SENSEVOLUTION®
Industrial measurement & analysis solutions

Product Data Sheet
BAH2SW_MZ70529AR4
January 2007

BAGGI®

BAH2SW

The Model BAH2SW "*H_2S in Water Analyzer*" is the result of combining the latest, state-of-the-art technology with over 60 years of industry experience.
The result is an unsurpassed, high-quality H_2S in Water measurement system required in today's optimized and cost-driven petroleum market place.

- √ Process Diode-Array Spectrophotometer
- √ The FlowCell system's Fiber-Optics are armoured and solarization free
- √ Custom Design for specific application
- √ Operating range depending on application (process conditions to be provided)
- √ Easy and quick installation and configuration
- √ Low maintenance required
- √ Fast response time
- √ Temperature & Pressure Process according to wetted parts
- √ Wetted material on request (stainless steel 316L, hastelloy-C276, PTFE, PVDF..)
- √ Cabinet in stainless steel 316L on request
- √ Touch screen or keyboard, Colour Display
- √ Outputs : Linear Analogue output 4-20mA, Digital I/O and custom Ethernet TCP-IP
- √ Project in conformity to ISO9001:2000
- √ Atex - CSA - UL for Zone 2 approved on request
- √ Worldwide Service for start-up, training & maintenance

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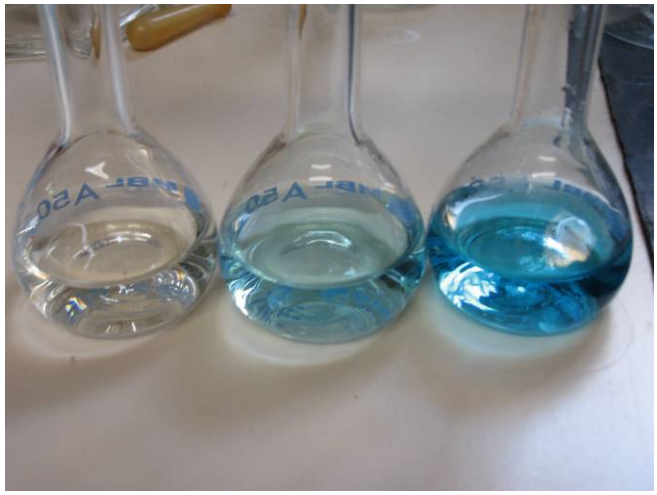
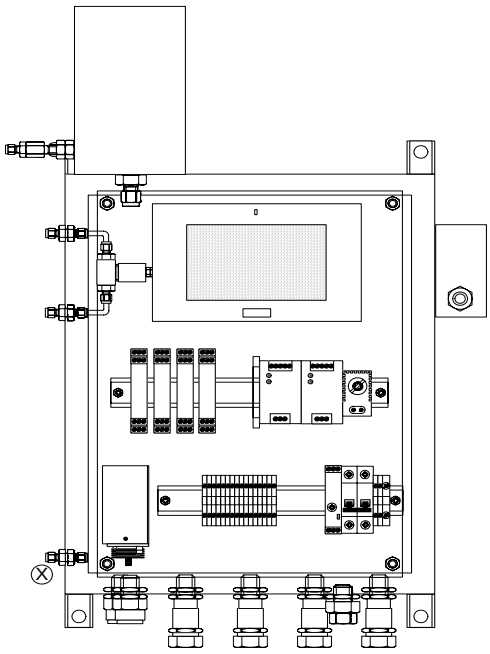
Application: H_2S in water

The system is customized for process conditions, to ensure during continuous measurement, the right performance in the accuracy and repeatability with the spectroscopy Technology.
For this specific application, where the H_2S concentrations are very low, B.A.G.G.I.Srl developed the BAH2SW system to guarantee the performance required to monitor in continuous H_2S in water.

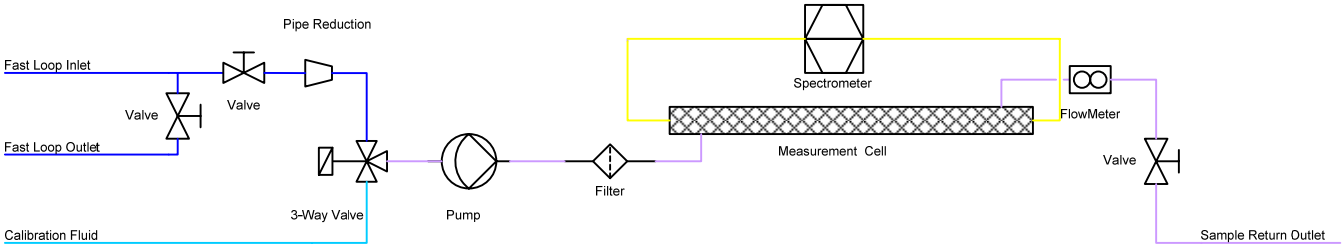
The same system could be used for several other applications with a specific calibration on demand.



