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**April 7, 2020**

## **Availability of Carbon Dioxide for Use in the Meat Industry**

On Friday, March 27, 2020 concerns about the availability of carbon dioxide (CO<sub>2</sub>) were expressed by member companies of the North American Meat Institute. In conjunction with a severe decline in oil prices, the production of ethanol as a renewable fuel source has severely decreased. An important byproduct of ethanol production is carbon dioxide. This CO<sub>2</sub> is captured and purified for use in the food and beverage industries. However, the meat industry is hearing that production of CO<sub>2</sub> has already started to decline due to the decrease in ethanol production. In response to a request from multiple companies to explore the availability of different types of CO<sub>2</sub>, the Meat Institute has gathered the following information and is taking steps to address the shortage.

### **Overview**

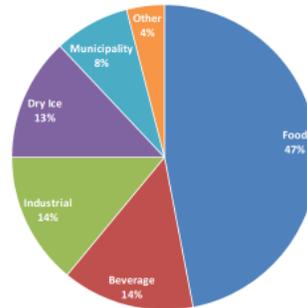
Carbon dioxide is used for various purposes in the meat industry. In fact, the slaughter industry uses approximately 25% of all CO<sub>2</sub> produced in the United States. The most common use of CO<sub>2</sub> in slaughter facilities is for chilling in meat mixers/tumblers and dry ice. Other uses include, but are not limited to, vacuum packaging, freezing, and controlled atmosphere stunning (CAS) of hogs, turkeys, and some chickens for slaughter. A complete breakdown of the US liquid CO<sub>2</sub> demand by market segment is displayed in Figure 1.

Reports from member companies indicate that in multi-species operations, approximately 5% of all CO<sub>2</sub> use is dedicated to CAS. In a company reporting use in a turkey plant, approximately 33% of CO<sub>2</sub> is used for stunning. However, for establishments that use CO<sub>2</sub> for controlled atmosphere stunning, there are no other gases that can be used as a substitute for CO<sub>2</sub>, so it becomes a rate-limiting step in some cases. This [letter](#), provided by Marel Meat out of Denmark, provides more information about the use of alternative gases and their lack of evidence-based results and limited efficacy for controlled atmosphere stunning.

**Figure 1. USA Liquid CO<sub>2</sub> Demand by Market Segment (POET)**

**USA Liquid CO<sub>2</sub> Demand by Market Segment**

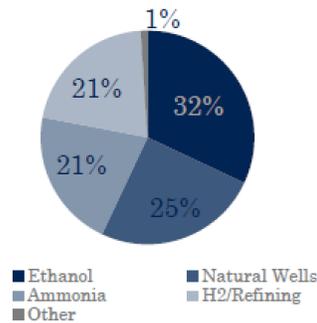
- Food & Beverage combined represent 61% of total US market demand
- All other sources of demand represent 39% of the total US market



Carbon dioxide comes from various sources that differ from geographic region to geographic region. Approximately 30% of all CO<sub>2</sub> produced in the US comes from ethanol production. Other sources include ammonia (fertilizer manufacturing), H<sub>2</sub>/refining processes, and natural wells and coastal refining in the southwestern and southeastern states (see Figure 2). However, due to shipping distance, cost of shipping, availability of trucks and drivers, much of the CO<sub>2</sub> the meat industry uses comes from ethanol production in the Midwest (some members report up to 60-65% of their CO<sub>2</sub> sourcing is from ethanol production).

**Figure 2. CO<sub>2</sub> Sourcing for US Merchant Markets (2019 Cryogas US Merchant Report)**

**CO<sub>2</sub> Sourcing for US Merchant Markets – 2019\***



\* Cryogas US Merchant Report - 2019

Most CO<sub>2</sub> produced is considered “food grade” rather than “commercial” or “industrial” grade because food grade CO<sub>2</sub> simply makes more money than industrial grade. Personal communications with CO<sub>2</sub> manufacturers and distributors reveal that approximately 98% of all non-enhanced-oil-recovery CO<sub>2</sub> produced in the US is food grade or above (personal communication, POET). The Compressed Gas Association (CGA) issues industry standards for the purity of CO<sub>2</sub>

required for different grades. Grade E is the lowest grade, and is used for medical or industrial uses ( $\geq 99.0\%$  pure). Grade H is food grade ( $\geq 99.5\%$  pure), and Grade I is beverage grade ( $\geq 99.9\%$  pure). Beverage grade is the purest form. All grades require the CO<sub>2</sub> product to be  $\geq 99.0\%$  pure. Small differences in the allowable levels of impurities exist, but are miniscule. For example, the allowable level of hydrogen sulfide in Grade E CO<sub>2</sub> products is 1ppm, and is 0.5ppm and 0.25ppm for Grade H and Grade I, respectively.

