Energy Savings through CO_2 Evaporation

A sustainable approach to optimizing production processes

The beverage industry is one of the largest consumers of carbon dioxide (CO_2), which is essential for producing carbonated drinks. During the use of CO_2, enormous amounts of cold energy are generated, which often remain unused and are simply released into the environment. To minimize these energy losses, the gas producer Air Liquide has developed an innovative solution that allows companies to efficiently recycle this excess cold energy. This process not only leads to significant energy savings but also promotes more sustainable production.

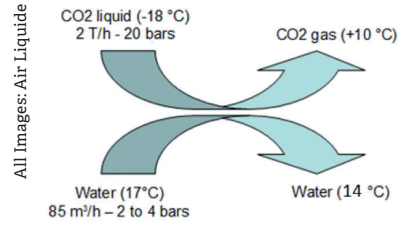
Carbon dioxide is primarily used in the beverage industry to give drinks a fresh, sparkling taste. It is significant that the CO_2 meets the highest purity and quality standards since it comes into direct contact with the final product. Food-grade CO_2 is indispensable, especially in beverage production, to ensure the safety and quality of the products.

CO_2 is sourced in various ways, mainly through three methods:

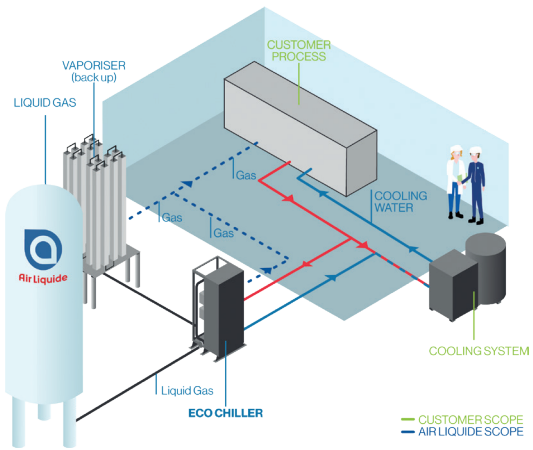
- **Underground sources:** Natural CO_2 is extracted from the earth.
- **Fermentation processes:** CO_2 is produced as a byproduct of alcoholic fermentation.
- **Chemical production processes:** In the chemical industry, CO_2 is also generated as a byproduct.

Regardless of the source, the CO_2 must go through several purification steps and then be liquefied for storage. This step is necessary to make it transportable and usable in production. For beverage manufacturing, the liquefied CO_2 must be converted back into a gaseous state.

All Images: Air Liquide



During the transition of CO_2 from liquid to gaseous state, the cold energy is transferred to the water.



Schematic representation of the cold energy recovery plant integration with the customer's production process

Cold energy from CO_2 evaporation: an untapped resource

The process of converting liquid CO_2 into gaseous CO_2—known as evaporation—is an unavoidable part of CO_2 usage in the beverage industry. During this process, cold energy is released, which often goes unused and is simply dissipated into the environment. This is where Air Liquide's innovation comes in: the company has developed a concept that allows this unused cold energy to be recovered, resulting in energy savings.

Air Liquide's process is based on recovering the cold energy released during the evaporation of CO_2. This cold energy is used to support other processes in production that also require cooling. This is achieved through a specially designed heat exchanger that the liquid CO_2 flows through, transferring the released cold energy to another medium. This medium can be water or a glycol-water mixture, commonly used in refrigeration systems. The efficiency of this system is impressive: evaporating just 100 kilograms of CO_2 per hour provides a cooling capacity of around 10 kilowatts. This capacity can be used for various cooling tasks, significantly reducing the load on the plant's regular cooling systems.

Applications of recovered cold energy

The potential uses for recovered cold energy are diverse and extend far beyond the beverage industry. Air Liquide's concept can be applied wherever large quantities of cryogenic gases, such as CO_2 or

The heat exchanger system from Air Liquide is designed to efficiently capture cold energy released during CO_2 evaporation.

nitrogen, are processed. However, it offers significant advantages in the beverage industry, where cooling is often required for various production steps. Possible applications include:

- **Air conditioning systems:** The recovered cold energy can be used to cool buildings, reducing the energy consumption of traditional air conditioning systems.
- **Cooling of air compressors:** Air compressors generate a lot of heat during operation, which can be reduced by using the recovered cold energy. This extends the lifespan of the equipment and improves efficiency.
- **Cooling of process water:** In beverage production, process water often needs to be cooled to specific temperatures. The recovered cold energy can be directly used to regulate the temperature of this water.

Automation and safety in operation

The cold energy recovery system operates fully automatically and integrates seamlessly into existing production processes. If a malfunction occurs or the available cold energy is insufficient, a backup system ensures that the CO_2 evaporator continues to operate in the conventional manner. This guarantees uninterrupted production.

A key advantage of Air Liquide's system is its flexibility. The systems are tailored to the needs of each company, and this customized approach allows existing production facilities to be retrofitted without major modifications. The system is ideal for companies looking to expand their production capacity or reduce energy costs without the need for extensive construction work. Additionally, in some countries, government incentives for energy-saving measures are available, making the investment in such a system even more attractive. Not only are operating costs reduced, but the company's ecological footprint is also minimized.

Purity requirements for CO_2 in the food industry

A key aspect of using CO_2 in the beverage industry is compliance with strict purity standards. Since CO_2 comes into direct contact with the final product, it must be food-grade. Under the brand name Aligal, Air Liquide offers CO_2 that complies with the food additive labeling regulation (E290). It must be at least 99.9% pure and is subject to strict traceability requirements throughout the production chain. All of Air Liquide's CO_2 sources are certified according to FSSC 22000, an international standard for food safety, ensuring that all processes meet the highest standards. The company also fulfils the guidelines of the International Society of Beverage Technologists (ISBT), which means additional safety for customers.

Ansgar Rinklake

Market Manager Food
Central Europe
Air Liquide
www.airliquide.com