

Gas Diffusion Techniques

All gas diffusion methods are based on interfacing the donor stream containing the analyte, with an acceptor stream containing a reagent. The porous hydrophobic membrane serves as a barrier that allows only the gaseous species passed through. This makes the gas diffusion methods very selective, since the non-volatile species will not reach the detector.

Flow scheme of gas diffusion unit and its photo shown from acceptor side. Unit dimensions are 4cmW, 2cmD and 3cm H.

The instrumental setup can be configured in two ways:

The continuous programmable flow method where both donor and acceptor stream are continuously pumped (FIALab 2500 or FIALab 2600).

The stopped flow technique where both donor and acceptor stream are controlled by syringe pumps (FIALab-MicroSIA, FIALab 2700 and FIALab-3200)

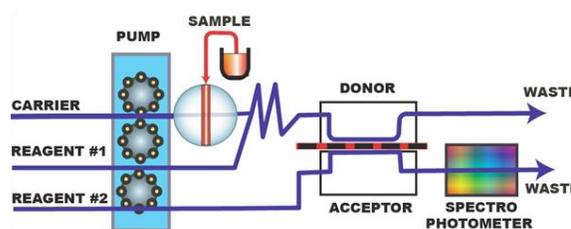
The gas diffusion unit for continuous flow has diffusion path 2 cm long and 2 mm wide. The acceptor stream is monitored by a flow cell with 10 cm long light path. The flow injection system is operated at a programmable flow rate of 0.75mL/min per channel while the sample passes through the diffusion unit and at a flow rate of 3.0mL/min during flush period. The injection volume is 300 microliters of sample and sampling frequency is 40 injections/hour.

The stop flow method uses is in contact with the gas diffusion the sandwich gas sensor, where the injected analyte membrane during the stopped flow period. It yields higher sensitivity and consumes far less of sample and reagents then continuous flow method. (FIALab-MicroSIA, FIALab-2700 and FIALab-3200)

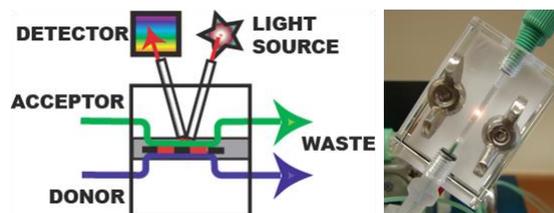
The Sandwich Gas Diffusion Sensor uses a pair of optical fibers that monitor the acceptor solution adjacent to the diffusion membrane. The stop flow FI technique is robust, since it uses syringe pumps, and therefore suitable also for continuous monitoring. Sensitivity of this method is easily adjusted by selecting the duration of the stopped flow time, while using the same experimental setup and reagent concentrations. The Sandwich Sensor provides response in real time, since it monitors the kinetics of the diffusion and of the subsequent chemical reaction and uses smaller volumes of sample than the continuous flow method.



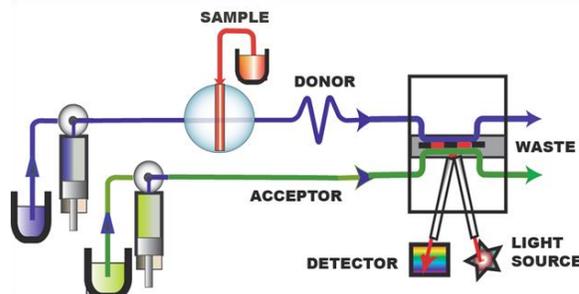
Flow scheme of gas diffusion unit and its photo shown from acceptor side. Unit dimensions are 4cmW, 2cmD and 3cm.



FIALab-2500. Flow injection system configured for gas diffusion based assay and the side view of the diffusion unit designed for continuous programmable flow method. 2 ppm to 40 ppmN at sampling rate 40s/hr.



The schematic of Sandwich Gas Sensor and its photo shown from the donor side



FIALab 4002sp. Syringe based flow system configured for gas diffusion stop flow based assay. The schematic of Sandwich Gas Sensor and its photo shown from the donor side. 0.1ppm to 50ppm N at sampling rate 30 to 60s/hr.

All FIALab gas diffusion modules use robust polymer made hydrophobic membrane.

Examples of Gas Diffusion Based Assays

Analyte	Monitored Species	Matrix	Method of Detection	Reference
Ammonium	Ammonia	Water	Fluorescence	18.866
		Marine Water	Fluorescence	18.136
		Seafood	pH/Spectrophotometry	16.597, 5.074
Trimethylamine	TMA	Fish	pH/Spectrophotometry	11.328, 11.059
Basic Volatiles	Ammonia, TMA	Seafood	pH/Spectrophotometry	13.200, 13.050
Ammonium	Ammonia	Fermentation	Spectrophotometry	6.662
Ammonium	Ammonia	Industrial Waste	Spectrophotometry	6.493
Kjeldahl N	Ammonia	Milk, Meat	Conductivity	17.938, 1.537
Kjeldahl N	Ammonia	Soil Digests	Spectrophotometry	12.02
Carbon	Carbon Dioxide	Water	pH/Spectrophotometry	18.069
Carbon Dioxide	Carbon Dioxide	Gas	pH/Spectrophotometry	13.779
Total Inorg. C	Carbon Dioxide	Water	pH/Spectrophotometry	13.719
Carbon Dioxide	Carbon Dioxide	Beer, Soft Drinks	pH/Spectrophotometry	6.387
Sulphite	Sulphur Dioxide	Fruit Juices	Amperometry	19.484
Sulphite	Sulphur Dioxide	Wine	Spectrophotometry	18.384, 15.654
Sulphite	Sulphur Dioxide	Wine	Conductometry	8.822
Chlorine	Chlorine	Water, Free Chlorine	Spectrophotometry	15.432, 11.820
Chlor Dioxide	Chlorine	Water	Spectrophotometry	9.815, 9034
Ozone	Ozone	Residual Ozone, Water		15.041, 839
Ethanol	Ethanol	Liquors	Spectrophotometry	16.229, 15.783
Cyanides	Hydrogen Cyanide	Waste Water @ Ppb Level	spectrophotometry	18.163, 18.113, 15.133
Xanthates	Carbon Disulphide	Flotation Bath	UV Spectrophotometry	19.157

Note: 1) Reference numbers refer to Hansen's Bibliography
2) See Manuals & Methods for more information

Other Applications

In principle any compound with high vapor pressure can be assayed by gas diffusion method. The samples, introduced into the donor channel can be either liquids or gases.

The gas diffusion modules can also be used for separation after hydride generation with subsequent electrochemical, atomic absorption (AA) or inductively coupled plasma (ICP) detection.

Limitations and Interferences

The body of gas diffusion module and of gas sensor is fabricated from Plexiglass and will not withstand organic solvents. Please enquire for other available materials (ULTEM, STEEL).

High concentrations of surfactants will flood membrane and destroy its gas permeation ability.