CASE STUDY
Water Source CO_2 Refrigerant Hot Water Heat Pump Application

ABOUT THE COMPANY

MYCOM Mayekawa is a leading provider of energy efficient compressors and thermal systems. Our focus is on developing energy efficient technology for refrigeration, air conditioning and heating applications.

We emphasize the use of "Natural Five" refrigerants (water, air, ammonia, CO_2 and hydrocarbons) which have the greatest application potential for the next generation of thermal applications and solutions.

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INTRODUCTION

Concerns over rising energy costs and the commitment to sustainable operations, Somerston Wine Co., producer of Highflyer, Priest Ranch and Somerston wines has installed the first ever integrated CO2 refrigerant heat pump heating and cooling system implemented in a winery in North America. The installation is at their state of the art, energy efficient winery located in a renovated 12,000-square-foot barn situated high in the eastern mountains of Napa Valley, California on Somerston's 1,682 acre ranch, and was designed to be functional, practical and energy efficient. Somerston's sustainable operations will eventually expand to include a neighboring structure with solar powered lithium batteries, resulting in a winery which is 100% off the grid.

A typical winery would install a natural gas or propane hot water boiler in addition to an air cooled or water cooled electric chiller for the hot water and chilled glycol systems used for tank fermentation control and barrel room cooling / heating requirements. These separate components cannot recover the heat that is wasted through the air cooled or water cooled condenser of the electric chiller. In addition, hot water above 180 F is required which cannot be met using a standard heat pump system.

ABOUT THE SYSTEM

The integrated MYCOM ECO Cute CO2 refrigerant heat pump heating and cooling system is comprised of four elements: a MYCOM CO2 refrigerant heat pump, a hybrid adiabatic fluid cooler that replaces the traditional cooling tower, a glycol warming system for tank and barrel room heating and a high efficiency water cooled glycol chiller for additional tank and barrel room cooling. The components represent cutting-edge technology used only by a handful of companies in the world, and Somerston Wine Co. is the first to integrate the components into a complete system. The CO2 heat pump system operates with zero emissions as all electric, while also achieving a vastly higher coefficient of performance to traditional propane-based hot water boilers and standard refrigerant heat pumps where high temperature hot water is needed. Where a standard propane-based hot water boiler is 80 percent efficient, Somerston's CO2 heat pump is 360 to 400 percent efficient while performing heating and cooling functions at the same time.

In addition, Somerston's MYCOM CO_2 refrigerant heat pump can achieve **194 F** hot water output temperatures, far outperforming HCFC and HFC refrigerant heat pumps which only achieve 160 F output at best.

The first component, a MYCOM Eco Cute electric-driven , water source, hot water heat pump, uses CO_2 as a refrigerant for glycol cooling and hot water heating all in the same unit. It is more efficient than a standard hot water boiler, especially while heating and cooling simultaneously. The heat pump operates using the trans critical refrigeration cycle. By using CO_2 instead of gas fired boilers and HFC refrigerants, Somerston's system results in a 28% lower carbon footprint overall. This MYCOM CO_2 refrigerant heat pump made its North American debut at the Somerston winery and is backed with a proven record of performance and effectiveness in Japan and Europe. A large insulated hot water storage tank was also installed for winery peak load requirements.

The second component of Somerston's system is a hybrid adiabatic fluid cooler, which replaces the traditional cooling tower. While traditional towers require large amounts of water and high maintenance costs, Somerston's fluid cooler acts as an air cooler during temperate months and a wet cooler during hotter months. Somerston is the first winery in the U.S. to utilize this technology.

A larger high-efficiency electric glycol chiller for harvest cooling loads and a glycol warmer are the final components of the system and are used for tank and barrel room cooling. The MYCOM CO_2 heat pump is used as an integrated component with these other systems to indirectly warm glycol with a special safety plate heat exchanger and directly cool glycol resulting in dramatically lower energy requirements than traditional systems, bringing Somerston's ideals of a sustainable, environmentally conscious property full circle.

"Somerston's guiding mission is to operate systemically as a sustainable, efficient, and land-focused project," says Craig Becker, partner, general manager, winemaker and vineyard manager at Somerston Wine Co. "While plenty of producers build efficiently, they rarely operate efficiently. Every element of the Somerston winery has a purpose, and the energy savings for the integrated CO_2 heating and cooling system will pay for the system's additional cost within three years."

RESULTS

Environmental Impact: Using CO_2 as the refrigerant for the heat pump system allows for high hot water temperatures in addition to eliminating the use of HCFC and HFC refrigerants. A 28% overall reduction in greenhouse gas emissions was also achieved.

Safety: The MYCOM heat pump is a closed type system that has a total CO_2 refrigerant charge of 24 lbs along with safety interlocks to ensure safe and reliable operation.

Costs: The overall cost using the hybrid components in an integrated system resulted in a 25% premium versus a separate gas boiler and glycol chiller system. The additional costs are expected to be recovered within three years.

Energy Efficiency: By combining the hot water heating system with the glycol cooling system using the MYCOM heat pump unit, a high COP is realized versus separate systems. The system has been in operation since late 2010 and a 22% energy reduction was achieved versus a more traditional system. In addition, the MYCOM heat pump can source heat from either the glycol cooling loop for low load conditions or from the higher temperature water cooled condenser of the electric chiller for increased COP and system performance.

SUMMARY

The use of trans critical heat pumps for high temperature hot water heating is a proven technology with very good overall energy efficiency. In addition, the water source version as described in this case study has many applications including Hotels/Resorts, Food Processors, Dairies, Breweries, Manufacturing and even Building HVAC systems that have a high temperature hot water load and simultaneous cooling load. These types of applications can result in maximum energy savings while using environmentally friendly equipment.

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