AL 2021

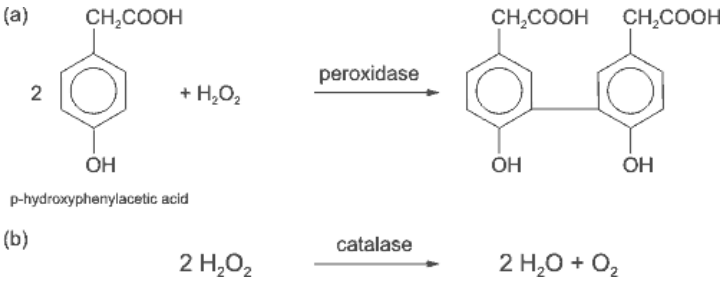
CONTINOUS HYDROGEN-PEROXIDE (H_2O_2) MONITOR FOR AIR AND WATER SAMPLES

Data sheet **AL2021** download

Further information

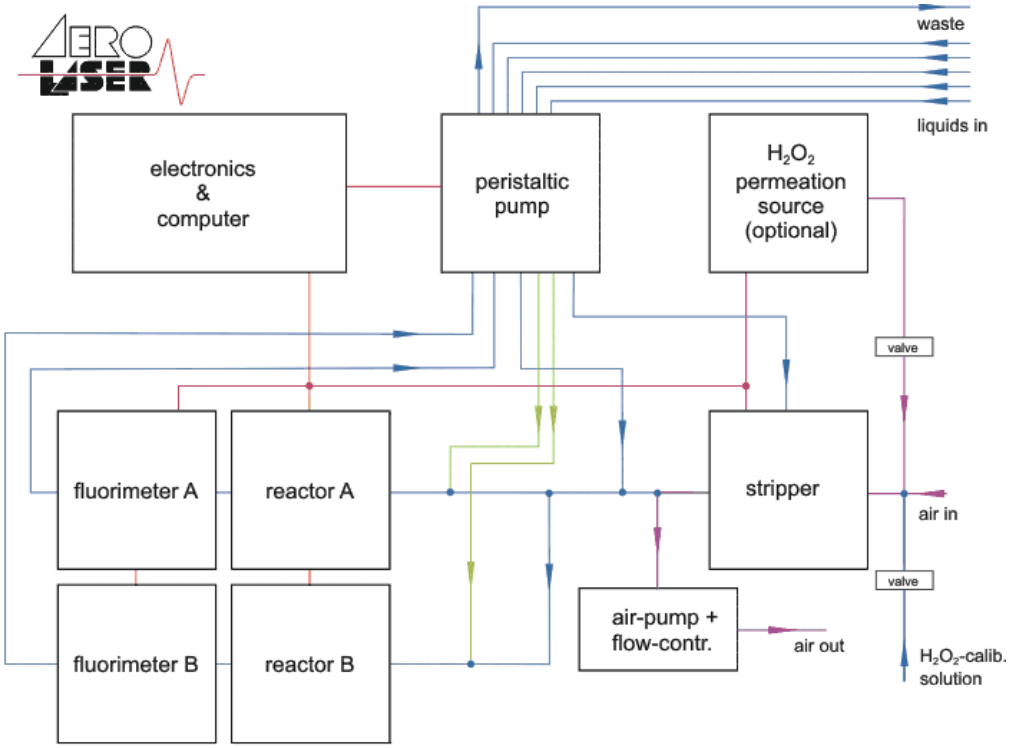
Principle of operation

The detection of peroxides is based on the liquid phase reaction of peroxides with p-hydroxyphenylacetic acid catalyzed by peroxidase. This reaction produces a fluorescent dimer, that can be excited at 326 nm (Cd-lamp) and detected between 400 and 420 nm. The technique is sensitive to **all** peroxides in the solution. To distinguish between H_2O_2 and organic peroxides two parallel channels are used.
In one channel (channel B) of the instrument, H_2O_2 is destroyed selectively by catalase prior to the fluorescent detection in the in-strument. The amount of H_2O_2 is then given by the difference between the signals from the two channels - signal for total peroxide (channel A) minus the signal for total per-oxide without H_2O_2 (channel B) - corrected for the destruction efficiency of the catalase solution.



The above reactions are carried out in aqueous solution of peroxides and other reagents. Therefore, for the measurement of gaseous peroxides, these have to be trapped in aqueous solution first. This is achieved in a stripping coil by pumping air and a stripping solution (pH-Buffered water free of H_2O_2) continuously at known flow rates. The air and liquid streams are afterwards separated in a glass separator and the solution is then analyzed for peroxides.

