CE 550
N2 - Membrane separation process

Learning objectives/experiments

- nitrogen production through gas separation
- introduction to selective permeation through the membrane surface
- effects of parameters on pressure loss in the membrane and the air factor
- adjustment of process parameters in the air supply, retentate and permeate
- measurement of residual oxygen in the retentate and permeate

Description

- **gas separation based on the principle of selective permeation**
- **SEPURAN® N_2 hollow fibre membranes for nitrogen production, purity up to 99,5%**
- **visualisation of operating parameters**
- **system control via integrated PLC with data acquisition**

Membranes for gas separation work on the principle of selective permeation through the membrane surface. The hollow fibre membranes made of SEPURAN® N_2 polyimide used here have low air consumption and generate a high nitrogen capacity over a wide temperature range. Performance remains stable over the entire service life and nitrogen purity of up to 99,5% is achieved. Energy consumption is very low. Auxiliary materials such as water or chemicals are not required.

The CE 550 experimental unit shows a low-maintenance and efficient process for producing nitrogen from air. Compressed air is forced through a bundle of hollow fibres. The air mixture flows through the fibres and oxygen, water vapour and other gases diffuse through the fibres, while the nitrogen is retained. At the end of the process, concentrated, dry nitrogen is collected as the product gas (retentate). The separated gas mixture (permeate) escapes into the environment as a by-product. The operating parameters of the membranes are displayed on the screen. The experimental setup can be observed through an illuminated viewing window.

The residual oxygen content in the retentate, the pressure in the air supply and the back pressure in the permeate exhaust line can be adjusted.

Two thermostat-controlled ventilators are installed to cool the measuring device.

The experimental unit is controlled and operated via the integrated PLC with touchscreen. The most important parameters are continuously measured and displayed. The entire process as well as the air factor and pressure loss across the membrane module are displayed. A compressed air system with suitable compressed air treatment or synthetic compressed air from compressed air cylinders, with a connected pressure regulator (max. pressure 20 bar g) is required.

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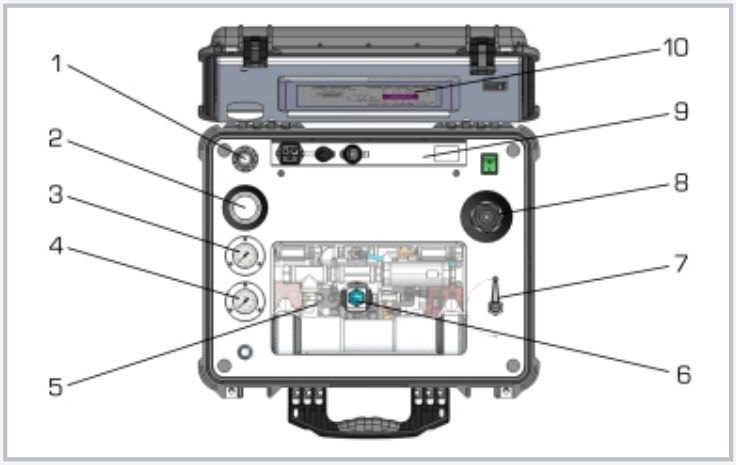
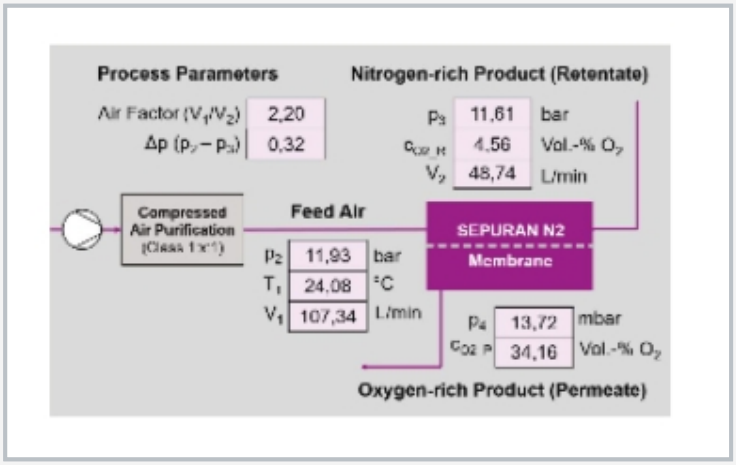
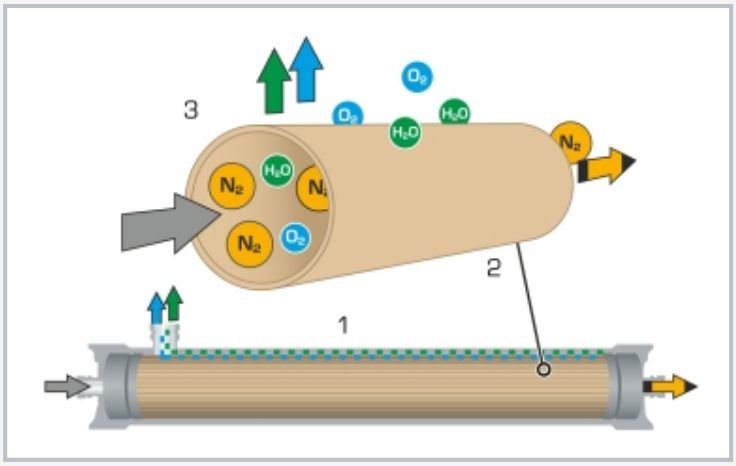


1 compressed air connection, 2 setting of inlet pressure in the air supply, 3 manometer: air supply, 4 manometer: back pressure in the permeate, 5 illuminated viewing window, 6 setting of back pressure in the permeate, 7 valve for venting permeate back pressure, 8 setting of residual oxygen content in the retentate, 9 electrical connection,
10 PLC with touch screen



Controlled by a PLC, operable via touchscreen



Functional principle of gas separation with hollow fibre membranes
1 bundle of hollow fibres made of polyimide, 2 individual hollow fibre, 3 gas separation; permeate green: H_2O, blue: O_2, retentate yellow/black: N_2, air mixture grey

Specification

[1] demonstration of gas separation based on the principle of selective permeation
[2] efficient nitrogen production from air mixture
[3] SEPURAN® N_2 polyimide hollow fibre membranes with purity up to 99,5%
[4] adjustable inlet pressure in the air supply and back pressure in the permeate
[5] safety valve for pressure limitation
[6] residual oxygen content in the retentate adjustable
[7] thermostat-controlled fans for cooling
[8] illuminated viewing window for observing the process
[9] recording of pressure, temperature, flow rate
[10] calculation of air factor and residual oxygen content
[11] controlled by a PLC, operable via touchscreen
[12] compressed air quality: class 1.4.1 according to ISO 8573-1:2010
[13] use suitable fittings for compressed air connection

Technical data

PLC: Siemens S7-1200

Membrane module
- SEPURAN® N_2 hollow fibre membranes
- type 2"-360

2 ventilators, adjustable
- thermostat-controlled
- preset to 25°C

Pressure regulator, air supply
- 0...11bar
- temperature: 5...40°C

Safety valve: 1,0bar

Measuring ranges
- pressure: in permeate: max. 400mbar
- temperature: 10...60°C

230V, 50Hz, 1 phase
230V, 60Hz, 1 phase
120V, 60Hz, 1 phase

Required for operation

Compressed air quality: class 1.4.1 according to ISO 8573-1:2010
Compressed air pressure: 0...11bar
Temperature range: 5...40°C
Suitable fittings for compressed air connection

Scope of delivery

1 case with N_2 membrane
1 set of cables
1 set of small parts