Every application is previously tested in Lab



BAH2SW ATEX EEx-p CL 1 - ZONE 2 - GR. IIB T3



Typical Application System

The principle of measurement: The Beer-Lambert Law

In optics, the Beer-Lambert law, also known as Beer's law is a relationship that relates the absorption of light to the properties of the material through which the light is traveling.

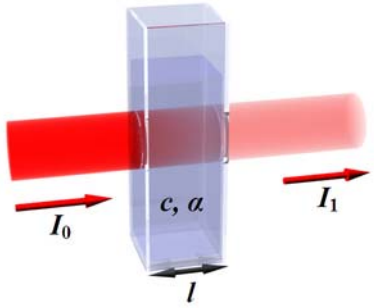


Diagram of Beer-Lambert absorption of a beam of light as it travels through a cuvette of size *l*

In essence, the law states that there is a logarithmic dependence between the transmission of light through a substance and the concentration of the substance, and also between the transmission and the length of material that the light travels through. Thus if l and α are known, the concentration of a substance can be deduced from the amount of light transmitted by it.

The units of absorber concentration (c) and absorption coefficient (α) depend on the way that the concentration of the absorber is being expressed.

If the material is a liquid, it is usual to express the absorber concentration as a mole fraction i.e. a dimensionless fraction. The units of the absorption coefficient are thus reciprocal length (e.g. cm^{-1}). If the concentration is expressed in moles per unit volume, α is a molar absorptivity (usually given the symbol ε) in units of $mol^{-1}\ cm^{-2}$ or sometimes $L \cdot mol^{-1} \cdot cm^{-1}$.

In the case of a gas, the concentration may be expressed as a number density (e.g. cm^{-3}), in which case α is an *absorption cross-section* and has units of area (e.g. cm^2).

The value of the absorption coefficient α varies between different absorbing materials and also with wavelength for a particular material. It is usually determined by experiments.

In spectroscopy and spectrophotometry, the law is almost always defined in terms of common logarithm. In optics, the law is often defined in an alternate exponential form,

$$\frac{I_1}{I_0} = e^{-\alpha' l c},$$

$$A' = \alpha' l c = -\ln \frac{I_1}{I_0}.$$

The values of α' and *A'* are approximately 2.3 (≈ln 10) times larger than the corresponding values of α and *A* defined in terms of common logarithm. Note though that when c is given as a number density and α' as an area it is often denoted by σ and represents the "true" cross section of the absorber (as can be seen from the derivation below). Therefore, care must be taken when interpreting data that the correct form of the law is used.

In molecular absorption spectrometry, the absorption coefficient α' is expressed in terms of a linestrength, S, and an (area-normalized) lineshape function, Φ. The frequency scale in molecular spectroscopy is often in cm^{-1}, wherefore the lineshape function is expressed in units of $1/cm^{-1}$, which can look funny but is strictly correct.

Since c is given as a number density in units of $1/cm^3$, the linestrength is often given in units of cm^2cm^{-1}/molecule. A typical linestrength in one of the vibrational overtone bands of smaller molecules, e.g. around 1.5 µm in CO or CO_2, is around 10^{-23} cm^2cm^{-1}, although it can be larger for species with strong transitions, e.g. C_2H_2. The linestrenghts of various transitions can be found in large databases, e.g. HITRAN. The lineshape function often takes a value around a few $1/cm^{-1}$, up to around $10/cm^{-1}$ under low pressure conditions, when the transition is Doppler broadened, and below this under atmospheric pressure conditions, when the transition is collision broadened. It has also become commonplace to express the linestrength in units of cm^{-2}/atm since then the concentration is given in terms of a pressure in units of atm. A typical linestrength is then often in the order of 10^{-3} cm^{-2}/atm. Under these conditions, the detectability of a given technique is often quoted in terms of ppm•m.

The law tends to break down at very high concentrations, especially if the material is highly scattering. If the light is especially intense, nonlinear optical processes can also cause variances.

Equations

There are several ways in which the law can be expressed,

$$A = \alpha\, l\, c$$

$$\frac{I_1}{I_0} = 10^{-A} = 10^{-\alpha l c}$$

where,

$$A = \log_{10}\left(\frac{I_0}{I_1}\right)$$

$$\alpha = \frac{4\pi k}{\lambda}$$

Here,

- A is absorbance
- I_0 is the intensity of the incident light
- I_1 is the intensity after passing through the material
- l is the distance that the light travels through the material (the path length)
- c is the concentration of absorbing species in the material
- α is the absorption coefficient or the molar absorptivity of the absorber
- λ is the wavelength of the light
- k is the extinction coefficient

Derivation

Assume that particles may be described as having an area, α, perpendicular to the path of light through a solution, such that a photon of light is absorbed if it strikes the particle, and is transmitted if it does not.

