# LiquiVap: Alternative for refrigeration plants

***In modern breweries $CO_2$ recovery plants are common practice to provide for the $CO_2$ supply of the brewery. With environmental awareness increasing and a general quest for potential cost reductions, energy saving possibilities are more important than ever. One of the most important parts of a $CO_2$ recovery plant is the cooling system, a cost-intensive unit both with regard to the capital investment and energy consumption.***

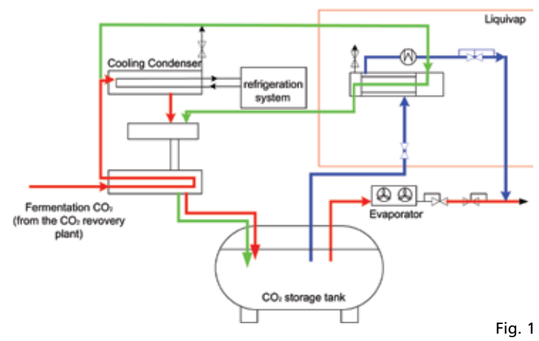


Fig. 1

The cooling plant consumes about 60 percent of the energy used during the $CO_2$ recovery process. Generally, the cooling system is an inherent (fixed) part of the $CO_2$ recovery plant, with a corresponding capacity.

However, for the expansion of existing recovery plants, there is an alternative for the cooling system – Norit Haffmans' LiquiVap. LiquiVap, an acronym derived from the words Liquefaction and Evaporation, is an energy saving system for breweries. In the process of recovering $CO_2$, the gaseous $CO_2$ has to be liquefied in order to be purified and stored in a tank (-24 °C 18 bar). The stored liquid $CO_2$ can further be used in the brewing process. For this purpose, the liquid $CO_2$ has to be evaporated by heating, using air or steam, and its pressure has to be reduced generally to a range of 8 to 10 bar. However, this way of processing consumes a considerable amount of cooling energy, which can be recovered by the LiquiVap system very efficiently. It uses vaporized $CO_2$ from the storage tank to liquefy gaseous $CO_2$ from the fermenters. In this way energy that usually comes from the cooling plant and heating energy that comes from the (steam) evaporators is saved. By evaporating the liquid $CO_2$ (blue line) in the LiquiVap, the recovered $CO_2$ (green line) is liquefied, saving both the cooling and heating energy. (Fig. 1)

At first, LiquiVap was primarily intended as an energy recovery system and added to existing $CO_2$ recovery systems, with a cooling and evaporation system, as an additional unit. However, after many successful projects, it became clear that it could cope with a large part of the cooling capacity, making the ammonia or freon cooling plant nearly obsolete. Almost all energy used during the liquefaction step was saved by using the LiquiVap. As a consequence, the original required capacity of the ammonia or Freon cooling plant was considerably reduced. When upgrading the capacity of a $CO_2$ recovery plant, part of the extension of the cooling plant could therefore be omitted and be replaced by the LiquiVap system.

One of the first customers where Norit Haffmans put this concept in practice was the Ploiesti Brewery in Romania. Here, LiquiVap was not solely intended as an energy savings system but as an extension of the cooling plant. During the upgrade of the $CO_2$ recovery plant from 800 to 1600 kg/h, the customer did not opt for an extra ammonia cooling plant of 800 kg, but instead chose an extra 1600 kg LiquiVap. (Fig.2)

An analysis of the simultaneity of the recovered $CO_2$ gas and the $CO_2$ used for production showed that there was always a stream of $CO_2$ going to the brewery that could cope with the need of the extra 800 kg/h cooling energy. Consequently, the Liqui-Vap could be used as part of the cooling load for the total plant. The advantages for the customer were considerable in both capital and operational costs. Generally, the cooling system of a $CO_2$ recovery plant is one of the more expensive parts. The capital expenditure for upgrading the existing system by 800 kg/h including a 1600 kg/h LiquiVap system without additional cooling was significantly lower than a traditional upgrade with cooling system, in this case the capital upgrade cost was reduced by approximately one quarter.

The operational costs were reduced because of two major benefits. First of all, about 60 percent of the cost involved when producing $CO_2$ with a $CO_2$ recovery installation are electrical energy costs. By using the LiquiVap system as an extension to the existing recovery system

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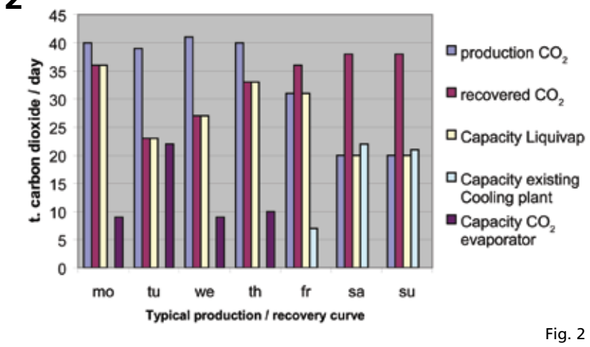


Fig. 2

the electrical energy consumption dropped by about one-third. The second benefit is that the LiquiVap system itself does not have any rotating equipment, enabling it to operate 24 h/d over a long period of time without preventive maintenance stops.

On top of that it reduces the running hours of the existing cooling plant, which reduces the maintenance costs. Together with the increase of the reliability and lower maintenance costs, the total price for the brewery to produce $CO_2$ dropped by about one-third. The system at Ploeisti has been operational for about 10 months. During that time, LiquiVap has been the primary cooling system. By a change in the control system, the $CO_2$ plant is even able to produce $CO_2$ when the existing cooling system shuts down. By choosing LiquiVap, the brewery not only saved initial capital costs, but produces $CO_2$ in a reliable, more environmental friendly way. Since the success at the Ploesti Brewery, Norit Haffmans has installed many similar systems worldwide and expects more breweries to follow Ploeisti's example in the future.

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# Norit Haffmans comprehensive service concept

***Until now, service was mainly defined as the supply of spare parts and consumables such as activated carbon and drying agents, and the performance of corrective maintenance (repairs). Norit Haffmans Service has been actively moving ahead and has now established various long-term service contracts with a number of new and established customers, including Heineken Sevilla and Bavaria in the Netherlands. Coordinated response times as well as guarantees on operating hours and costs for the entire $CO_2$ recovery unit have been agreed as part of these Service Level Agreements.***

Norit Haffmans' Service Level Agreement plan provides a transparent overview of agreements relating to response times, the availability of spare parts and consumables, and the performance of the $CO_2$ recovery unit. With regard to the performance of the $CO_2$ unit as required by their customers, Norit Haffmans has reached clear agreements about when which activity will be performed on site.

As designer and producer of $CO_2$ recovery units, Norit Haffmans knows the processes that take place in these units better than anyone else. Maintenance means more than just the preventive replacement of wearing parts. Maintenance technicians have an exact understanding of how each component works and can offer customers the kind of service that is really necessary to ensure that a unit delivers maximum service at minimum cost.

Norit Haffmans Service provides made-to-measure instruction courses for operators or technical personnel that are geared to the needs and the target group. These courses can consist of operator training, maintenance training or safety training. Instruction courses can be organized individually or as part of a service contract. By so doing, we can make sure that your staff stays motivated and that operating losses are kept to a minimum.

Safeguarding the quality and continuity of each unit over the long term is Norit Haffmans service challenge.

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