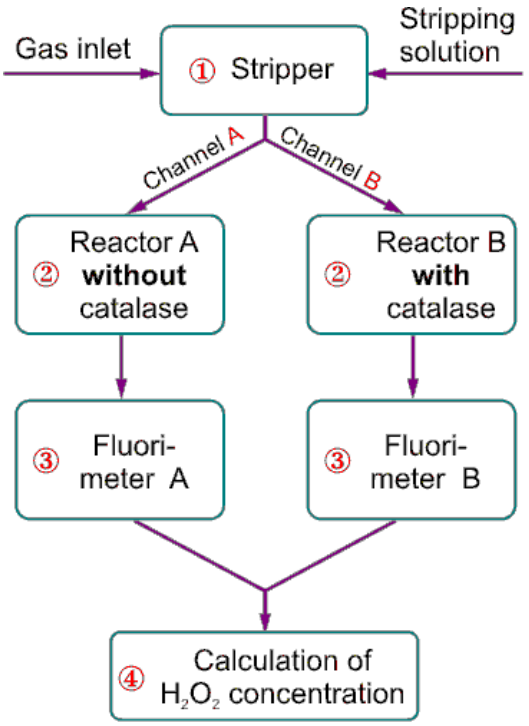
In the instrument **AL2021**, capable for measuring H_2O_2 in air and water samples, the H_2O_2 mixing ratio in air is then calculated from the concentration in solution and the ratio of air and stripping solution flow rates.
The coil size and the flow rates of air and stripping solution are optimized for quantitative stripping of H_2O_2. Due to lower solubilities however, the stripping efficiency for other peroxides is lower than that for H_2O_2 and probably varies between the 60% found for methylhydro peroxide and 100% for H_2O_2. As the composition of organic peroxides in air is unknown, the signal from channel A (after destroying H_2O_2 by catalase) gives only an approximate estimate of the concentration of organic peroxides. Therefore, the instrument **can not** determine exactly the amount of organic peroxides in air but a relative measure of the concentration is indicated.



Simplified block diagramm of the H_2O_2 analyzer ***AL2021***

Peroxides in aqueous solutions can be measured directly by each model of the instruments. In this mode, stripping is not necessary and, consequently, either zero air has to be applied to the samples inlet or the internal zero trap has to be switched on. Model **AL2021W** has been designed for measuring H_2O_2 only in water samples. Therefore no stripping coil is required. In case of using a permeation source for automatic calibration, a gas stripping system is required for transferring gaseous H_2O_2 into solution.
Automatic routine measurements require regular calibrations of the instrument. As liquid phase standards of H_2O_2 are unstable and have to be prepared freshly directly before use, the instruments can be equipped with a gas phase calibration unit and a stripping coil without stabilized gas flow. All the molecules from a permeation gas H_2O_2 source are trapped in a known amount of water thus giving known liquid phase calibration standards.
The technique is described in details by Lazrus et al.:

Lazrus et al., *Automated fluorometric method for hydrogen peroxide in atmospheric preciptation*, Analytical Chemistry **57** (1985) 917 and
Lazrus et al., *Automated fluorometric method for hydrogen peroxide in air*, Analytical Chemistry **58** (1986) 594, see Appendix.



① **Stripper:** Highly efficient dissolving of vaporous H_2O_2 in stripping solution. The aqueous solution is than seperated into two channels.

② **Reactor:** Here the reaction between all peroxides and p-hydroxyphenylacetic acid takes place. In channel B the H_2O_2 is destroyed by catalase.

