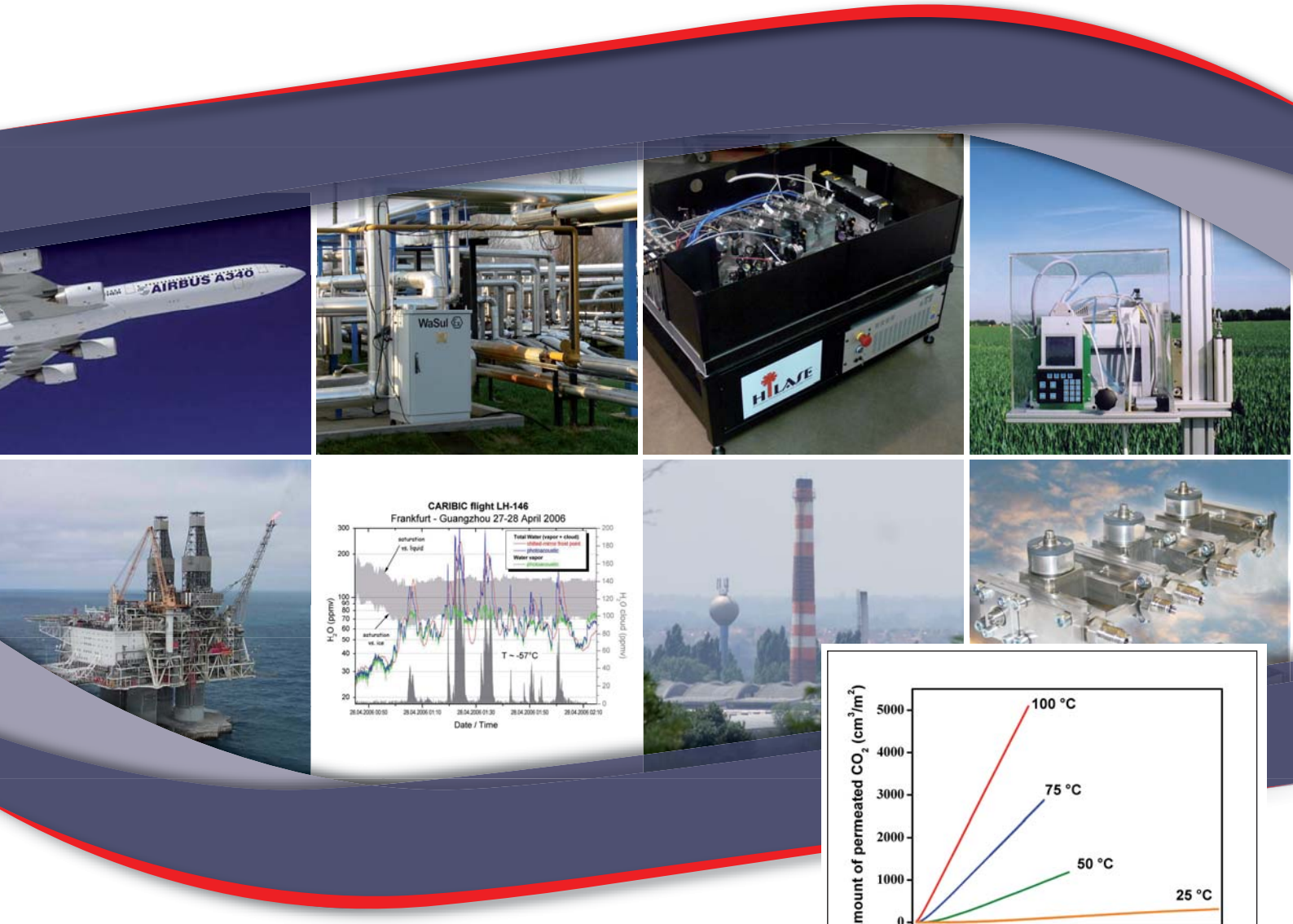
- Process control and quality monitoring instruments for the natural gas and the biogas industry
- Airborne instruments for atmospheric research
- Environmental monitoring instruments (air and water quality monitoring)
- Measuring instruments for pollution in industrial gases and liquids
- **Gas permeation instruments for the polymer industry**

