity (pH) is adjusted using CO_2. The process is fully automatic and much easier to control than using aggressive liquid acids.

  Finaly the acidity (pH) is adjusted using CO_2. The process is fully automatic and much easier to control than using aggressive liquid acids.

- **Food protection.** Certain types of food are packed and transported under a CO_2 blanket keeping the food fresh for longer.
- **Beverages**. The most well know application in our daily life for fizzy drinks like beer and soft drinks. Already invented in 1772, it was noted that when CO_2 was added to water, a light acidic water was formed we still know under the name “soda water”. Every year, Wilhelmsen Ships Service provides enough CO2 to the cruise industry to carbonate 59,000,000 litres of beer and fizzy drinks!
- **Welding.** For the welding of mild steel, wire welding using CO_2 as a shielding gas is often practiced. Although CO_2 at the arc temperatures is not inert, the effect on the quality and properties for mild steel is limited. The effect of controlling the welding process is more important.

Other applications in idustry

CO_2 is widely used in industry in other applications.

- Dry cleaning of clothing can be done with liquid CO_2. Its strange chemical properties enable oil and fat dissolve easily, and it is much more environmental friendly and less toxic than the traditionally used organochlorides.
- A strange application is its use as an as Asphyxiant. In some countries, cattle are killed by exposing them to high concentrations of CO_2
- By enriching the atmosphere in green houses with CO_2, the growth of plants

can be stimulated and higher yields can thus be achieved.

- The solid form of CO_2 (dry-ice) can be produced in the form of blocks or pellets. Dry-ice maintains a temperature of -78 ºC (-108 ºF). Typically this is used in insulated boxes for small shipments when other cooling methods are not practical.

The dangers

Good ventilation is vital when working with CO_2. Just 0.5% of CO_2 in the air is considered unhealthy, at which levels humans will show signs of drowsiness. By the time it reaches 10% it can be lethal. As it is heavier than air, the odourless gas will collect along the floor, and in low-lying sections of vessels, such as tank tops and engine rooms. Good safety training for crew, and the provision of adequate and up to date EEBD-sets (Emergency Escape Breathing Devices) is essential for onboard safety.

Wilhelmsen Ships Service supplies regulatory products and services, Unitor marine products, Nalfleet marine chemicals, maritime logistics and ships agency.

Wilhelmsen Ships Service has the world's largest maritime services network, with 4,600 marine professionals servicing 2 200 ports in 125 countries. Wilhelmsen Ships Service supplies regulatory products and services, Unitor marine products, Nalfleet marine chemicals, maritime logistics and ships agency to the maritime industry. Last year the company made 214 000 product deliveries to 23 000 vessels and handled 54 000 port calls.

For more information, see www.wilhelmsen.com/shipsservice or contact wss.marketing@wilhelmsen.com