POST-COMBUSTION CAPTURE OF CARBON DIOXIDE

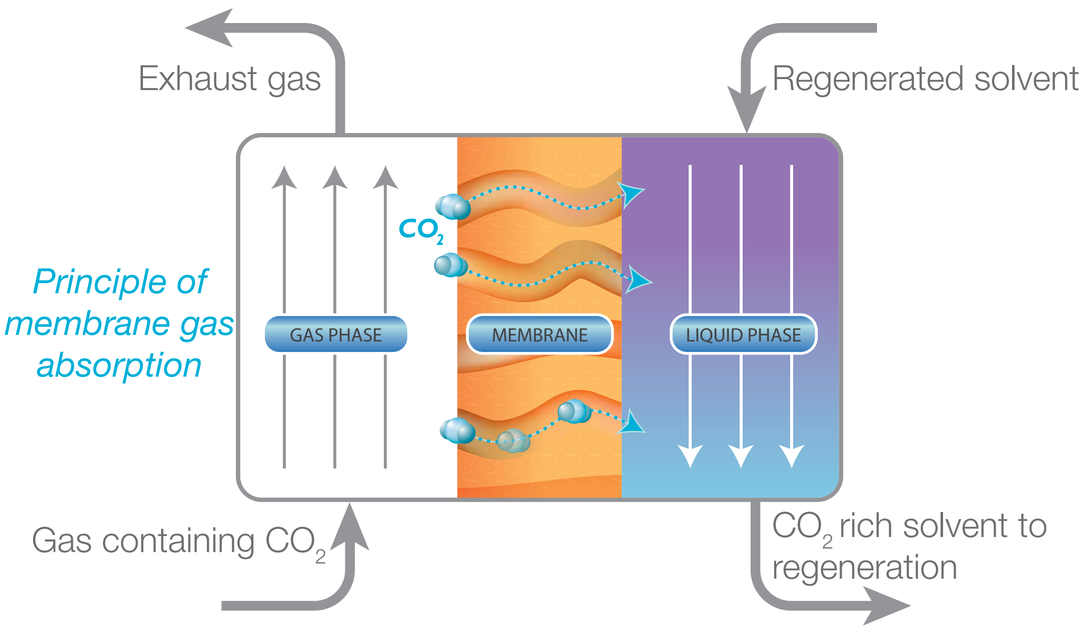
Membrane technologies

Membranes, generally made of polymers or ceramics, can be used to effectively sieve out carbon dioxide (CO_2) from gas streams. The membrane material is specifically designed to preferentially separate the molecules in the mixture. The process has not yet been applied on a large scale and there are challenges related to the composition and temperature of the flue gases.

Membranes are used to separate CO_2 from other gases (gas separation membranes) and to allow CO_2 to be absorbed from a gas stream into a solvent (membrane gas absorption). There are a range of membrane types for these processes.

Membrane gas absorption

A membrane can be used with a solvent to capture the CO_2. The CO_2 diffuses between the pores in the membrane and is then absorbed by the solvent. The membrane maintains the surface area between gas and liquid phases. This type of membrane is useful when the CO_2 has a low partial pressure, such as in flue gases, because the driving force for gas separation is small.



In the diagram above, the porous membrane allows gases to come into contact with the solvent. Only CO_2 is absorbed because of the selectivity of the solvent. The membrane itself does not separate the CO_2 from other gases, but rather maintains a barrier between the liquid and gas with permeability through the pores.

In a traditional solvent absorption process, the liquid and the gas are together, which leads to flow problems such as foaming and channelling. The physical separation of the gas flow from the liquid flow in a membrane absorber eliminates these problems.

Using a compact membrane can reduce the size of the equipment required to absorb the CO_2. Research is focused on developing appropriate materials that ensure that solvent does not penetrate the membrane pores.

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The CO2CRC H3 Capture Project at International Power's Hazelwood Power Station is conducting research into membrane gas absorption for CO_2 capture. The project aims to:

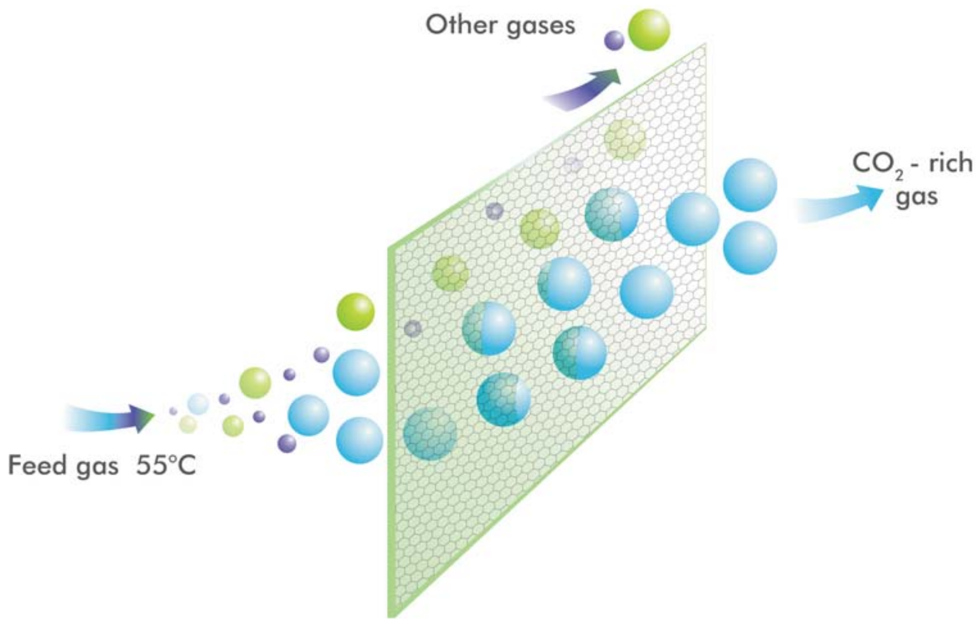
» test a range of membrane materials with a range of solvents; and

» evaluate the performance of each configuration.

Gas separation membranes

The advantage of using gas separation membranes is that the equipment is much smaller and there is no solvent involved. At the current stage of development, the main cost is the energy required to create a large enough pressure difference across the membrane to drive separation.

A membrane acts as a semi-permeable barrier. The CO_2 passes through this barrier more easily than other gases. In general, the rate at which a particular gas will move through the membrane can be determined by the size of the molecule, the concentration of gas, the pressure difference across the membrane and the affinity of the gas for the membrane material.



While the equipment is smaller, gas separation membranes require a large pressure difference to drive separation.

The CO2CRC H3 Capture Project at International Power's Hazelwood Power Station is conducting research into gas separation membranes for CO_2 capture. The project aims to:

» test a range of gas separation membranes;

» investigate the separation performance of these membranes under real flue gas conditions; and

» monitor the effects of minor gas components in the flue gas.

The project is part of the Latrobe Valley Post-combustion Capture Project and is supported by the Victorian Government, through their Energy Technology Innovation Strategy (ETIS) Brown Coal R&D funding.

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