HILASE

When reliability matters most



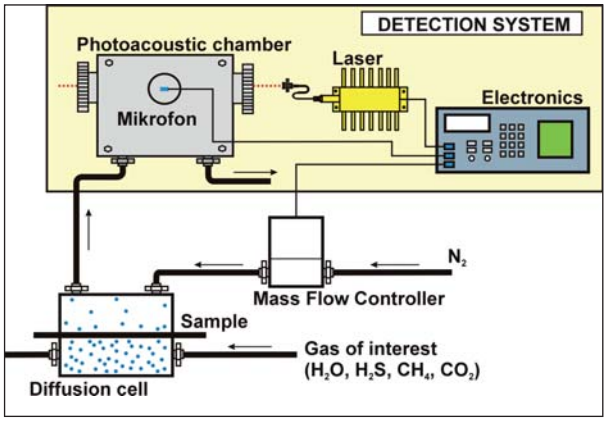
CH_4 H_2S H_2O NH_3 BTX CO_2

Main features of the WaSul™-Perm systems

The diode laser based permeability measuring systems of Hilase Ltd. offer unique possibilities for gas permeability measurements on plastic, rubber, paper, textile or other samples. Due to its continuous operation mode, excellent selectivity, high sensitivity and wide dynamic range WaSul™-Perm is insensitive to the usual measurement interferences. The measurable permeating components include **water vapor, hydrogen-sulfide, methane, ethane, carbon-dioxide, BTEX, ammonia, oxygen** and many other components. Furthermore, the excellent selectivity of the system makes WaSul™-Perm suitable to study the **permeation of gas mixtures**, too. With a WaSul™-Perm system **up to five samples** can be measured **in parallel**. It is also possible to measure the permeation of **several gas components in parallel**.

Basic variants of our permeability measuring system

WaSul™-Perm is available in two basic versions. The first one, which is based on photoacoustic gas detection, is optimized for measurements **at normal pressure and temperatures up to 120 °C**. The second one, which is based on photothermal beam deflection method, can be used also at **extreme pressures (up to 1000 bar) and also at high temperatures**. An outstanding feature of the high pressure system is that it can be operated by using the **same pressure on each side of the sample**, so mechanical distortion of the sample can be avoided.



SCHEMATICS OF THE WASUL™-PERM SYSTEMS FOR PERMEABILITY MEASUREMENTS AT NORMAL PRESSURE AND TEMPERATURE UP TO 120 °C

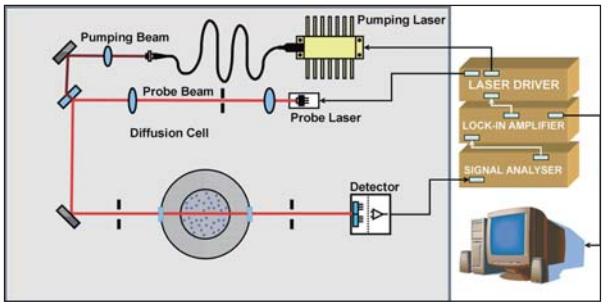


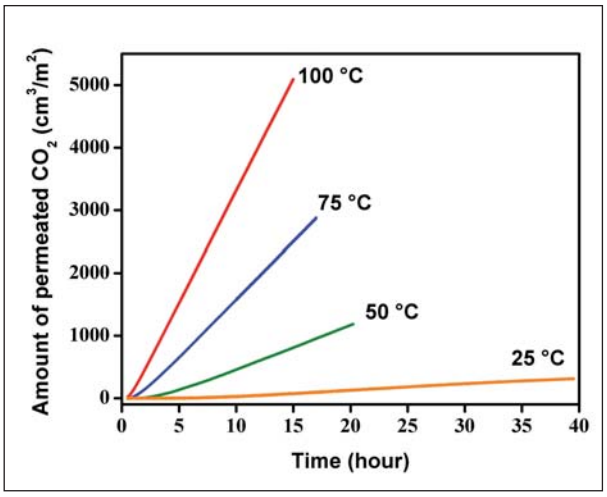
PHOTO OF THE 4-CHANNEL AND DUAL LASER VERSION OF THE WASUL™-PERM SYSTEM

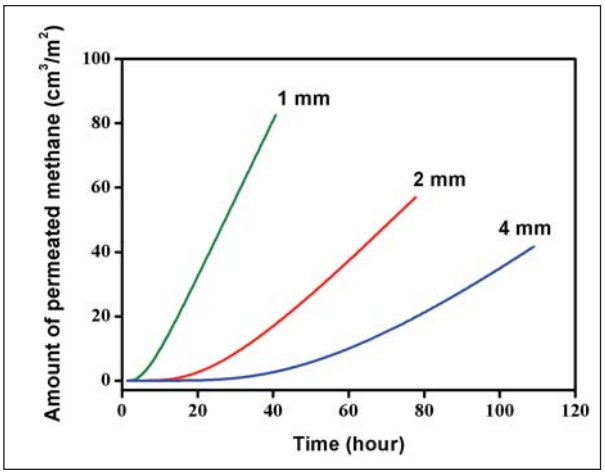
SCHEMATICS OF THE WASUL™-PERM SYSTEM FOR PERMEABILITY MEASUREMENTS AT PRESSURE UP TO 1000 BAR AND TEMPERATURE UP TO 120 °C

Mathematical modeling

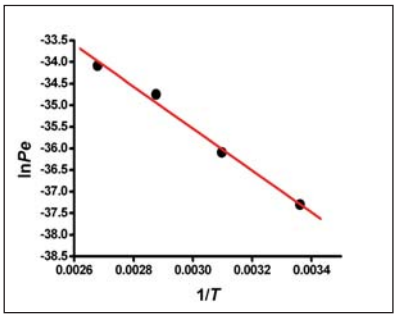
An outstanding feature of our system is that due to its high dynamic range, the entire permeation curve can be fitted numerically with good precision. Consequently, the measurement time needed for the accurate and precise determination of the permeation parameters (i.e. permeability, diffusivity and solubility) is much shorter compared to conventional measurement methods.

