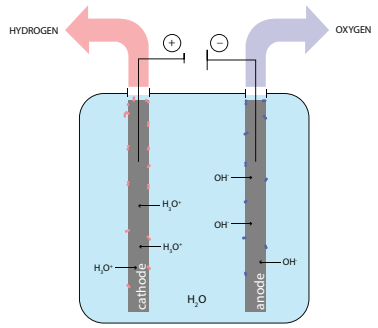
Water splitting for hydrogen production

Application note A068-EN99CM02-0217B

- Splitting water
- Clean energy

To retrieve fossil fuels such as natural gas, oil and coal, you have to drill for them to get them out of the earth's crust. In contrast to that, the energy carrier hydrogen does not occur in nature freely.

The most common way to generate hydrogen is in a chemical way, through the reaction of hydrocarbons such as natural gas with steam at high temperatures. In this process, hydrogen is released from the natural gas with the greenhouse gas carbon dioxide as a by-product. However, there is an alternative way to split water for hydrogen production, which is more competitive in price and efficiency. By means of electrolysis and other physical processes water is splitted into hydrogen and oxygen. Both gases have to be separated from each other with a membrane, to obtain hydrogen as pure as possible. Bronkhorst supported this process development by delivering mass flow controllers for hydrogen and oxygen flows.



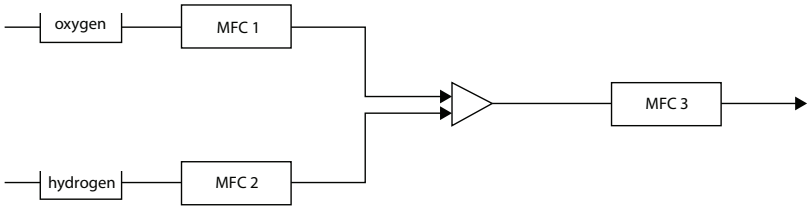
Electrolysis principle

Application requirements

As part of the process development, the performance of the membrane that separates hydrogen from oxygen has to be measured. To that end, both hydrogen and oxygen have to be supplied to the membrane in known amounts in an accurate way, and the flows that leave the membrane also have to be measured accurately.

Important topics
- Control accuracy
- Measurement accuracy

Process solution

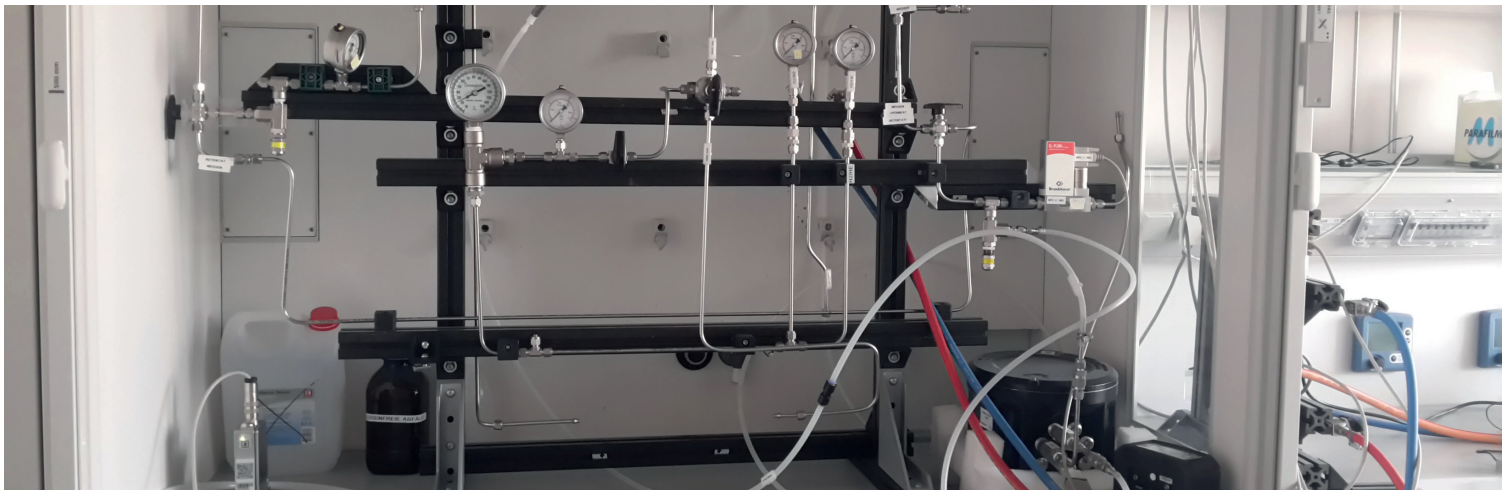


Flow scheme

In the experimental setup, with two mass flow controllers – a mini CORI-FLOW M14 for oxygen and a EL-FLOW Prestige for hydrogen - hydrogen and oxygen are fed to the membrane in a controlled way. The permeate - i.e. the part of the feed that passes the membrane - enters a three way valve where a choice can be made to measure the flow rate or the composition of the permeate gas flow. The flow rate is measured using another EL-FLOW Prestige device, and the gas composition by means of a binary gas sensor. This sensor can only handle a specific mass flow.

The three mass flow controllers/meters used in this experimental setup were doing an excellent job. In addition, during a short period of time another mini CORI-FLOW M14 was ordered, to measure the mass flow of the retentate - i.e. part of the feed that is retained by the membrane. ■

Bronkhorst®



Recommended Products

	**EL-FLOW Prestige** EL-FLOW Prestige is the next generation of Bronkhorst Mass Flow Meters / Controllers for gases. Nearly all core components have been redesigned and many improvements and innovations have been incorporated. Introducing the "Differential Temperature Balancing" technology, which ensures a superb sensor stability.	◆ High accuracy (standard 0,5% Rd plus 0,1% FS) ◆ Rangeability in digital mode up to 1:150 ◆ Extremely fast and dynamic response ◆ An on-board gas conversion model ◆ Multi-Gas / Multi-Range functionality ◆ Pressure ratings 64 / 100 bar ◆ Analog I/O-signals, RS232-connection; optional on-board fieldbus interface)
	**mini CORI-FLOW** The unique design of the miniature Coriolis sensor features unsurpassed performance, even with changing operating conditions in pressure, temperature, density, conductivity and viscosity. Contrary to many other Coriolis flow meters on the market, mini CORI-FLOW offers integrated PID control and close-coupled control valves or pumps.	◆ Direct mass flow measurement ◆ High accuracy, excellent repeatability ◆ Cost-effective design ◆ Compact design, with integrated PID controller for fast and stable control ◆ Now suitable for (very) low flow ranges ◆ Digital technology allows fieldbus communication and offers configurable control characteristics

Contact information

Bronkhorst®

T +31(0)573 45 88 00 **F** +31(0)573 45 88 08
I www.bronkhorst.com **E** info@bronkhorst.com

Water splitting for hydrogen production

A068-EN99CM02-0217B

EN: Energy
99: Other
CM: (Petro) chemical, metal, glass
02: Fine chemicals