Vacuum systems for the oleochemical industry

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GEA steam jet vacuum pumps

There is no limit to the variety of applications for jet vacuum pumps within a defined suction capacity and suction quantity.

Jet vacuum pumps are used to create and maintain the vacuum in evaporators, driers, in distillation and rectification plants, and in the processes of freeze drying, polycondensation, degassing and deodorizing.
These sorts of equipment consist fundamentally of jet pumps and condensers or of a combination with other vacuum pumps such as, e.g. liquid ring vacuum pumps.

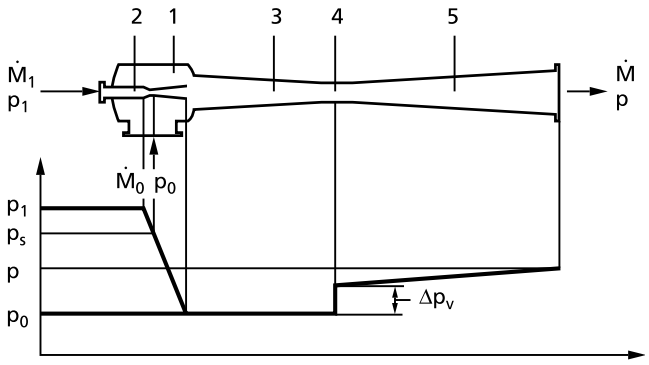
Jet pumps, also referred to as ejectors, use the expansion work of a motive medium to create the vacuum. A high velocity jet is generated in the motive nozzle; at low suction pressure, this jet entrains the suction medium and accelerates its path.
Through transformation of the kinetic energy, this mixture is brought up to a higher pressure level in the throat and the diffuser of the ejector.

Working principle of a steam ejector and the pressure differences over he flow path

1	*Head*	
2	*Motive nozzle*	
3	*Inlet cone*	*Mixing nozzle*
4	*Throat*	
5	*Diffuser*	

p1	*Motive steam pressure*
po	*Suction pressure*
p	*Counter pressure*
ps	*Pressure at sound velocity*
Δpv	*Compression thrust*

$\dot{M}_1$	*Motive steam flow*
$\dot{M}_0$	*Suction flow*
$\dot{M}$	*Mixing vapor flow*



The compression ratio of a single stage steam jet vacuum pump is limited (1:10, max. 1:20). Therefore, for low suction pressures, several jet vacuum pumps are arranged in series. A condenser is arranged between two ejectors in order to condense the motive steam as far as possible.

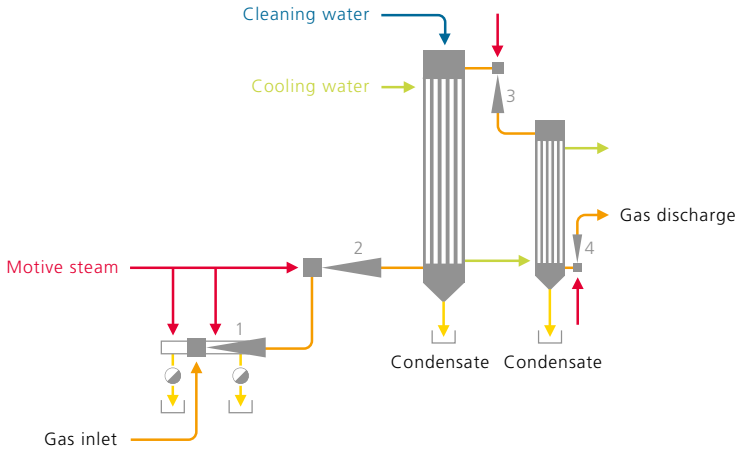
In this way, the volume of the complete gas mixture and thus the energy requirement of the next stage are reduced. Such multi-stage steam jet vacuum pumps are constructed for suction pressures up to approx. 0.01 mbar. and suction flows of 10 m³/h to 2,000,000 m³/h.

Condensation is done by surface condensers or water cooled mixing condensers. Surface condensers are usually preferred to avoid any possible contamination of the cooling water with the suction medium.