Selected measurement results

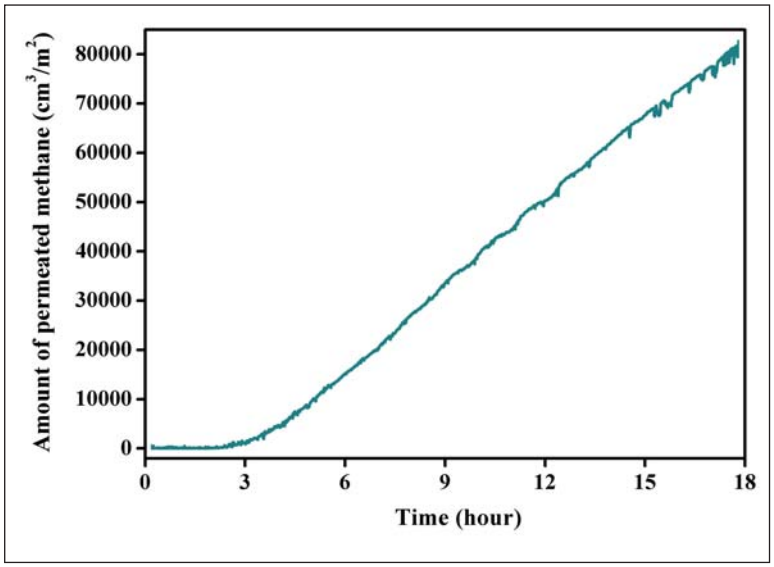




METHANE PERMEABILITY TESTS ON RUBBER SHEETS OF DIFFERENT THICKNESS



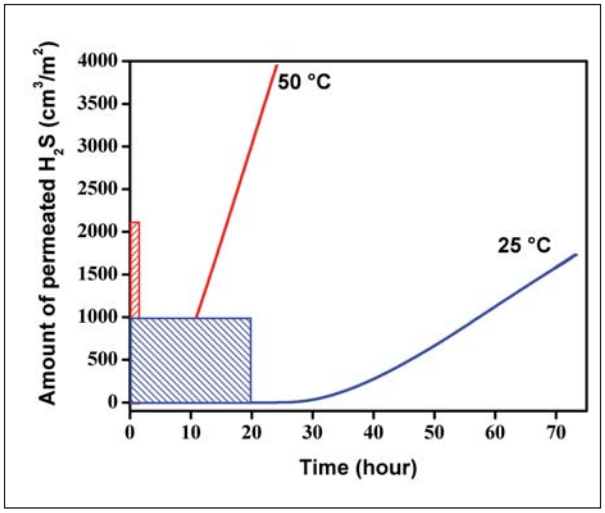
CO_2 PERMEABILITY TEST RESULTS AT DIFFERENT TEMPERATURE
(ARRHENIUS-DIAGRAMS ARE IN GOOD AGREEMENT WITH THEORY)



HIGH PRESSURE METHANE PERMEABILITY TEST RESULT
(220 BAR, ROOM TEMPERATURE, 1 MM RUBBER SHEET)

Measurement in case of anomalous gas permeation

With WaSul™-Perm reliable determination of the permeation parameters is possible even when some of the diffusing molecules are precipitated by a **chemical reaction** within the polymer sample. Further advantages of WaSul™-Perm system include its ability to measure spontaneous gas emission in minute amounts from the measured sample.



ANOMALOUS H_2S PERMEATION THROUGH RUBBER SAMPLE
(SHADED AREAS INDICATE THE TIME INTERVAL DURING WHICH THE CHEMICAL BINDING REACTION TOOK PLACE)

List of further test measurements, references

Contitech Phoenix Rubber Ltd. (Szeged, Hungary)

H_2O, H_2S, CH_4 and CO_2 permeability tests at elevated and room temperatures and at atmospheric and high pressure test conditions on rubber sheets layers and sealing elements of flexible off-shore pipes.

DuPont UK Ltd.

Successful determination of the methane permeability of DuPont Total gas barrier membrane with extremely low permeability.

Montan University (Leoben, Austria)

Carbon-dioxide and methane permeability measurements on polymer samples at various temperatures.

Central Food Research Institute (CFRI, Budapest, Hungary)

Water vapor and carbon-dioxide permeability tests on calibrated foils. CFRI issued an expert opinion stating the good precision of the WaSul™-Perm systems.

Several other measurements including:

Oxygen permeability testing on plastic heating pipes at high temperature and high pressure conditions, ammonia permeability testing on insulating polymers, methane permeability testing of multi-layered membrane walls of biogas containers etc.

HILASE

Developing, Producing, Servicing and Trading Limited Company

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