Define *z* as an axis parallel to the direction that photons of light are moving, and *A* and *dz* as the area and thickness (along the *z* axis) of a 3-dimensional slab of space through which light is passing. We assume that *dz* is sufficiently small that one particle in the slab cannot obscure another particle in the slab when viewed along the *z* direction. The concentration of particles in the slab is represented by *c*.

It follows that the fraction of photons absorbed when passing through this slab is equal to the total opaque area of the particles in the slab, α*Ac dz*, divided by the area of the slab, or α*c dz*. Expressing the number of photons absorbed by the slab as dI_z, and the total number of photons incident on the slab as I_z, the fraction of photons absorbed by the slab is given by

$$\frac{dI_z}{I_z} = -\alpha c\, dz.$$

The solution to this simple differential equation is obtained by integrating both sides to obtain I_z as a function of *z*

$$\ln(I_z) = -\alpha c z + C.$$

For a slab of real thickness, ℓ, the difference in light intensity I_0 at $z = 0$, and I_1 at $z = \ell$, is given by

$$\ln(I_0) - \ln(I_\ell) = (-\alpha 0 c + C) - (-\alpha \ell c + C) = \alpha \ell c,$$

or

$$\text{Transmittance} = \frac{I_1}{I_0} = e^{-\alpha \ell c}.$$

$$\text{Absorbance} = -\log_{10}\left(\frac{I_1}{I_0}\right) = \epsilon \ell c, \text{ where } \epsilon = \alpha/2.303$$

It is instructive to consider the consequences of error in the assumption that one particle in a slab cannot obscure another particle in the slab. Implicit in the integration step is an extension of this assumption, namely that one particle cannot obscure another particle in any other slab. This assumption can only approach accuracy, of course, in very dilute solutions, and it becomes increasingly inaccurate with increasingly concentrated solutions, high extinction coefficients or long optical pathways. High extinction coefficients commonly occur in spectroscopic assays of biological macromolecules.

In practice, the accuracy of the assumption is better than the accuracy of most spectroscopic measurements up to an absorbance of 1 (or : $\frac{I_1}{I_0} = 0.1$).

Process Photodiode Array (PDA) Spectrophotometer

The PDA is based on modern spectroscopy, basically the light emitted from a Xe Flashlamp passes through a fiber optic and a collimating lens that transforms the light into a beam of parallel rays. This light passes through the sample and some particular wavelengths are absorbed.

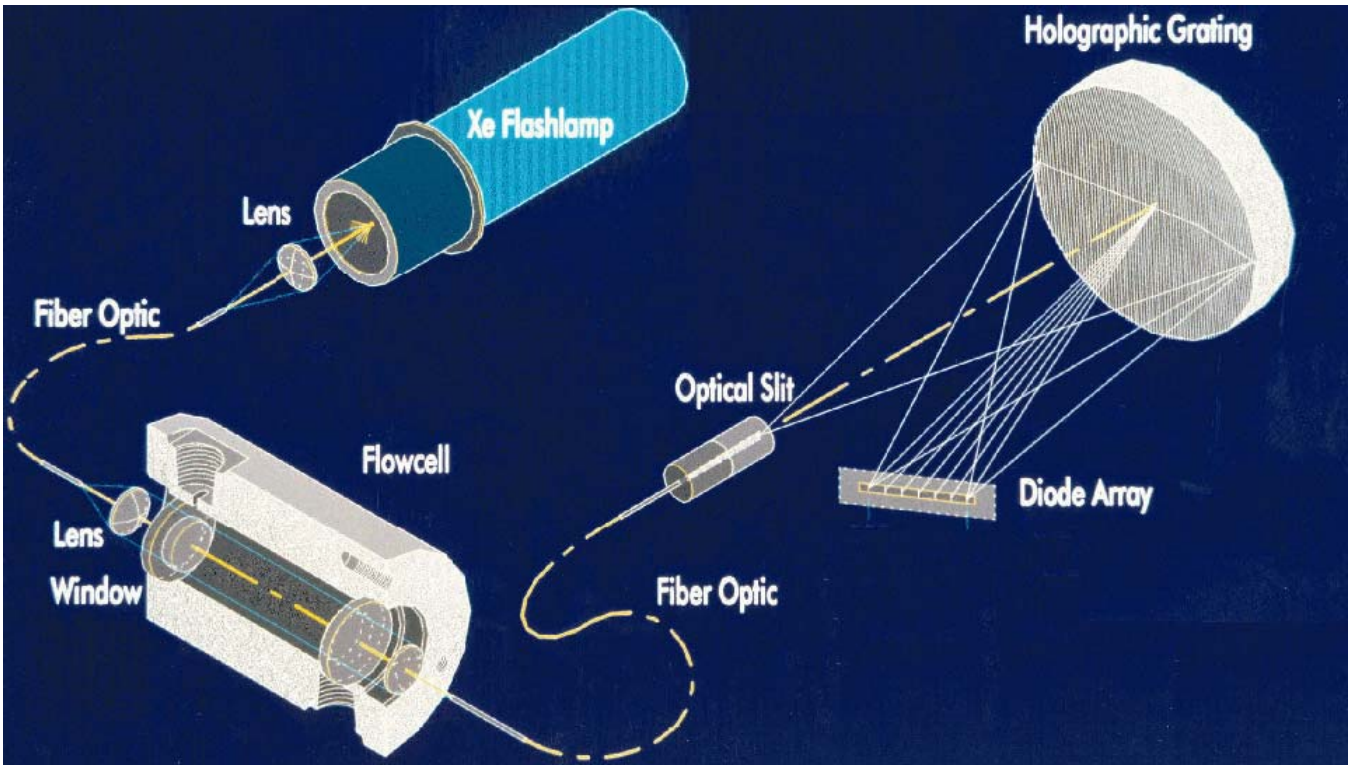
The light passes through another collimating lens in the optical fiber and then impacts to a holographic grading disk. This disk will divide each wavelength on a specified resolution Diode Array.

