IN-SITU® PROBE

The latest in solid state gas probes

- High accuracy n repeatability
- Instant response
- Long useful life
- High resistance to corrosive elements
- High resistance to thermal shocks
- Wide range of temperatures
- Virtually maintenance - free
- Wide choice of lengths
- Solid state-no moving parts

PRINCIPLE :

IN-SITU OXYGEN probe makes use of the well established characteristic of Partially Stabilized Zirconia (PSZ) being partial to $\underline{O}$ ions transference. Zirconium dioxide (ZrO_2) stabilized with Yttria (Y_2O_3), presents a very high mobility of oxygen ions at temperatures above 700°C and is thus an excellent solid electrolyte. The **IN-SITU** probe employs a Zirconia thimble/disc reaction bonded or a pellet/disc fusion bonded to a carrier tube like recrystallised alumina. This forms the basic electrochemical cell. The two, opposite surfaces of the zirconia are suitbaly "electroded" by using porous platinum deposited by special techniques. One side of the cell is exposed to the unknown gases while on the other side a reference gas with a known O_2 concentration is made available.An accompanying thermocouple completes the complement.The process of $\underline{O}$ ion transference is governed by the well known **NERNST-EINSTEIN** equation

$$E = \frac{RT}{4F} \log_n \frac{PO_1}{PO_2} + C, \text{ where}$$

E = Emf of the cell in volts

R = Universal gas constant (8.314 joule^{-1} mole^{-1})

T = Temperature of the cell (°k)

F = Faraday's constant (96487 coloumbs g equivalent^{-1})

PO_1 = Oxygen partial pressure of reference gas (usually air with 20.95% O_2)

PO_2 = Oxygen partial pressure of unknown gas

C = Cell constant.

Since R, F and C are constants, PO_1 is known, the emf of the cell becomes a function of only unknown oxygen in the gas if temperature is kept constant.

DESCRIPTION :

FYKAYS offer two distinct types of **IN-SITU** Probes

Reaction Bonded : (RB) unsheathed probes.

Fusion Bonded : (FB) sheathed probes

Reaction bonded probes, which can be used without external sheathing and the associated assembly and maintenance probelms make use of a patented process in which a ZrO_2 thimble or pellet is bonded on to an Al_2O_3 tube by reaction through a platinum washer as shown:

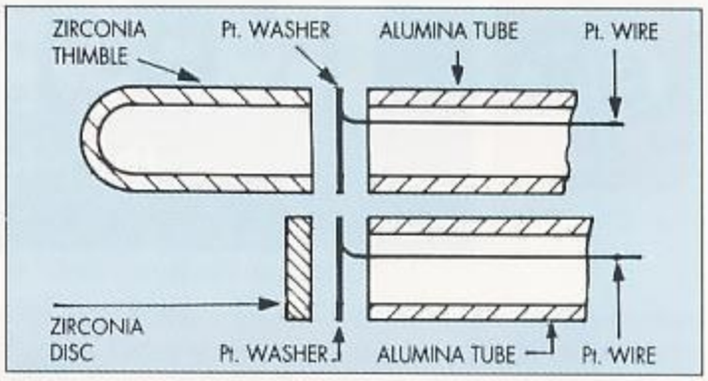

Fig. 1: R. B. SENSOR

When thus bonded the $ZrO_2/Pt/Al_2O_3$ forms a gas tight joint even under extreme pressures. The Pt washer is in contact with the external $\underline{O}$ ions. An internal platinum wire, usually the limb of a Platinum - Rhodium thermocouple placed under pressure against the inner surface of the zirconia forms the common return path for the cell as well as the thermocouple. Thus it is an improvement over the 4 wire system common in fusion bonded probes. RB sensors are ideal for very high temperature applications beyond the scope of sheathing materials like Inconel, Hastelloy etc. However, RB sensors have very long useful life in oxidising atmospheres but rather limited application in highly reducing atmospheres.

