LTMEMBRANE (NO3.5b)

LOW TEMPERATURE MEMBRANES FOR CO2 CAPTURE IN TILLER – TRONDHEIM

Last Updated: 2021-12-10T06:34:23

Tillerbruvegen 200, 7092 Tiller, Norway

Operated by

Description

SINTEF LTMembrane in Tiller is dedicated to testing of membranes for separation of gases at realistic conditions for advanced stages of development, usually higher TRL (Technology Readiness Level) than lab scale.
Taking good advantage of SINTEF's infrastructure in Tiller, realistic flue gas from a gas burner or a biofuel/coal burner can be tested for CO_2 separation by membranes. The explosion proof facility can perform tests with high CO_2 or CH_4 content (up to 90%), high pressure (up to 60-90 bar), and high temperature (up to 90 °C).

The facility has also a compact and handy hollow fibre manufacturability testing installation which can screen or pick out the best from new or modified membrane candidate materials which may include organic or inorganic particles/fillers.

Scientific Environment

The LTMembrane facility is located in SINTEF Tiller where experienced scientists and highly skilled technicians are available with state-of-the-art installations (in-house real height solvent CO_2 absorption tower test facility with gas burner and biofuel/coal burner, explosion proof building with safety cells, high pressure gas reservoir tank (about max. 100 bar, 14 m^3) to supply gases for pilot scale testing, etc.). Besides, more standard laboratories in SINTEF and NTNU are available where a number of GC, MS and IR gas analysers are available, if needed.

SINTEF has implemented and maintains a quality management system which fulfils the requirements of the standard NS-EN ISO 9001:2008 within research and development in materials technology, advanced materials and nanotechnology, applied chemistry and biotechnology, oil and gas, and green energy and process industry.

State of the Art

As explained above, all the installations have unique features. The LTMembrane facility provides advanced experimental techniques with automatic control and monitoring systems and offers a variety of experience and know-how from SINTEF experts. The permeation experiments can be conducted under realistic conditions at low to high temperatures, low to high pressures, and with various gas sources including synthetic mixtures and various real flue gases.

CCUS Technologies

Capture

- Membranes

Research Fields

- Material science
- Modelling
- Physical processes
- Engineering

Scale of Facility

- Small pilot

Research Facility Contact

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SINTEF experts, not only within the membrane technology field but also from various other fields, together with highly skilled technicians, offer cooperation for testing and analysis of membrane materials for gas permeation at various conditions to produce high quality data and discuss about results and plans.

Areas of Research

- Higher TRL membrane testing and development for CO_2, CH_4, C_2-C_4, N_2, O_2 separation
  - Realistic flue gas CO_2 separation membranes
  - Natural gas sweetening membranes
  - Subsea natural gas sweetening membranes
- Membrane testing for high CO_2 (or high CH_4) content (up to 90%) gases
- Membrane testing at high pressures (up to 60-90bar) and high temperatures (up to 90^{o}C)
- Hollow fibre manufacturability testing of polymeric, inorganic and hybrid membrane materials

Installations

Real gas membrane test rig in Tiller CO_2 Lab with flexible connectivity

The real gas membrane test rig aims at accommodating realistic gases for testing of CO_2 separation by membranes. The membranes can be polymeric, inorganic or hybrid, and the membrane area may be from tens of cm^2 up to several hundred cm^2.

The feed gas line is connected to the flue gas sources from a gas burner and a coal/biofuel burner in the Tiller CO_2 lab. The feed gas can be pumped to the rig by a blower (max. about 1-2 m^3/hr and 2-4 bara) while it can be either water vapor humidified by a humidifier or not humidified depending on the membrane test requirements. The retentate flow line is back-pressure regulated to control the pressure on the membrane module. The permeate line can be operated by either vacuum or sweep gas. Water vapor can be removed from both the retentate line and the permeate streams by a cooling separator and heat-tracing, not harming the equipment for flow measurement and gas composition analysis (GC).

