Meeting Green Initiatives in Food Delivery...

What You May Not Know about Dry Ice

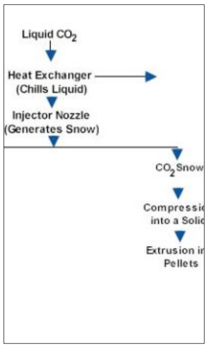
The production of dry ice requires the use of transmission lines, compressors, delivery trucks, and vaporizers which all consume energy. A typical food distributor that uses an average of 8,000lbs of dry ice each week would generate a carbon footprint of 77,522 lbs per year. Those Greenhouse Gas emissions are equivalent to putting an additional 5.71 mid-size cars on the road[1].

MJST
MI-JACK SYSTEMS & TECHNOLOGY, LLC
3111 W. 167TH STREET, HAZEL CREST, IL 60429

www.mjst.com
(877) 473-2367

Carbon Footprint for Making Dry Ice

In the production of dry ice, carbon dioxide (CO2) gas is compressed into a liquid and bottled. The bottles are transported to a manufacturer where they are placed in a vaporizing machine and then further processed into their block or pellet form.



Real World Production

Enthalpy of Sublimation of Dry Ice 571 kJ/kg (kilojoules/Kilogram) is the amount of "heat" (energy) used to transition dry ice from its solid phase to its gas phase. The reverse process of turning a gas into a solid is much more complicated and thus uses even more energy. This amount plus all of the other components that contribute to energy inefficiency (for example the heat given off by equipment used during vaporizing and processing) contribute to the total amount of "heat" (energy) used in the production of dry ice, CO_2 in a frozen/solid state.

By working backwards, the energy that is required at the power source to generate the final dry ice product can be estimated (see below). Standard 80% efficiencies in the compressor and vaporizer and a representative 93.5% efficiency along the transmission line are used to denote potential energy losses in the example below.

Power	Transmission	Compressor	Bottle
Source -- >	Lines ---->	80% ----	Liquid CO_2
955 kJ/kg	93.5%	892kJ/kg	714kJ/kg

Delivery Truck to User

Bottle -	Vaporizer 80%	Dry Ice
	714 kJ/kg	571 kJ/kg

To further express the impact of this process in terms of potential carbon footprint impact, envision the kilogram block of dry ice from the above example was produced in one hour and the power source output is 955kJ/kg over the same 1 hour of time. A Watt = 3.6kJ/hr so the 955kJ/kg for 1 hour at the power source can be converted to 265 Watt-h or .265 kWh. According to US Energy Administration a broad spectrum of energy sources (coal, nuclear, wind, solar, steam, and natural gas) produces 0.608 kg CO_2 footprint for each kWh. This kilogram of solid CO_2 has a calculated carbon foot print of:

$$265\text{kWh} \times \frac{0.608 \text{ kg } CO_2 \text{ footprint}}{\text{kWh}} = \frac{0.1613 \text{ kg } CO_2 \text{ foot print}}{\text{kg dry ice produced}}$$

The delivery truck also contributes to the carbon footprint. Assume it has 10,000kg of product delivered in a 200 mile trip with the truck getting 8 mpg or using 25 gallons of diesel. Diesel emits 10.1 kg CO_2/gallon burned. The carbon footprint of delivery is:

$$\frac{25 \text{ gal} \times 10.1 \text{ kg } CO_2/\text{gal}}{10{,}000 \text{ kg product delivered}} = \frac{0.02525 \text{ kg } CO_2 \text{ footprint}}{\text{kg } CO_2 \text{ delivered}}$$

Thus making the total footprint:

$$0.1611 + 0.02525 = \frac{0.18635 \text{ kg } CO_2 \text{ footprint}}{\text{kg } CO_2 \text{ produced}} \text{ or the same } \frac{0.18635\text{lb } CO_2 \text{ footprint}}{CO_2 \text{ lb produced}}$$

If a plant is producing 8000lb per week, then the CO_2 footprint is 1,491lb per week or 77,522lbs per year with the inefficiencies mentioned.

Perfect World Production

Even given the possible argument that all transmission, all equipment, and all lines of production run perfectly efficient, the carbon footprint created by this process would still be 60% of 1490lb/week or 895lb/week = 46,488lb/year.

(1)Based On Carbon Emissions of a 2008 Chevy Malibu operating 12,000 miles as calculated on www.carbonfootprint.com.