Measuring the emitted voltage of the single diode you have the exact energy received from each wavelength. This system permit to analyze the spectral absorption of the sample and to give the exact concentration of a particular substance contained in the sample

Variable length Flowcell

If the process conditions change as contaminants or concentration range, the system could be calibrated on site saving time and money, to get the same performance.

B.A.G.G.I.Srl is able to make a custom design to meet the process specification.



TECHNICAL SPECIFICATIONS

Instrument Specification

Power:
- Standard: 90-264 VAC, 47-63 Hz; 6A max

Environment:
- 0° to 40°C (32° to 104°F)
- 0° to 55°C(32° to 131°F), with vortex cooler

Dimensions (without sample system):
- Wall-Mount: 500mm H x 400mm W x 250mm D (19,68" H x 15,74" W x 9,84" D)

Mounting:
- wall (standard)

Approximate Weight (without sample system):
- 15 Kg

Detector:
- Diode array spectrophotometer with pulsed Xenon Lamp

Analogue Inputs:
- Four inputs filtered with transient protection, user scalable and assignable (optional)

Analogue Outputs:
- Three isolated analogue outputs, 4 – 20 mA (standard);
- Three additional isolated analogue outputs (optional)

Digital Inputs:
- Six digital inputs; user assignable (optional)

Digital Outputs:
- Four isolated relay output signal: Fault, operation, Calibration, lamp replacement
- Four additional relay output (optional)

Enclosure Protection:
- IP66

Compliances:
- EN61326, EN 61010-1
- ATEX EEx-p CL 1 - ZONE 2 - GR. IIB T3 (on request)

CE Ex

Integrated Computer Specification

Display:
- 7" touchscreen 262K colour display
- Resolution:800*480
- Brightness(cd/m2):220
- Contrast Ratio 400:1
- Pixel Pitch (mm) 0.1905(H) x 0.1905(V)
- Viewing Angle (H-V) 140/100

Storage:
- 1GB CFII

Serial Communication Ports:
- One serial ports with RS-232
- (optional) One serial ports with RS-232, RS-422 and RS-485 standard is available with: Modbus, Profibus and FieldbusFoundation Protocol

Parallel Printer Port:
- One parallel port available for printed reports(optional)

Modem:
- Field-configurable; 300 to 33.6k baud rate (optional)

Ethernet Card :
- Two 10/100 mbps with RJ-45 port

WIFI Card :
- One Integrated WIFI card 11Mbit/s

Cooling system :
- Passive Heatsink (Fanless)

Operative System :
- Microsoft Windows XP Embedded

Software specification

Compound detection :
- Real-Time concentrations measuring

Calibrations Events :
- Automatic For 0
- Manual for Spam

Gating Options:
- Fixed-Time, Slope and Automatic gating of peaks

Password protection :
- 2 Levels: User, Maintenance

Sample Specification

Measured Compound:
- H2S in Water

Measured Range:
- 0,05 to 1ppm (others on request)

Precision
- ±5% F.S.

Sample Temperature
- 5° to 95°C (-15° to 203°F)

Sample Pressure
- 0 to 30 PSIG