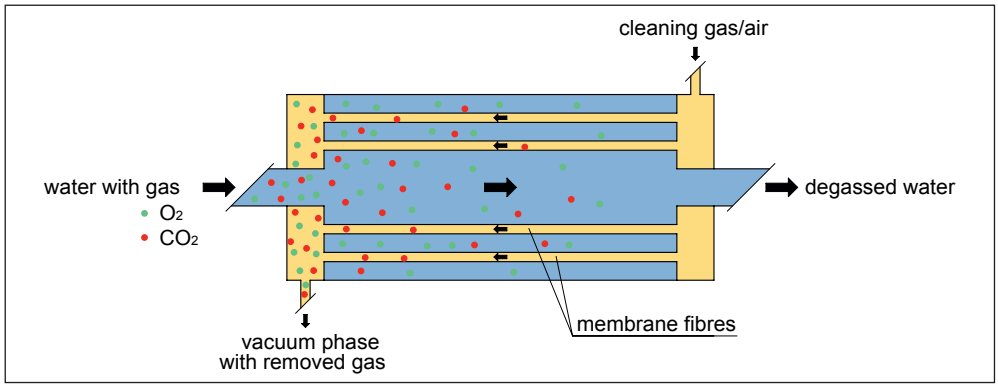
Membrane degassing systems

Membrane degassing is a very effective degassing method. It also supports desalination processes.
Membrane degassing enables carbon dioxide (CO_2) to be removed from water in pure stripping air mode down to values of less than 2 mg/l (ppm) or in combination with a vacuum pump to values of less than 1 mg/l (ppm).
Using industrial nitrogen as the stripping medium and in combination with a vacuum pump enables oxygen (O_2) to be reduced to residual values of less than 1 µg/l (ppb), as is required in the semiconductors industry for example.

Function

Creating a corresponding partial pressure gradient as the driving force (stripping with air/gas and/or creating a vacuum) causes the gases to diffuse out of the liquid and into the gas-bearing membrane fibres through microporous, hydrophobic (water-impermeable) hollow-fibre membrane modules, and to be transported away with the stripping gas.



Functional principle of membrane degassing

The individual hollow-fibre membranes are combined in modules (known as membrane contactors). Initially, the liquid flows via the contactor's inlet nozzles into a distributor pipe and is directed along the hollow fibres by a deflection barrier so that the gases can penetrate into the hollow fibres. The degassed liquid then leaves the contactor via a manifold and the subsequent outlet nozzle. In the counter-current, the stripping gas is directed through the hollow fibres via two separate nozzles on the inside. Depending on what is required in terms of gas outlet concentration and treatment volume, individual contactors are connected either in series or, in the case of a high volume flow, also in parallel.

Components

A membrane degassing system basically consists of:

- Membrane contactors
- Prefilter with 3 µm filter fineness for stripping gas
- Prefilter with 5 µm filter fineness for the liquid being degassed
- Measuring instruments and valves
- Frame and piping
- Components for the stripping gas
- Vacuum pumps / fan
- Pipelines

Operating conditions

The water flowing in should at least be decarbonised (partially desalinated) or softened, since during degassing hardeners precipitate and the membrane fibres can block up (scaling) due to the shift in the lime-carbonic acid equilibrium. As many undissolved substances as possible must also be removed by filtration, otherwise they will also cause blockages (fouling).

For striping gas operation (with CO_2 removal), the media temperature should be 30 °C maximum. Higher operating temperatures (up to 60 °C) are possible when nitrogen is used as the stripping gas (for O_2 removal).

Two-line system with membrane degassing units

Membrane degassing is used to support desalination processes. In the case of demineralization with ion exchangers, membrane degassing allows the load to be relieved on the anion exchanger, resulting in a significant reduction in the need for regeneration chemicals (mainly sodium hydroxide). This makes membrane degassing a good alternative to the CO_2 percolator, but with the advantages of requiring much less space and energy (e.g. no pressure increase required).

In addition, membrane degassing is useful between EDI (electrodeionization) and reverse osmosis. Firstly, free carbon dioxide passes the membranes of the reverse osmosis system, and secondly the shift in the lime-carbonic acid equilibrium releases additional carbon dioxide. This places a great load on the downstream EDI, which often results in a deterioration of the diluate conductivity. Here, membrane degassing is an ideal addition between reverse osmosis and EDI, as it reliably removes CO_2 from the reverse osmosis permeate and causes only a low pressure loss during throughflow. Stable operation of the EDI which is vulnerable to CO_2 is thus guaranteed.

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