

Ventilators for mechanical vapour compression

Planning, production, assembly and service







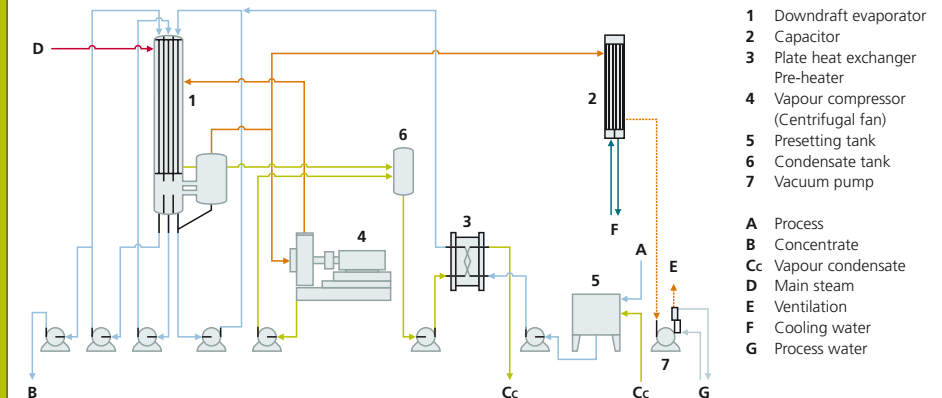
23 times from the earth to the moon: Piller and the mechanical vapour compression

It is incredible, but true: An impeller in the interior of a Piller vapour compressor leaves every space shuttle easily behind, at least regarding the performance. Because it covers more than 8.8 million kilometers per year. That means a route of 23 times to the moon. Try to demand this from a shuttle: negative report!

And while every flight of a space shuttle is celebrated as global media spectacle, the excellent work and the brilliant performance of the impeller in the Piller vapour compressor are mainly hidden to the wide public. Who really knows, what a beneficial device this is or wherefore such an installation is needed at all?

Since 1983 Piller Industrieventilatoren GmbH has been fabricating mechanical vapour compressors and has been continuously developing further. Nearly 1000 fans have left our factory since then and are worldwide extremely reliable in operation. More and more mechanical vapour compressors operate in processes, where process-related high temperature differences (high ΔT) of definite more than 10 K or even 18 K are required. These processes were so far a classical domain of the turbo compressors. Through a serial connection of two or even three high-performance vapour compressors, an increase in temperature up to 18 K respectively 27 K can be achieved, depending on the inlet temperature at the compressor.

Scheme of mechanical vapour compression



Closed-Process Evaporation

In this process, the steam, collected by a vapour compressor, is heated to a higher energy level and is then returned to the process as fresh heating steam. The energy contained in the steam is not lost; only the energy required to raise the energy level needs to be added.

Since the dramatic increase of the energy costs in the last decades, one tries to reduce the wastage of fossil fuel and the CO₂ emission as well as to lower thitherto high steam consumption for these processes.

With the mechanical vapour compression these efforts can be achieved, as it is matured to an economic and reliable process for evaporation, distillation, crystallization and drying. The closed process make it possible to evaporate temperature-sensitive liquids like milk in hard vacuum at ca. 60 °C or even blood plasma at 35 °C. Precious ingredients for the end product (e. g. powdered milk) remain and increase the quality and with it the value of the product.

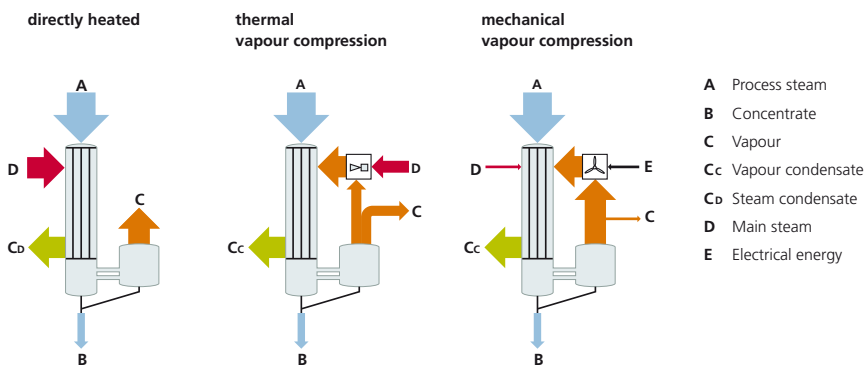
Fields of Application

If mechanical vapour compression was initially used almost exclusively in the milk industry, the areas of application were extended during subsequent years.

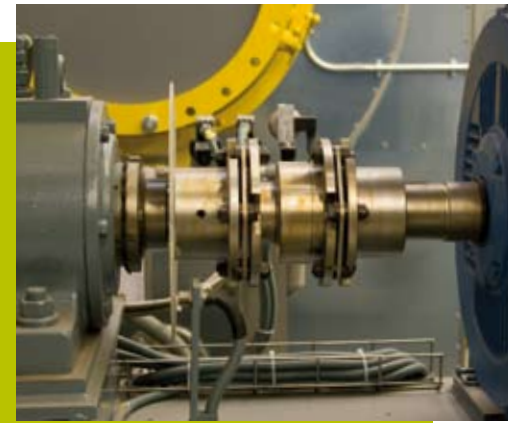
Fields of Application

- Milk /Whey
- Starch
- Sugar
- Yeast Production
- Alcohols
- Bioethanol
- Gelatine
- Pectins
- Grain Processing
- Vegetable Processing
- Fruit Juices
- Electrolyte Baths
- Saline Water
- Citric Acid and Acetic Acid
- Sulphuric Acid
- Nicotinic Acid
- Sewage Sludge and Lacquer Sludge
- Liquid Manure
- Oil Recycling
- Recycling of special metals
- Seawater Desalination
- Wood Drying, Pellets Drying and Peat Drying
- Paper Drying
- Boiler Feedwater
- Blood Plasma
- Commercialisation of Meat and Fish

Vapour compressor by comparison (evaporators' ways of heating)



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Coupling with speed control

The Piller mechanical vapour compressors are high-end-design solutions that have been standardized to an extremely high degree. There is no other Piller product that passed through so many innovations. With the standardization the basis for cost-effective solutions was created which can quickly be realized.

