Hydrogen Peroxide (H_2O_2) in Air and Water Monitor AL2021

BULLETIN AL-2021

General Description

The Model AL-2021 is a state-of-the-art digital hydrogen peroxide (H_2O_2) analyzer that is available in several different application-specific configurations. Both single and dual channels models are available for air or water H_2O_2 measurement applications.

Features

- Absolute calibrated concentrations for H_2O_2 and relative values for organic peroxides
- Fully automated operation using internal micro controller
- Automated calibration using internal H_2O_2 permeation source and/or liquid H_2O_2 standards
- Liquid phase ranges: 0-30.0 µg/l
- Gas phase ranges gas phase: 0-20 ppbV
  0-200 ppbV
- H_2O_2 gas phase detection limit of < 50 ppt
- H_2O_2 liquid phase detection limit of <70 ng/l
- Rugged and simple to use
- RS-232 Serial interface

Applications

- Plastics Production
- Pharmaceuticals
- Chemical Research
- Ozone Drinking Water Purification

Model AL2021 H_2O_2 Air and Water Monitor

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 dimmer 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 instrument. 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.

$$2\ H_2O_2 \xrightarrow{\text{catalase}} 2\ H_2O + O_2$$

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, 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 **cannot** determine exactly the amount of organic peroxides in air but a relative measure of the concentration is indicated.

Provided the sensitivity is known for each channel, this is the case after performing an calibration cycle, the calculation of concentrations is done in two steps. In the first step the equivalent mixing ratios are calculated from signals from both channels. In the second step, the H_2O_2 concentration is calculated from the difference of two equivalent mixing ratios. This difference is then corrected for the transmission efficiency of the inlet tubes, for the catalase destruction efficiency, and for the efficiency of the zero trap.

Peroxides in water solutions can be measured directly. 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.

Due to time response, in applications requiring two channels (such as input vs. output process checks) or simultaneous *air and water* measurements two analyzers are used ganged together. The fully automated nature of the system allows the system to be tailored to many configurations and on line process applications.

Specifications

Physical Dimensions	Length 33 cm Width 17 cm Height 21 cm Weight 7.5 kg
Power Requirements	120/240VAC, 80 Watts
Operating Environment	10 - 40 °C 5 - 95% Relative Humidity
Measurement Range	Liquid phase (provides calibration by liquid peroxide standard): 0 to 300 µg/l* Gas phase (provides calibration by liquid peroxide standard if no gas phase standard is available): 0 to 100 ppbV * Gas phase (provides calibration by gas standard. gas standard permeation rate can be determined by using liquid standard) 0 to 100.0 ppbV
Detection limit	< 50 ppt gas phase (calibration with 30 µg/l or internal H_2O_2 source) < 0.07 µg/l equivalent to $2 * 10^{-9}$ M in solution (liquid phase)
Noise (each channel)	< 2% at full scale
Time constant	100 sec (10-90%), delay time 180 sec
Interference from (e.g. 100 ppb O_3 would indicate a signal of 30 ppt in presence of O_3 perterber)	O_3 30 ppt H_2O_2/100 ppb NO 12 ppt H_2O_2/100 ppb
No detectable interference from	SO_2, PAN, NO_2, Glyoxal, Isobutane, Iso-butylene, 1-Butane, Formaldehyde, Benzene, Toluene, Methanol, Acetone, Methyl-amine, Dimethylamine, n-Butane, Cis-2-Butene, Trans-2-Butene, and Ions such as Iodide, Chloride, Nitrate, Bromide, Phosphate, Benzoate
Zeroing	internal zero trap
Signal output	Analog: 0-5 Volts FS. calibration sets automatically output to 4.0 Volt of maximum value of chosen range Digital: via RS-232 serial interface
Maintenance Interval	1 Month (typ)
Calibration	Internal H_2O_2 permeation device or liquid of H_2O_2 standards

YANKEE ENVIRONMENTAL SYSTEMS, INC.
Airport Industrial Park
101 Industrial Blvd., Turners Falls, MA 01376 USA
Tel: (413) 863-0200 Fax: (413) 863-0255
E-mail: info@yesinc.com http://www.yesinc.com