High pressure/temperature gas permeation test rig in Tiller explosion proof facility

This rig can accommodate a wide range of test conditions from atmospheric up to 90 bara feed gas and from room temperature to 90 °C. The feed gas (max about 3.6 litre/min) can be supplied either directly from synthetic gas cylinders or via a gas booster (compression up to about 95 bar) if the supplied gas cylinder cannot

provide high enough pressure (for example, max. supply pressure from 70% CO_2 cylinder from vendor is only 28 bar). The retentate flow line is equipped with a back-pressure regulator to control the pressure on the membrane module. The sweep gas will be He, N_2, CH_4, or not needed if the permeate stream flow rate is high enough or vacuum is used. One more unique feature of the rig is that the permeate line is also equipped with a back-pressure regulator. This enables control of the permeate pressure as well (up to about 90 bara), according to the requirements of the project.

Compact membrane spinning rig for polymeric materials including inorganic/nanoparticles

This spinning rig has an easy-to-operate compact spinning machine (or a "beaker" spinning machine). It is suitable for any stage of membrane development for selecting the best potential materials with good spinnability by screening various candidate materials. The small scale of this machine requires a relatively small amount of raw material solution (doping solution, about 1-2 litres only). If necessary, the prepared hollow fibre membranes can be further tested for separation performance and characterized in SINTEF.

If the materials under development are hybridized from a polymer and nano/ inorganic particles, which may often cause problems in complex or large conventional spinning machines, this machine is able to create quick responses and results. It is easy to wash and clean and requires small amounts of raw materials, saving cost and time.

The spinning rig is suitable for checking fibre spinnability of new materials, including hybrid materials, as a pre-test or materials screening. Another application is testing of various fibre spinning parameters without excessive material consumption at the early stage of a project or as a supplementary test in the middle of a project.

Quality Control / Quality Assurance (QA)

https://www.sintef.no/en/sintef-group/a-certified-institute/

Quality Commitment

ISO 9001

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Facility Availability

Unit of Access (UA)
Day

Availability Per Year (in UA)
100 UA (days)

Forms of Access
In Person, Contract Research, Cooperative Research

Present Facility State of Access
Fully Accessible

Average Duration of a Typical Access
5-30 UA (days)

Operational or Other Constraints

Specific Risks
n/a

Legal Issues
n/a

Figures

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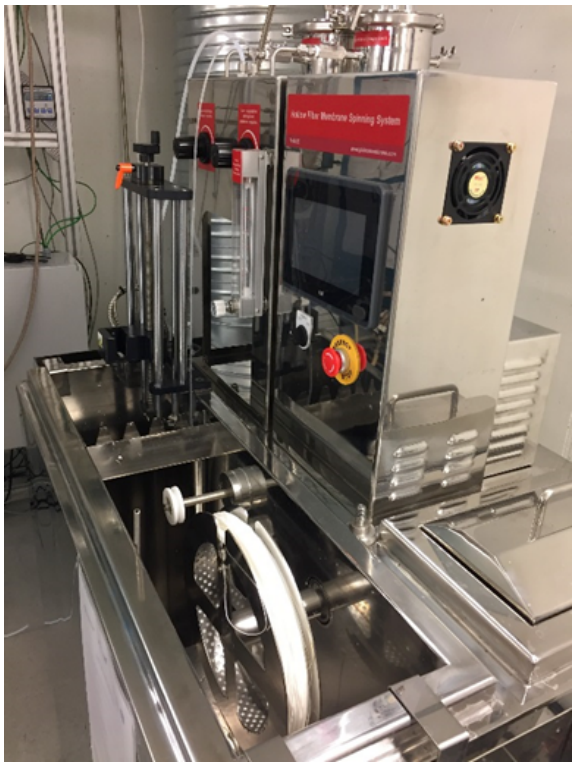

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