Dimensioning

The decision on how best to dimension an evaporating plant is directly dependent on two main cost factors, for energy and investment. The process conditions, moreover, are decisive, e.g. the process-specific temperature increase required for the product to be evaporated.

Costs

The trend for a modern plant concept moves today in most cases towards higher temperature differences (higher Delta T) and smaller heat exchange areas. Piller Industrieventilatoren GmbH has early reacted to this trend by developing high-performance fans. With an increase of temperature of up to 10 K (single-stage, depending on suction temperature and volume flow) the required heat exchange areas can be kept small.

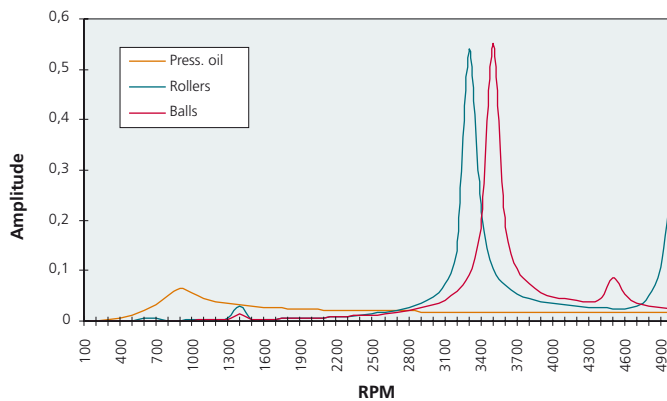
Thus, plant operators can reduce total investment costs when deciding in favour of standardized Piller evaporators and motors with frequency converters. Moreover, the otherwise high maintenance and operating costs of the very specific turbo compressor can decisively be reduced.

Technology

The Piller high-performance fans reach temperature rises through impeller peripheral speed of up to 300 m/s, using special materials even up to 310 m/s. Impeller geometries have also been optimized regarding best possible mechanical load and efficiency requirements.



Vibration amplitudes for pressurized oil & conventional anti-triction bearings



Buffer medium control and filter unit for steam



Bearings

In order that the rotors run permanently reliable and nearly vibration-free, Piller has developed the unique Piller squeeze oil damper bearing and has then applied for a patent. This bearing that is available for roller bearing and for sleeve bearing is supercritically designed. Hence bearing rigidity is here no longer of special importance in the bearing design, and the unwanted critical reaction to the rotor-wheel balance can be notably reduced. In the interests of greater reliability, the bearings can be precisely adapted to the loads experienced (load factors) and the peripheral speeds. This involves combining smaller bearings with larger final rotational speeds.

For more detailed information we refer you to our information sheet "Compressor Fans at their Limits".

Shaft Seal

Various shaft-seal concepts are available, depending on the intended use. In general, distinctions are made between the following operating conditions:

- > Process operates in a high vacuum
 $50 \text{ mbar} < p_{\text{abs}} < 200 \text{ mbar}$
- > Process operates under overpressure
 $1 \text{ bar} < p_{\text{abs}}$
- > Process operates in a high vacuum without a buffer medium

Buffer Media

Demineralised water or cleansed process steam can be used as buffer media for the shaft seals. For operations in a vacuum, buffer media prevent contamination of the vapour by the ambient air and, for operations under overpressure, they reduce the rate of leakage via the shaft seal. Pre-switched filter units purify the buffer media, thereby increasing the service life of the shaft lip seals. The drive shaft is protected against wear by a shaft sheath of radial packing rings.

Water injection

A specially designed water injection prevents the steam from overheating, keeps it saturated and increases the efficiency in the heat exchanger. Positive side effect: continuous cleaning of the impeller during operation and avoidance of caking which can lead to unbalance.



2600 kW vapour compressor for the sugar industry



Squeeze oil damping bearing with oil-supply plant



Evaporation ventilator with steam turbine for the fruit-juice industry

Control Devices

By default, every Piller mechanical vapour compressor is equipped with control electronics. The sensors are combined in a common junction box and record the following parameters:

Casing temperature

Bearing temperatures

Oscillation value of fan shaft

Speed

Oil temperature

Oil level

Oil volume flow

Oil pressure

Condensate level at casing bottom

Further fan specific data (e.g. injection quantity, pressure and volume flow of buffer media etc.) can additionally be controlled, if required. The microprocessor-controlled Piller Remote Control offers the possibility for a professional monitoring of your machine by our experts from the Service-Centre 24/7. The continuous analysis of the data enables a preventive maintenance which helps avoiding downtimes of the compressor and therewith cost-intensive production interruption.

If you have any further questions our service department will be happy to assist you.



Vapour compressor in the milk industry



Sliding bearings with squeeze oil damping



Vapour Compressor in a seawater desalination plant



The Center of Motion.

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