Carbon dioxide and MAP applications in the food industry

By **Sam A. Rushing** on Oct 22, 2009

Of today's approximately 20 million annual tons per year (tpy) in CO2 merchant consumption, up to 40% of this would be consumed in the US alone. Close behind would be Japan and then the European Zone.

Of the most interesting applications in the carbon dioxide industry, and perhaps the most versatile, is the food industry – from dry ice applications, to various liquid applications, to gaseous MAP and purge forms of usage.

Furthermore, in a gaseous form, CO2 is used in a more humane method for stunning animals before slaughter. As for additional food-related applications, CO2 can be used in trucks (via dry ice sublimation or shot into the truck as a snow) and could apply to certain ship holds, and other forms of shipping and containing methods for food products.

Furthermore, CO2 is successfully used in lieu of certain (sometimes carcinogenic) chemical compounds for grain fumigation – there have been tests and some success shown in applications for enriching irrigation water, for crop-growth enhancement.

When speaking of crops, we must also remember that CO2 gas is used in many greenhouse settings to lend a hand in the process of photosynthesis, thus enhancing certain bedding plants, flowers, fruits and vegetables.

Some food plants also run their pneumatic systems with CO2 rather than air, therefore creating less rust in these systems with a much dryer gas than air. The food industry can also benefit from CO2 in water treatment and Ph reduction applications – such as effluent run-off and discharge.

MAP applications
The acronym MAP represents Modified Atmosphere Packaging, which is modifying the gaseous composition within a packaged food or drug product, designed to enhance quality and the shelf life.

In most cases, oxygen content is reduced from the usual atmospheric content of about 20% all the way to 0% by volume – of course this practice is designed to slow down the growth of aerobic organisms and therefore reducing spoilage, and reducing oxidation reactions.

Replacing the oxygen atmosphere would be via nitrogen or carbon dioxide. In the form of CO2 instead of nitrogen, the further advantage here is a reduction in the Ph as well, as to retard aerobic bacterial growth.

Cryogenic freezing
Most likely in (primarily) the developed world, up to 40% of all merchant consumption is often categorised as food related; and the lion's share would be in cryogenic freezing and blending applications.

The cryogenic freezing is introduced as a gas into the linear, spiral, or multi-pass freezers, generally utilising variable speed conveyors and temperature controllers to maintain the freezing zone temperature. In the past, a number of gimmicks have been used to claim one freezer exceeding the other via 'Prazo' valves, crust freezing of whole poultry, cryo-mechanical freezers, and enhancing the temperature of the cryogenic liquid line via mechanical means.

However, much of this has little relevance or added value to the process and is believed to be merely a sales gimmick. Other new slants are being claimed today for cryogenic freezers, however, much of this would represent little more than mere claims too.

Blending applications (via CO2 snow or dry ice pellets), such as into pork, beef, and poultry, which is being ground, thus reducing temperatures and bacterial count is much more effective and less sloppy than using water-based ice in a similar application. Blending applications are often achieved via dry ice pellets, and rice-sized dry ice is becoming more popular for this application.

The same result, and something which is often more popular than dry ice (particularly if liquid is used in the food processing plant), can be liquid flashed into a snow through a snow horn. The snow horn can be on an automatic timer, delivering snow into a grinder – or for that matter, into packages such as boxed poultry via an automated conveyor based system.

The so-called snow horn can be manually operated as well. In all cases, when producing CO2 snow, and in the case of cryogenic freezing, adequate ventilation is essential.

With respect to cryogenic freezing, essentially this method is in lieu, or in conjunction with mechanical freezing; this being from miniaturised settings such as small cryogenic batch freezers – all the way up to very large linear, multiple pass, or spiral cryogenic freezers.

In short, the advantages when cryogenically freezing with CO_2 rather than mechanical refrigeration would include a shorter residence time in the freezer and a higher level of production capacity, ensuring savings in labour and quality factors.

Many feel the end result found with cryogenically freezing rather than mechanical refrigeration represents a better quality food product, since less cellular wall damage is induced with the fast freezing than the mechanical.

Much of this improved appearance is particularly representative when freezing certain meat products. The term IQF or individually quick frozen, is the term often applicable to food products frozen cryogenically.

Grinding, blending and other CO2 snow applications
As referred to earlier, a wide range of CO2 snow applications exist via discharging liquid to the atmosphere through a snow horn or similar device – from applying snow into boxed food products for shipment, to applying into grinding and blending applications of meat and other food products.

The same can apply to dry ice, usually pellets, and rice-sized ice. Many food plants, such as those in the meat and poultry operations, include IQF, snow generation for grinding, and MAP applications for packaging. Further to this, dry ice is often found in many poultry and other food plants for various temperature reduction needs and generating CO2 gas via sublimation for shipping purposes.

Other applications in food related industries
I mentioned using CO2 for Ph reduction in food plants which might otherwise use mineral acids (usually sulfuric acid); thus representing an environmentally friendly by-product from the reaction of CO2 compared to sulfuric acid in the form of carbonates and bicarbonates and sulfates in the effluent or run-off.

There are many successful examples, and a growing market for CO2 usage in insect control – fumigants have changed over the years, from once carbon tetrachloride, to alternate product, some of a halogenated hydrocarbon nature; but often unhealthy and unsafe and potentially carcinogenic.

CO2 is successfully used to enhance the growth and quality of certain plants, which consume the gas in photosynthesis, and merchant product is in storage onsite for often huge greenhouse operations – generating positive results. The product is sometimes used in a gaseous form for stunning poultry and cattle as opposed to less humane methods of preparing the animals for slaughter.

Some applications exist for usage of CO2 in irrigation water for crop growth enhancement; and more applications for food and plant growth are created or improved upon via the use of CO2 throughout the industry – from seedlings and algae production (algae oil used in biodiesel feedstock) to the final meat, vegetable, fruit, and grain product being prepared for the consumer.

The application in this vast sector will continue to be ever-growing in scope and in volume.

About the Author
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