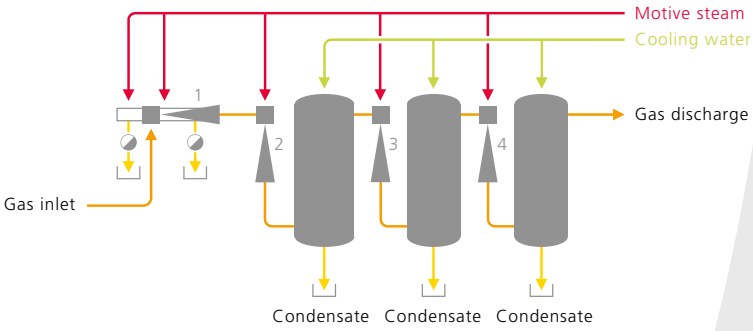
Advantages of jet vacuum pumps

- No moving parts
- Reliable operation, long equipment life
- Low maintenance costs
- Low operating costs if operated correctly
- Almost any vacuum duty can be accommodated including large suction flows
- Manufacture possible in different materials

Steam jet vacuum pumps with surface condensation



Steam jet vacuum pumps with mixing condensation



Left: Vacuum system for oil bleaching

Right: Main condenser and de-aeration unit of a vacuum unit for the deodorization of edible oil

Questionnaire

for the planning of a steam jet vacuum pump or a vacuum condensation plant

*) Several components to be stated separately.

1. SUCTION FLOW

Suction temperature . . . . . °C

Air . . . . . kg/h | Non-condensable gases . . . . . kg/h | Mol weight . . . . . kg/kmol

Water vapour . . . . . kg/h | Condensable vapours *) . . . . . kg/h | Mol weight . . . . . kg/kmol

2. PRESSURE

Suction pressure . . . . . mbar abs. | Discharge pressure . . . . . mbar abs.

3. CONDENSATION

MIXING CONDENSER ☐

SURFACE CONDENSER ☐ | **Installation:** horizontal ☐ vertical ☐

Cooling water: tube side ☐ shell side ☐

Max. allowable tube length . . . . . mm

External tube diameter . . . . . mm

Wall thickness . . . . . mm

Fouling factor (cooling water side) . . . . . $m^2K/W \cdot 10^{-4}$

Fouling factor (vacuum/product side) . . . . . $m^2K/W \cdot 10^{-4}$

4. TYPE OF INSTALLATION

Barometric ☐ | Semi-barometric ☐ | Non-barometric ☐

5. MOTIVE STEAM CONDITION

Temperature . . . . . °C | Pressure min. . . . . bar abs.

6. COOLING WATER

Temperature max . . . . . °C | Pressure min. . . . . mbar abs.

Permissible pressure loss . . . . . mbar

7. MATERIALS

STEAM JET PUMPS . . . . . | Motive nozzles . . . . .

MIXING CONDENSERS . . . . .

SURFACE CONDENSERS: Tubes . . . . . | Tube sheets . . . . .

Shell . . . . . | Water channels . . . . .

8. PRE-EVACUATION

Volume of the total system . . . . . m^3 | to be evacuated in . . . . . minutes

from atm. pressure to . . . . . mbar abs.

9. COMBINATION: STEAM JET / LIQUID RING VACUUM PUMP

With ☐ / without ☐ heat exchanger to recool the operating liquid

Cooling water temperature . . . . . °C

Operating liquid . . . . .

Motor data . . . . . V . . . . . Hz | Ex-protection yes ☐ no ☐

Type of protection . . . . . | Temperature class . . . . .

Temperature of the operating liquid . . . . . °C

10. PARTICULARS ON OPTIMIZATION

Operating hours / year: . . . . . h | Amortization period . . . . .

UTILITY COSTS: Motive steam . . . . . | Cooling water . . . . . Electricity . . . . .

Additional details, if required, are to be stated separately.

Your inquiry no. . . . . . | Offer submitted until . . . . . | Requested date of delivery . . . . .

FURTHER NOTES: . . . . .

. . . . .

YOUR ADDRESS

Company . . . . . | Street/P.O. Box . . . . . | Telephone . . . . .

attn. . . . . | ZIP code/City . . . . . | Telefax . . . . .

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