### **Regulation of CO<sub>2</sub> Use in the Meat Industry**

There is no Food Safety and Inspection Service (FSIS) regulation, directive, or guidance that stipulates that food grade (Grade H) CO<sub>2</sub> must be used for stunning of animals, or in chilling, blending, or packaging of meat products. Regarding CO<sub>2</sub> use for food products, 21 CFR 184.1240 (the Food and Drug Administration's [FDA] regulations for Generally Recognized as Safe [GRAS] for CO<sub>2</sub>) states:

In accordance with 184.1(b)(1), the ingredient is used in food with no limitations other than current good manufacturing practice. The affirmation of this ingredient as generally recognized as safe (GRAS) as a direct human food ingredient is based upon the following current good manufacturing practice conditions of use:

- (1) The ingredient is used as a leavening agent as defined in 170.3(o)(17) of this chapter; a processing aid as defined in 170.3(o)(24) of this chapter; and a propellant, aerating agent, and gas as defined in 170.3(o)(25) of this chapter.
- (2) The ingredient is used in food at levels not to exceed current good manufacturing practice.

This means that it is the responsibility of the industry to support the safety of the product, and it should provide supporting documentation for the safety of any CO<sub>2</sub> product being used for any purpose. It is the Meat Institute's understanding that current good manufacturing practices are those outlined in CGA's CO<sub>2</sub> standards document.

Regardless of the amount of industrial vs. food grade CO<sub>2</sub> produced, the meat industry would like to have all options available when considering the procurement of CO<sub>2</sub>. Therefore, the Meat Institute requested that FSIS exercise regulatory flexibility regarding the grade of CO<sub>2</sub> used for controlled atmosphere stunning. There should be no problem with efficacy of CO<sub>2</sub> for stunning, since the cause of anesthesia is a drop in blood pH due to excess CO<sub>2</sub> inhalation and subsequent respiratory acidosis. One or one half of one percent will not make a difference in the anesthetic effect of CO<sub>2</sub>. Additionally, any grade will be metabolized in the same way in the animal(s), with little to no perfusion of muscle tissue. If establishments

choose to use a CO<sub>2</sub> source other than food grade, establishments must assess the differences in the specifications of the CO<sub>2</sub> products and provide adequate evidence that they do not impart a lasting food safety effect on the animal(s). Additionally, changes in specifications of the CO<sub>2</sub> product and the date any changes in supply were made, and continue to monitor CO<sub>2</sub> concentration in the pits or tunnels, in accordance with their established programs to demonstrate efficacy.

### **General CO<sub>2</sub> Availability**

As the ethanol industry slows production in response to decreased use/prices, the meat industry expects a severe disruption in CO<sub>2</sub> availability, particularly in the Midwest, where most CO<sub>2</sub> is produced as a byproduct of ethanol production. Some member companies are already seeing deliveries to processing plants being restricted, and surcharges being applied to delivered loads. Again, because almost all CO<sub>2</sub> produced is food grade (approximately 98%), there is little opportunity to switch to a different grade for more availability.

To help address this issue and find answers to industry questions, the Meat Institute has joined a coalition of livestock production groups and trade associations representing the compressed gas and renewable fuels industries. On April 7, 2020, the coalition submitted a letter requesting temporary federal assistance for CO<sub>2</sub> manufacturers to help address any shortages that may occur. Additionally, the Office of the Vice President requested a list of slaughter and processing facilities that have already experienced or are likely to experience a CO<sub>2</sub> shortfall to help identify potential new sources, by geographic location, of food-grade CO<sub>2</sub>. That information was provided to the Meat Institute by its members, and was submitted to the Vice President's office on April 6, 2020.

Below are some other ideas and questions Meat Institute staff has considered. Some questions can be addressed by Meat Institute member companies. If members have answers to these questions themselves, or have any questions or suggestions to add, please contact Tiffany Lee at [tlee@meatinstitute.org](mailto:tlee@meatinstitute.org) or 913-683-3563.

- Questions
  - Are meat production companies aware of the possibility of a CO<sub>2</sub> shortage in the coming days/weeks?
  - Who is currently experiencing shortages of CO<sub>2</sub>?
  - Which meat production companies have been charged a surcharge upon delivery of CO<sub>2</sub>?
  - What is the ratio of CO<sub>2</sub> used in plants for stunning vs. all other purposes?
  - How quickly are ethanol plants going off-line?
    - Are ethanol plants simply decreasing production, or closing altogether?

- Is there an opportunity to keep the ethanol plants that also produce CO<sub>2</sub> open for the foreseeable future? What kind of support would that take?
  - USDA?
  - Individual states?
- Will CO<sub>2</sub> be more available to specific food industry sectors vs. others?
- If ethanol is being produced in excess, are there other industries that can use this excess or at least store it for a period of time so that the production of byproducts continues?
- Opportunities
  - The crude oil industry has been hit hard—western Texas has a significant amount of oil production
    - This industry uses CO<sub>2</sub> for enhanced oil recovery, but right now, some of that CO<sub>2</sub> is not being used because oil production has decreased
    - Can we ship this CO<sub>2</sub> (approximately 95% pure) to ethanol plants in the Midwest for further purification processes?
  - CO<sub>2</sub> for medical purposes
    - How much CO<sub>2</sub> is not being used in medical settings because of the decrease in elective surgeries in hospitals during the pandemic? Is it enough to help the meat industry?