

MVR-HP**EPCON Evaporation Technology AS**

Figure 1: Installation of multistage standard MVR fans

Summary of technology

EPCON supplies turnkey, tailor-made HTHP solutions based on Mechanical Vapor Recompression (MVR). As system integrator, EPCON combines equipment from prequalified sub suppliers to obtain optimized systems on a case-to-case basis.

The MVR-HP utilizes surplus heat from various industrial processes in direct, indirect or closed heat pump systems. It employs water vapor or other process vapors as working fluid, featuring serial compression driven by electricity, for flexible system design and optimized COP. The set-up is also suitable for cascade configurations with bottom cycle heat pumps, in addition to vacuum or partially vacuum operation.

Relevant applications include industries with existing or new thermal separation processes such as evaporation, distillation and drying, and plants with excess thermal energy available. The MVR-HP can directly elevate vapor temperature and pressure or produce steam at required quality from waste heat sources. Energy is subsequently delivered as steam or heat exchanged with other fluids. EPCON's background from thermal separation and inhouse heat transfer equipment design, also enables tailor made

evaporators, reboilers, etc. to be part of the scope in suitable cases.

The compression technology consists of centrifugal fans and blowers. The fans have been used in MVR evaporators since mid-1980s, and allow for flexible operation, including rapid startup and shutdown without lubrication in direct contact with the working fluid. Consequently, the MVR-HP is based on mature technology with high TRL. Several systems have been delivered throughout the years, and multiple projects are ongoing.

The MVR-HP systems rely on application specific design where core components are chosen to best match the process. The multistage arrangement enables extraction and supply of heat in intermediate stages, and the flexible design accommodates multiple heat sources and sinks.

Performance data for the MVR-HP is provided in Table 1. The first row refers to an installed direct system (2005) in the food industry, where MVR-HP is used in a rebuilt multistage evaporator. Water vapor is recovered, compressed in 3 stages, and supplied as water vapor to reboilers. The second row refers to an installed closed system in a chemical plant (2014), where top vapor latent heat is recovered and steam is supplied as water vapor to



a distillation reboiler, using a single stage MVR roots blower. The third row refers to a direct system in the food industry (2021), where a multistage evaporator is rebuilt to MVR-operation. Process water vapor from the evaporators is compressed in a 2-stage MVR-train and fed back to the evaporators. The last row refers to an indirect system (2023), further described in the next section.



Figure 2: 4-stage compact MVR fans

Table 1: Performance.

T _{source,in} [°C]	T _{source,out} [°C]	T _{sink,in} [°C]	T _{sink,out} [°C]	COP _{heating} [-]
90	-	-	110	5
80	80	85	85	13
88	-	-	100	11
88	87	-	112	8

Project example

A turnkey indirect MVR-HP system with water as working fluid was integrated in a distillation process in the chemical industry. Solvent top vapor latent heat is used as energy source, condensed in an EPCON-designed falling film evaporator. On the tube side, water is evaporated and compressed in 4 serial connected MVR-fans to a higher temperature and pressure level. Pressurized steam is delivered with direct injection to the bottom of a second distillation column.

The commissioning period was very efficient, and the MVR-HP startup and shutdown sequence are smooth and fast. The reflux and performance of each column is not affected. The rebuild is also performed in such a

way that the existing mode of operation can be performed during maintenance. The main performance indicators - energy saving and COP - were achieved from the first day of operation.

FACTS ABOUT THE TECHNOLOGY

Heat supply capacity: 0.2MW to 100MW

Temperature range: Max supply 210°C, preferred source temperature above 50°C (if glide, then 50°C is return source temperature)

Working fluid: Water (R718) and process vapors

Compressor technology: Centrifugal fans and blowers

Specific investment cost for installed turnkey system:

- System integration depends on several factors, resulting in CAPEX variations
- Lower capacity range of 1-3MW, specific cost 500-1600€/kW, typical dT 25-75°C
- Higher capacity range, 3-30MW, specific cost 200-1000€/kW, typical dT 25-75°C

TRL level: 9

Expected lifetime: 25 years

Size: Depends upon capacity, configuration, and temperature lift/number of MVR machines. Possible to reduce footprint by placing MVR machines in two or more building levels.

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All information were provided by the supplier without third-party validation. The information was provided as an indicative basis and may be different in final installations depending on application specific parameters.