Fusion bonded sensors on the other hand use sintered ZrO_2 pellet cemented and fused to the Alumina tube as shown:

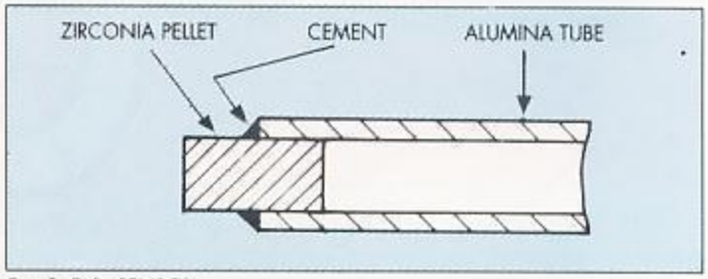

Fig. 2: F. B. SENSOR

As in case of RB sensors, FB sensors are formed to be gas tight under extreme pressures. These probes are versatile equally in oxidising, neutral and reducing atmospheres, but have a limited upper temperature application, by virtue of having to use a metallic sheath for contact with the external cell surface and use of same metal wire as internal cell contact. FB sensors are ideally suited for carburising application where the temperatures are low.

SPECIFICATIONS :

Length of Probes:
Standard lengths available are 150, 300, 600, 900,

1000, 1200 and 1500 mm. Longer lengths upto 2500 mm are available on special request.

Sheathing Details:
RB sensors do not require sheathing. However for mechanical stability a part of the length from the connector head is provided with "Spine" of heat resisting stainless steel as shown:

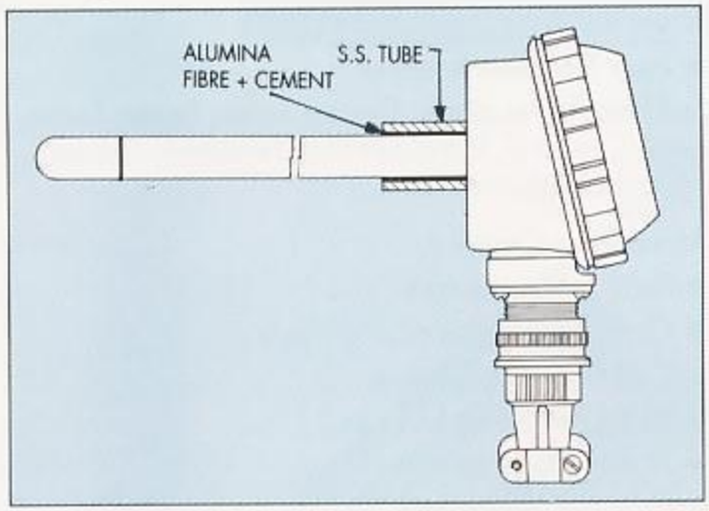

Fig. 3: COMPLETE ASSEMBLY

The length of the spine is variable and the material specification is totally independent of the probe and Thermocouple material.

FB sensors are normally supplied sheathed over the entire length using special alloys like Inconel 600, Hastelloy X etc. The sheath acts as the return path for the cell emf. In order to avoid thermocouple effects, the internal contact wire for the cell MUST be of the same material as the outer sheath. A typical construction is as shown:

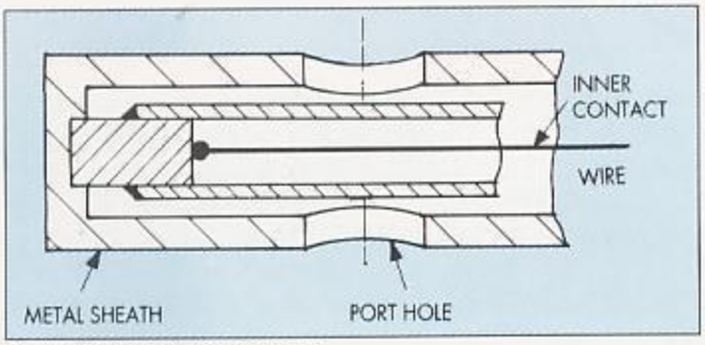

Fig. 4: CROSS SECTION OF PROBE

Thermocouple Specifications :
For RB sensors the thermocouples are normally type 'R' or 'S' (Pt.Pt.Rh 13% or Pt.Pt.Rh 10%).

For FB sensors the choice is extended to 'K' type (chromel-alumel), for lower temperature applications. For extra high temperatures probes are supplied with 'B' type (PtRh6% - PtRh 30%) thermocouples (RB sensors only)

Temperature Limits :
FB sensors upto 1400°C
RB sensors upto 1800°C.

STANDARD ACCESSORIES :

Reference Air :
Heavy duty, continuous rated diaphragm pump with 100 micron filter and flow regulator provides a steady low pressure of oxygen supply to the internal face of the cell. A special nipple is provided for this purpose on the probe head.

