

# HAFFMANS CO<sub>2</sub> RECOVERY SYSTEM MOLSON COORS

CASE STUDY



## KEY FACTS

### Location

Burton on Trent

### Application

Brewery

### Capacity

2,000 kg/h CO<sub>2</sub>

### Start-Up

2010

## A DURABLE SUSTAINABLE SOLUTION

One of the United Kingdom's largest and most modern carbon dioxide (CO<sub>2</sub>) recovery plants at a brewery is in operation at Molson Coors with a 24/7 capacity of 2,000 kg/h CO<sub>2</sub>.

Molson Coors Brewing Company brews, markets and sells a portfolio of leading brands across North America, Europe and Asia. It operates in Canada through Molson Coors Canada; in the U.S. through MillerCoors. In the UK, Molson Coors (UK & Ireland) has over 2,000 employees and breweries in Burton on Trent, Alton and Tadcaster. Its portfolio includes Carling, the UK's best selling lager for three decades, Coors Light, Grolsch, Worthington's, Caffrey's, Corona, Cobra and a range of speciality beers.

The Burton Brewery, a fusion of two neighboring breweries, has a capacity of five million UK barrels per year. Even today, the tradition of two breweries in the same town on the same site remains. Molson Coors (UK & Ireland) continues to brew beer in separate production sites, now called North and South.

### CO<sub>2</sub> – an essential brewing element

After entering the UK brewing market in 2002 Molson Coors continued to purchase CO<sub>2</sub>, which at the time was mainly derived from non-natural and old chemical production processes. Against this backdrop, Molson Coors looked into a CO<sub>2</sub> recovery system in 2005. But because CO<sub>2</sub> price, quality and availability were acceptable in the UK at that time, the investment was postponed.

In 2008, several major CO<sub>2</sub> production facilities closed and, as a result, many beverage producers faced bottlenecks.

Due to the shortage, CO<sub>2</sub> became very expensive. In 2009, Molson Coors restarted the CO<sub>2</sub> recovery system project with clear goals. First, the brewer wanted to be CO<sub>2</sub> self-sufficient. Carbon dioxide is essential for beer production. Molson Coors did not want to risk running out of CO<sub>2</sub>, a lesson they learned during the UK's CO<sub>2</sub> shortage. Secondly, they wanted a solution that was energy efficient. Moreover, the system had to be durable as this was a long-term investment.

Molson Coors needed a single solution to meet the CO<sub>2</sub> needs for both the North and the South breweries. This posed a special challenge for the CO<sub>2</sub> collection and distribution system. The CO<sub>2</sub> is collected in only one of the two breweries and then delivered to all operating sites. At the South site, for example, can filling is located, while the bottle and keg filling is at the North site. That means long distances for the CO<sub>2</sub> to travel.

The solution was to source the green short-cycle CO<sub>2</sub> generated during fermentation. Pentair Haffmans had the responsibility for processing, storage and evaporation of the CO<sub>2</sub>. Moreover, the company's expertise was essential for the entire process chain, from the collection at the fermenters through transporting the CO<sub>2</sub> to where it is used.

### The road to "Green CO<sub>2</sub>"

During beer fermentation, nearly equal amounts of alcohol and CO<sub>2</sub> are generated. Roughly, 2.5 kg CO<sub>2</sub> per hectoliter of beer can be recovered from an original wort of 12 degrees Plato. Considering a beer of 13 degrees Plato this would amount to roughly 2.9 to 3 kg of CO<sub>2</sub>.

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#### GREEN CO<sub>2</sub>

Before the green CO<sub>2</sub> is used, it must be purified. The CO<sub>2</sub> generated during fermentation contains several impurities including dimethyl sulfide (DMS), hydrogen sulfide (H<sub>2</sub>S), and oxygen (O<sub>2</sub>) that must be removed as they have a negative effect on taste, odor and shelf life on the finished product. A state-of-the-art CO<sub>2</sub> recovery system is a cost-effective, sustainable way to purify the CO<sub>2</sub> to food-grade quality. Such a system includes the following steps:

- Foam separator
- Gas balloon
- Gas washer
- CO<sub>2</sub> compressor
- Activated carbon filter
- Dryer
- CO<sub>2</sub> condenser
- Storage tank

Collection of the CO<sub>2</sub> is mainly from the top of the fermenters. Other sources are the maturation vessels and the bright beer tanks. The necessary inlet purity for the treatment of the CO<sub>2</sub> depends on the installed technology and ranges from 95 to 99.7 percent.

#### Up to 60 percent energy recovery

Most of the energy consumed during the CO<sub>2</sub> recovery process is used during gas compression, removal of off-flavors, to dry the gas, and during CO<sub>2</sub> liquefaction and vaporization. However, there are a number of reverse processes in the recovery system. Carbon dioxide, for example, is first liquefied and in the next step vaporized. This means that a great amount of energy must be extracted, while later almost the same amount of energy is added again.

Another example is the compression of the gas. Before the gas is sent to the brewery, the pressure must be slightly reduced. By linking such processes together, both inside and outside of the recovery process, costs can be considerably reduced and the net energy use for CO<sub>2</sub> recovery can be reduced by up to 60 percent.

The heat recovery system, type LiquiVap makes it possible to liquefy the CO<sub>2</sub> while using very little energy for cooling. If CO<sub>2</sub> production and consumption take place simultaneously, there is an immediate energy saving because the extracted CO<sub>2</sub> can be used to liquefy the CO<sub>2</sub>. At times when there is no CO<sub>2</sub> production or consumption, it is possible to liquefy or vaporize CO<sub>2</sub> in the traditional way, for example, at the start of the week when the fermentation has not yet started, but the beer is already being bottled, canned or put in kegs.

By using the LiquiVap system whenever possible, Molson Coors saves energy in a number of processes, including CO<sub>2</sub> condensation energy with the release of heat to the centralized brewery cooling system linked to it, when pre-cooling the cooling water, and as the energy necessary to vaporize CO<sub>2</sub>. However, the heat recovery system cannot cool more than is actually evaporated. For example, the capacity of a plant like the system installed at Molson Coors is 2,000 kg/h.

During production, only 1,000 kg/h CO<sub>2</sub> is needed and therefore only 1,000 kg/h can be cooled down by the LiquiVap system. For the remaining 1,000 kg/h a separate cooling method is necessary. The control system accurately regulates the plant so it uses only the energy for the 1,000 kg/h. Optimum energy efficiency is always reached – and



up to 60 percent of the energy consumption can be saved. Water consumption is also significantly reduced.

In operation since mid 2010, Pentair Haffmans' CO<sub>2</sub> recovery system encompasses production, processing, storage and distribution at Molson Coors' Burton-on-Trent brewery and runs 24/7. A five-year Service Level Agreement between Molson Coors and Pentair Haffmans was put into place in 2011 to maintain the high performance level.

#### HAFFMANS BV

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