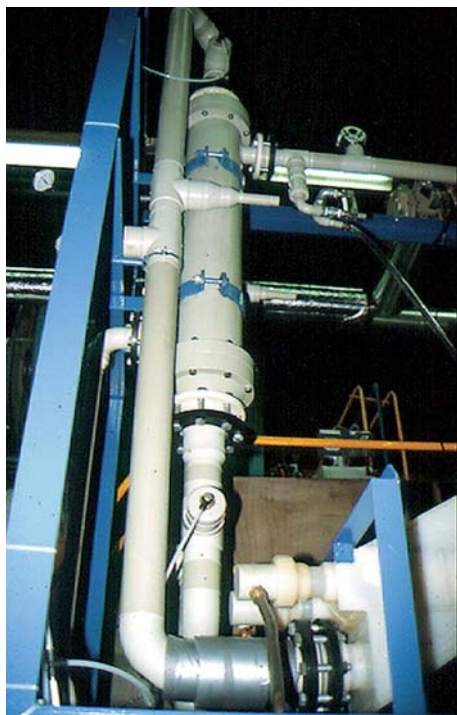


Flue Gas Desulphurisation

New opportunities with Membrane Gas Absorption (MGA)

The concern for the environment is a major issue for the industry. Acid rain is one of the problems and is caused by SO_2 in flue gases. At this moment you surely use all possible means to minimise SO_2 emission.



MGA pilot plant.

Probably you are using a wet scrubber system, which until now fulfills the legal requirements.

In the near future environmental regulations will be more strict which will force you to more severe measures to minimise the SO_2 emission. The relative inflexible absorber systems will be difficult to adjust in that case. The stricter regulations will require also treatment of smaller emission sources for which treatment was not necessary under the existing environmental regulations. Absorbers are not an optimal solution for these type of applications. You may use sulphite solutions or pure SO_2 gas as feed stock in your production processes. It is possible to recover sulphur dioxide from flue gases and recycle it as feed stock in your production process.

Our Solution

To solve these problems the emerging new technology membrane gas absorption will be of interest to you. Compared to wet scrubbers **membrane gas absorption** offers major advantages in: low costs, very compact equipment, low energy consumption, modular adjustable equipment and easy and flexible process operation.

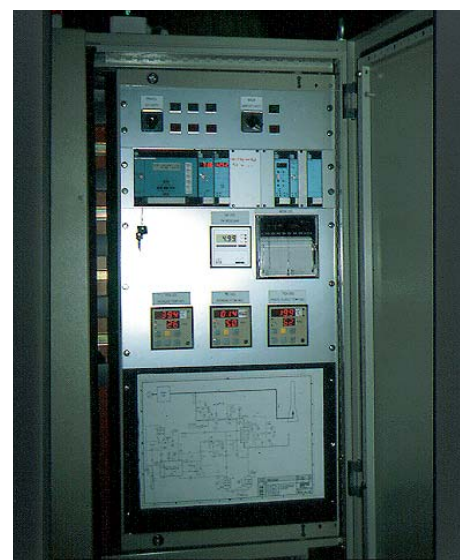
Membrane Gas Absorption Features

The membrane gas absorption technology is able to treat gas streams with extreme variations in gas flow and or SO_2 concentration at low costs in very compact equipment. The reduction in volume and weight compared to a conventional absorber can be more than a factor 10. Membrane gas absorption uses porous membranes for the transfer of components between a gas and a

liquid. The membrane forms a gas-permeable barrier between a liquid and a gaseous phase. Gaseous components diffuse through the pores and are absorbed by a suitable liquid.

Industrial Pilot Plant Experience

A membrane gas absorption pilot plant with a capacity of $100 \text{ m}^3/\text{h}$ has been designed and built in collaboration between TNO and industrial partners. The pilot plant has been installed in a potato starch production plant of AVEBE the Netherlands. In this plant combustion of H_2S containing biogas in a steamboiler results in SO_2 containing flue gas. A part of the total flue gas flow is used in the pilot plant. In the membrane gas absorption unit sulphur dioxide is recovered as bisulphite from the flue gas. The bisulphite can be re-used in AVEBE's production process. The pilot plant has been tested successfully for two production seasons each six month long.



Process control.

A SO₂ recovery of over 95% has been obtained at a capacity of 120 m³/h; the installation has been designed for 100 m³/h. The installation has proved to be very easy in operation. Variation in gas flow rate or SO₂ concentration can be handled without any problems. During the experiments no fouling of the membranes or decline in mass transfer have been observed. With the gas absorption membranes there is a flow of the bulk of the feed along the membrane. There is only a diffusive transport through the membrane. The diffusive transport in stead of convective flow is seen as the main reason that gas absorption membranes are less sensitive to fouling than conventional membranes.

Your benefits

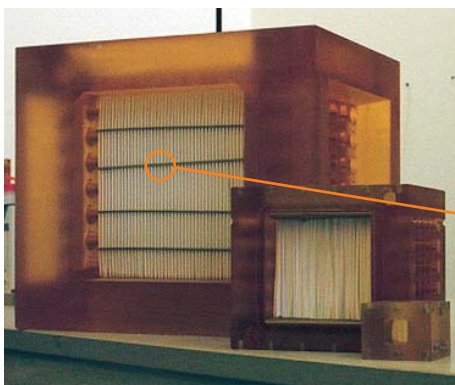
Through the use of hollow fibre membranes the membrane gas absorption process can offer you the following operational and economical advantages over conventional spray towers or packed columns.

Operational advantages:

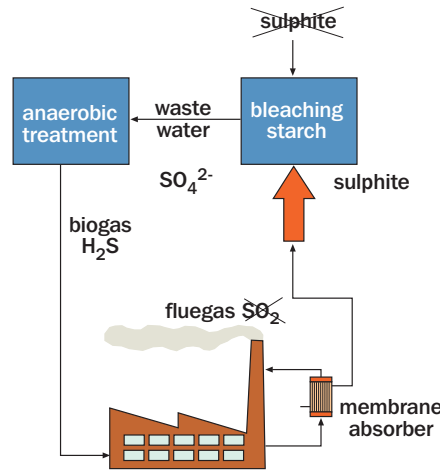
- Independent Gas/Liquid control.
- Flexible operation.
- Optimal load absorption liquid.
- No entrainment, flooding or foaming.
- Modular equipment compact.
- Low weight very compact equipment.

Economical advantages:

- Low costs of ownership.
- Low pumping power.
- No expensive civil engineering work necessary.



MGA membrane module.



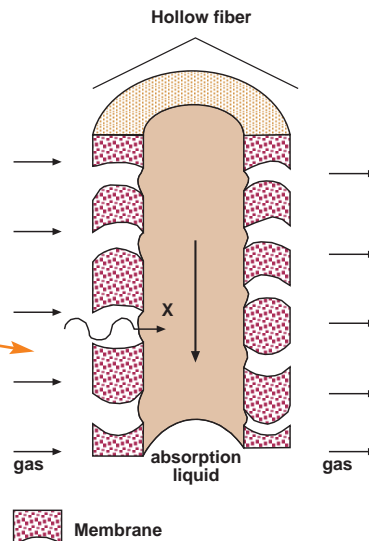
Sulphur recycling.

What TNO can offer

To your benefit Membrane Gas Absorption for flue gas desulphurisation can be realised at short notice for small size emission sources up to 5000 m³/hr flue gas at any SO₂ concentration level.

TNO offers:

- Feasibility study for your specific application.
- Organisation of demonstration project including search for partners, funding possibilities, project management, construction of installation together with OEM, start up of the installation, the test programme and report.
- Know how transfer for industrial use of the process.



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