Probe Cleaning :
In dusty atmospheres like solid fuel fired boilers, metallurgical furnaces etc, sooty atmospheres like carburising furnaces and it is absolutely necessary to periodically clean the external surface of the cell to prevent clogging and resultant loss of sensitivity. Fykays offer a specially designed field programmable probe purging system consisting of high pressure connector solenoid, oil moisture and dust filter. The purge controller which is of solid state electronic design is built into **FYKAYS' OXY COMP G®**. Separate purge controller is also available for users not having this facility. Use of ceramic fibres as filters is considered inefficient and out of date. Even in case of ceramic filters, periodic dismantling and cleaning is required whereas **FYKAYS'** purge controller facilitates ON-LINE cleaning. This feature makes use of shop floor compressed air at a pressure of not less than 5 kg/cm^2. A special nipple is provided on the probe sheath for this purpose.

Umbilical Cord :
A specially designed 5 core cable of HR PVC is offered as an integral accessory for **IN-SITU** Probes. Of the 5 cores, 2 cores consist of high purity electrolytic copper for conducting cell emf. 2 other cores are high grade compensating leads matching the type of thermocouple used in the probe. The 5th core which is the heart of the cable consists of a high density polythene (HDP) tubing of liberal dimensions to avoid pressure drop over lengths upto 75 meters and conveys the reference air from the pump in the instrument panel to the probe installed at site.

Probe Head :
Sturdy die cast aluminium head with weather proof cover has, as standard, following fixtures:-

- 4 pole polarised heavy duty male/female connector with lock nut.
- Reference air connecting nipple with internal Nylon/PTFE tubing and SS Capillary.
- Flame trapping fitting/packing.

SPECIAL ACESSORIES (on request) :

- Double walled, water cooled probe heads for those applications where temperatures are likely to exceed 100°C.
- Mounting fixtures - either socketed type or flanged type.
- Probe heating furnace with ON-OFF control for applications where gas temperatures are low or it is not practical to mount probes in areas where gas temperature is above 700°C.
- Heat resisting steel hangers/supports for extra long probes.
- Special wear resistant steel (e.g. Mn steel) enclosures for extra erosive environments.
- Wall mounting/floor mounting sheet steel fabricated panel for housing all accessories.
- Specially designed coolers and filters for aspirated systems.

Electrical Specifications :

Unless otherwise specified, all accessories such as reference air pump, solenoids, purge controllers etc are all designed for 230V, 1Ph, 50 Hz operation.

Probe Refurbishing :

Fykays offer at a nominal fee periodic probe refurbishing service. Please consult our service department for details.

APPLICATIONS :

Energy Conservation :

- Boilers of any/all types
- Rotary Kilns
- Reheating/heating furnaces
- Forging furnaces
- Tunnel Kilns
- Heat Treatment furnaces

End Use: Power plants, Cement,Sugar, Paper, Textile, Steel, Chemical, Petro-chemical, Fertilizers, Ceramic and other industries.

Atmosphere Control :

- Endo gas generators
- Carburising furnaces of all types.
- Carbonitriding furnaces.
- Bright Annealing furnaces.
- $N_2/H_2/O_2$ generators.
- Explosive atmosphere.
- Coke oven/producer gas plants.
- Hydrogen filled furnaces.

End Use : Heat treatment industry, air separation plants, petrochemical, Dyes and Pigments industry, steel plants etc.

CO/CO_2 Control :

- Decarburising of molten steels

End Use : Vaccum metallurgy.

FYKAYS' PRODUCTS:

THERMOTIP • MINITIP • ANSPLATIP • FONDTIP • DIGITAL PYROMETERS • CARBOTIP FOR STEELS AND IRONS • CARBOCOMP AUTOMATIC, CEV, C & SI ANALYSER FOR IRONS • CARBOCOMP AUTOMATIC C ANALYSER FOR STEELS • THERMOXYTIP • OXY-COMP G • OXYCOMP AUTOMATIC O_2 ANALYSER IN STEELS • OXYMONITORS FOR COMBUSTION & ATMOSPHERE CONTROL • METALLIPOPS: SAMPLERS FOR METAL BATH, STREAMS, INGOTS, 2-IN-1, ETC. • VARIOUS TYPES OF THERMOCOUPLES • VARIOUS TYPES OF PANEL INSTRUMENTS • TEMPERATURE CONTROLLERS AND INDICATORS • MICOUPLE AND MICAB • INSTAMETER INSTANT CALIBRATOR • AND MANY MORE

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