PILLER
Blowers & Compressors

ENERGY EFFICIENT METHANOL STRIPPING WITH MVR BLOWER TECHNOLOGY

Industrial heat pumps are one of the key technologies to recover waste heat from chemical plants. They significantly improve overall efficiencies and recycle waste heat for process heating.

METHANOL STRIPPING: WASTE HEAT RECOVERY WITH PILLER MVR BLOWER TECHNOLOGY

With an annual production of over 100 million tons, methanol is one of the most important basic chemicals worldwide. About 85 % of it is used as starting material for syntheses or as a solvent. 15 % are used in the energy sector as fuel or fuel additive. Besides the raw material input, the purification process is energy consuming and cost intensive.

SAVING ENERGY AND REDUCING CO_2

By implementing an industrial heat pump based on PILLER MVR Blower Technology to the methanol stripping process, energy cost savings and a reduction of CO_2 emissions can be reached. To optimize methanol stripping in counter flow distillation, there are two options using vapor compression cycles:

1. closed loop Heat Pump Cycles
2. open-loop MVR Systems

A Coefficient Of Performance (COP) of 5.67 or 5.94 results from a retrofit.

ENERGY BALANCE: TYPICAL PROCESS HEATING AND COOLING

In the rectification column, a thermal separation of methanol and water takes place using a live steam heated reboiler. Within that process, methanol vapor with 75 deg C is produced on top of the column as overhead vapor, while water leaves the column as liquid bottom product at 111 deg C. The overhead vapor is condensed in a heat exchanger and extracted from the process as distillate.

The energy balance can be described by the typical heating and cooling sections of the conventional process:

1. low temperature waste heat on top of the column and
2. high temperature heat demand at its bottom.

To reach more energy efficiency, cost reduction, and to reduce the negative environmental impact, there are two solutions, using MVR Blower Technology in vapor compression heat pumps. One is to use a closed loop steam compression cycle; the other option is an open-loop MVR system.

The comparison of the conventional and the retrofitted systems (Option I and II) in the table shows how the efficiency is increased by reusing the process heat. With low electricity input the heat remains in the system and saves high amounts of fossil fuel.

Retrofitting results	closed loop heat pump cycle	open-loop MVR System
Reduced heat rejection thru cooling towers	72.2 MW	64 MW
Replaced energy input from fossil fuels by adding electric power for the MVR blowers	13.4 MW	12.9 MW
Resulting COP (heating only) of	5.67	5.94

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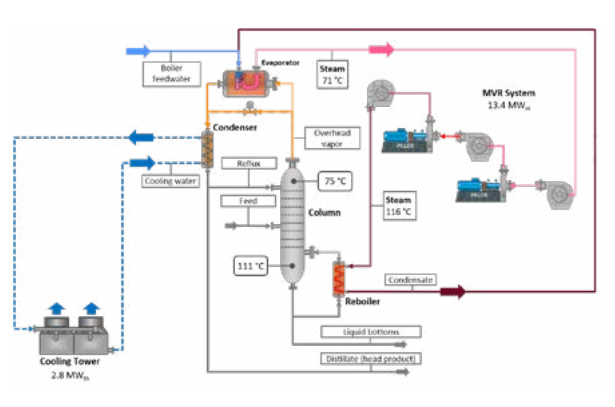
ALWAYS ADVANCING

OPTION I: CLOSED LOOP HEAT PUMP CYCLE

Implementing an industrial heat pump with steam generation allows waste heat to be elevated to a usable temperature level while preserving the heat of vaporization.

Base component for steam generation within an industrial heat pump is the evaporator. Instead of condensing overhead vapor and squandering the heat as cooled waste steam, the overhead vapor is routed to the heat exchanger, where it evaporates boiler feed water and generates steam at a low pressure or temperature. At the beginning of the loop, the boiler feedwater is evaporated at a saturation temperature of 71 deg C, respectively 325.7 mbar absolute.

Within the retrofitted process, vapor can now be compressed while preserving energy and feeding it at the lowest cost into the process. Key element of the closed loop heat pump cycle is the PILLER High-Performance Blower System. The design of the individual blowers and their arrangement in a multi-stage system are perfectly adapted to achieve the needed compression of the working fluid. Steam from the evaporator is compressed to a saturation temperature of 116 deg C (1,748 mbar absolute) and used as heat source in the reboiler. To run the process without additional water, condensate from the reboiler is reused.



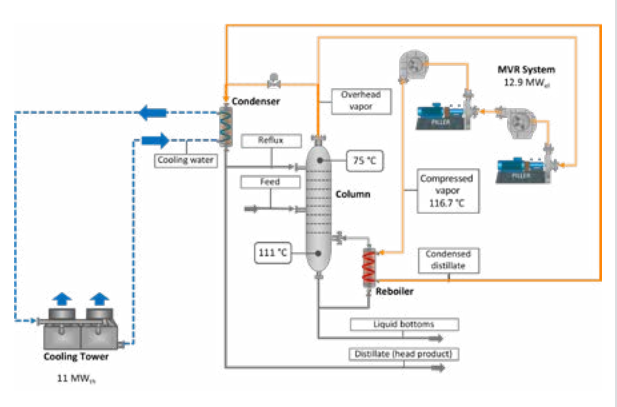
Closed loop heat pump cycle with PILLER Blowers

OPTION II: OPEN-LOOP MVR SYSTEM

In case the overhead vapor from the methanol stripper is directly introduced into the MVR Blower System, an open-loop solution is implemented. The methanol product is drawn from the same system and used as working fluid. The blower system has the primary purpose to recompress methanol vapor, providing the necessary temperature lift to heat the reboiler.

Equally to the compression system in Option I, a multi-stage high-performance blower system is implemented to achieve the needed compression rate. The overhead vapor – which was considered as low temperature waste heat – is compressed from 75 deg C to 116 deg C saturated. The high temperature heat demand of the reboiler is reached, thus the MVR Blower System eliminates the steam boiler.

As no further heat input from outside is necessary, the heat is fully recovered. The only input factor is the use of electrical energy for the steam compression unit, which replaces the energy input from fossil fuels. Results are an overall optimized performance, CO_2 reduction, and heat rejection. To optimize a methanol distillation process in terms of energy balance, this option results in a COP of 5.94 – considering heating only.



Open-loop MVR System with PILLER Blowers

DECISION MAKING: FEASIBILITY AND ECONOMIC VIABILITY

Which of the two options is ultimately considered for implementation depends on several variables, such as energy costs, steam prices, investment costs, and payback period.

All options are jointly developed and discussed with the responsible plant constructor and operator, considering technical and economic feasibility.

Industrial heat pump systems based on PILLER MVR Blower Technology have proven themselves in many different industries and applications. PILLER Blowers provide the needed compression performance. Over 20 steam compression systems for heat recovery have been installed and commissioned in the last decade.

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