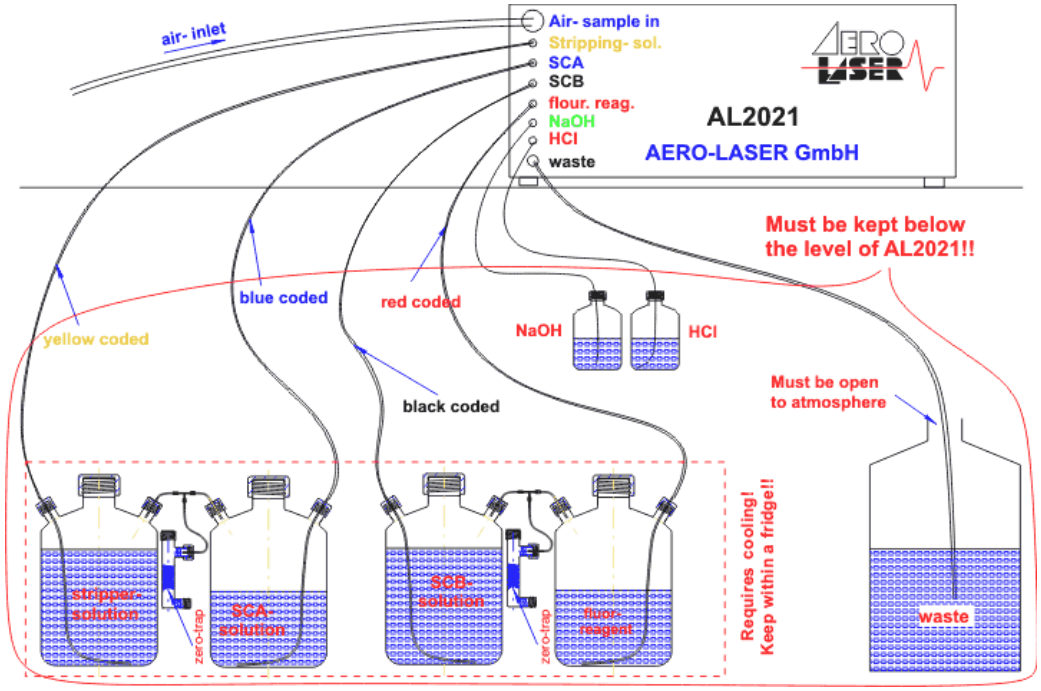
③ **Fluorimeter:** The concentrations of the peroxides are measured fluorimetrically for both channels.

④ **Calculation:** The absolute concentration of H_2O_2 is calculated as the difference of the signals from channel A (all peroides) and channel B (all peroxides without H_2O_2) corrected by the catalase destruction efficiency.

Flow diagram for the determination of the H_2O_2 concentation using two seperated channels.

The technique is linear up to peroxide concentrations of appr. 5×10^{-5} mol/l (eq. to appr. 2000 µg/l). For the measurement of higher concentrations the sample is prediluted inside the instrument. In this case the sensitivity range of the instrument can be expanded even to concentrations above 3000 µmol/l (eq. to appr. 100 mg/l). The dilution system is applied also if seawater has to be analyzed. Due to chemical reactions between seawater components and the chemistry used for the detection of peroxides otherwise a strong precipitation occurs inside the instrument. Dilution of the seawater helps to minimize this effect. Nevertheless it proved to be necessary to clean the instrument by flushing with 1n HCl solution on a regular time basis. This HCl cleaning step is included automatically in the instrument.

The instrument is designed to be installed in a 19" rack. In order to ensure a steady flow of the reagents, the **AL2021** should be installed above the cooling box containing the reagents.



*Scheme of tubing between the **AL 2021** and the reagents*

Features of the instrument

- Provides absolute concentrations for H_2O_2 and relative values for organic peroxides.
- Operates with gas phase and liquid phase samples.
- Fast and continuous monitoring of H_2O_2 concentration with time constant of 100 sec (10-90%).
- Fully automated operation using micro controller.
- Fully automated calibration by internal H_2O_2 permeation source or liquid H_2O_2 standards.
- Rugged and simple to use. RS232 interface and analog output.

The instrument **AL2021** operates with individual measuring ranges. The liquid calibration for **AL2021** can be defined by the user within the ranges given as examples below:

Ranges for liquid phase measurement:	0 to 30 µg/l
(free programmable)	0 to 300 µg/l
	0 to 3 mg/l
Ranges for gas phase measurement:	0 to 20 ppbV
(free programmable)	0 to 200 ppbV
	0 to 2 ppmV
H_2O_2 detection limit (liquid phase):	<70 ng/l
H_2O_2 detection limit (gas phase):	<50 ppt
Equivalent to:	2×10^{-9} molar
Zeroing:	Internal zero trap
Calibration:	Liquid H_2O_2 standard or internal H_2O_2 permeation source (optional)
Signal output (analogue):	0-5 V FS. Calibration automatically sets output to 4.0 V for maximum value of choosen range.
Signal output (digital):	RS232 interface
Operation temperature:	-10°C to 40 °C
Dimensions:	Width 19'': 50cm×50cm×21cm (W×L×H)
Power requirement:	110/220 VAC or 24 VDC, ~100 W

Interferences from other substances

O_3	30 ppt H_2O_2/100 ppb O_3 (1:3500)
NO	12 ppt H_2O_2/100 ppb NO (1:8000)

No detectable interferences from:

SO_2	PAN	NO_2	Glyoxal
Isobutane	1-Butane	Formaldehyde	Benzene
Toluene	Methanol	Acetone	Methylamine
Dimethylamine	n-Butane	cis-2-Butene	trans-2-Butene

Ions, such as: J^- Cl^- Br^- NO_3^- PO_4^- Benzoate