

CASE STUDY – PILLER MVR TECHNOLOGY IN THE DISTILLATION PROCESS AT CHIVAS BROTHERS

Customer & Industry

HOW PILLER HEAT PUMP TECHNOLOGY PAVES THE WAY TO CARBON-FREE DISTILLATION AT CHIVAS BROTHERS

Chivas Brothers, the Scotch whisky business of Pernod Ricard, is working to achieve carbon neutral distillation by 2026. The implementation of PILLER Heat pump technology based on the energy recovery process of Mechanical Vapor Recompression (MVR) is key to achieving this industry-leading goal. For both upgrading existing and equipping new plants, Chivas Brothers relies on PILLER VapoFans, which in a vapor compression heat pump system, delivered a COP of 12 in this project.



heap pump system. A vertical condenser and an MVR set consisting of three PILLER VapoFans in series,” explains Neil Fraser of Chivas Brothers. In the new installation, the latent heat of the product vapors leaving the pot still is recovered by the vertical condenser. This heat exchanger produces low-pressure steam (LPS) at a temperature a few degrees below the condensation temperature of the product. The key to high efficiency is to avoid subcooling and pressure losses on both sides. The generated low-pressure steam is compressed by a three-stage VapoFan system and supplied to the still’s reboiler for heating at higher pressure and temperature.

In a single pot, around 1 MW heating duty of the reboiler is supplied by using 90 kW of electric power. The incorporated water injection saturates the steam feeding to the reboilers and amplifies the efficiency.

Challenge

WELL-ESTABLISHED, BUT ENERGY- INTENSIVE DISTILLATION PROCESS

Traditionally, malt whisky is produced by batch distillation using copper stills. After the pot still has been filled with the alcohol containing feed, boilers powered by natural gas or other fossil-based fuels provide the steam to the reboilers that heat the still.

The process of evaporating the alcohol usually takes several hours and is therefore very energy-intensive. Besides the very high energy costs, heating with fossil fuel-based steam boilers is linked to high CO₂ emissions. Without the use of MVR technology, most of the energy used to heat the distillation process is released into the environment via cooling towers after condensing the alcohol.

Solution

VAPOR COMPRESSION HEAT PUMP TECHNOLOGY APPROACH

“To reach the goal of carbon neutrality we came up with the idea of using highly efficient Mechanical Vapor Recompression (MVR) technology,” said Neil Fraser, Engineering Manager at Chivas Brothers.

“The heat recovery technology allows Chivas Brothers to recover the energy from the product vapor formerly lost via the cooling towers and use it to boil the still, thereby significantly reducing carbon emissions.”

Product & Equipment MAIN COMPONENTS FOR REDESIGN

“Our MVR process is based on two main components that constitute the

RESULTS

The great flexibility of operation and variable frequency drives of the VapoFans make the heat pump system based on PILLER mechanical vapor recompression technology a perfect fit to Chivas Brothers’ needs. “The heat pump system adapts to the constantly changing process conditions during distillation and provides the required compression at each stage of the process,” says Gregor Schumm, Head of Process Engineering at Piller Blowers & Compressors. Starting with a high temperature

difference across the process at the beginning of the batch, the speed is reduced to the end, where more and more water is condensed on the steam generator. The higher water content raises the distillate temperature and allows a higher saturation pressure to be used for vapor compression. "The continuous adaption to the needs of the process boosts up the efficiency even higher. Starting at a COP of 9, the batch ends with a COP around 20, resulting in an average COP around 12", says process engineer Oscar Sgrott of PILLER. The COP is defined as the relationship between the thermal power (kW) that is supplied by a heat pump for heating, and the power (kW) that is supplied to the compressors. As soon as a batch is distilled after a few hours, the VapoFans are simply ramped down in two minutes and ready for the next batch to be

distilled. Hence, compression on demand in combination with high efficiency MVR machines leads to substantial COP numbers. Neil Fraser of Chivas Brothers mentions another big plus: "Water as a heat transfer medium is the ideal way to combine product and environmental safety with high efficiencies by heat pumps directly on the process unit."

FUTURE PLANS

After a successful pilot of the MVR technology was implemented in 2021 at the Glentauchers distillery near Keith in Speyside, Scotland, Chivas Brothers decided to install two further MVR heat pumps on wash stills at the location. To date, PILLER MVR technology a part of the enhanced integrated heat recovery system has reduced total energy consumption almost by half (48%) at Chivas Brothers' Glentauchers distillery

site, reducing its total carbon emissions by 53% as a result. The carbon emissions have been reduced from 8,290 tonnes CO₂ to 3,970 tonnes CO₂ per year on full production.

As MVR technology is considered a major step towards the ambitious target of carbon neutral whisky distillation by 2026 at Chivas Brothers, the company recently announced an investment of more than £ 60 million over the next three years. Based on the intended application of heat recovery technology at all applicable Chivas Brothers sites, the company will bring their heating energy down from the current average of 5.82 kwh/litre to 4.00 kwh/litre. This alone will reduce the projected carbon emissions by more than 30,000 tonnes per annum – a reduction of approximately 38 %.

SUMMARY	
CUSTOMER	CHIVAS BROTHERS / PERNOD RICARD
INDUSTRY	BEVERAGES, SCOTCH WHISKY
CHALLENGE	Batch distillation process with high energy demand Reduce site energy demand significantly Reaching the industry-leading target of carbon neutral Scotch distillation by 2026
SOLUTION	VAPOR COMPRESSION HEAT PUMP TECHNOLOGY BASED ON MECHANICAL VAPOR RECOMPRESSION Redesign of the energy-intensive distillation process by implementing a MVR process based on two main components that constitute the heap pump system, a vertical condenser and an MVR set consisting of three PILLER VapoFans in series. The heat recovery technology allows Chivas Brothers to recover the energy from the product vapor formerly lost via the cooling towers and use it to boil the still, thereby significantly reducing carbon emissions.
PRODUCT AND EQUIPMENT	THREE PILLER VAPOFANS IN SERIES VERTICAL CONDENSER
BENEFITS	48 % REDUCTION OF TOTAL ENERGY CONSUMPTION At Glentauchers the total energy consumption was reduced from 27 MJ/LA to 14 MJ/LA
	53 % REDUCTION OF CO₂ EMISSIONS The carbon emissions have been reduced from 8,290 to 3,970 tonnes CO ₂ /year
	31 % PREDICTED REDUCTION OF REQUIRED HEATING ENERGY PER LITRE Based on the intended application of the technology at all applicable sites, heating energy will go down from the current average of 5.82 kwh/litre to 4 kwh/litre

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