I. INTRODUCTION

Oxygen is present in 46% of the compounds that make up the earth's crust. Since it is very electro-negative element, it readily reacts with other elements to form compounds such as SiO2, H2O and Fe2O3. Metal elements are easily oxidized and therefore most ores found in the earth's crust are in form of metal oxides.

Corrosion is the chemical reaction of oxygen with a metal to form its metal oxide. The resulting compound has totally different physical and chemical characteristics from the original metal. Metal oxides are mechanically hard but porous and offer little tensile strength. The presence of water appears to have a large effect on the reaction rate for metal oxide formation. As the metal oxide is formed and erodes from the metal surface, new corrosion sites are exposed and the reaction continues at an accelerated rate.

Billions of dollars are lost annually due to corrosion and subsequent erosion in steam producing equipment. For this reason turbine and boiler equipment manufacturers recommend that the oxygen be monitored and kept at very low levels.

The Swan Oxy-Trace Analyzer is designed to provide continuous measurement of oxygen in steam or water circuit of power plants for corrosion management. It can be used in many systems including power plants, industrial steam generators and waste water treatment plants. Common points for oxygen measurement are economizer inlet, de-aerator cutlet, condensate return and boiler feed and make-up water.

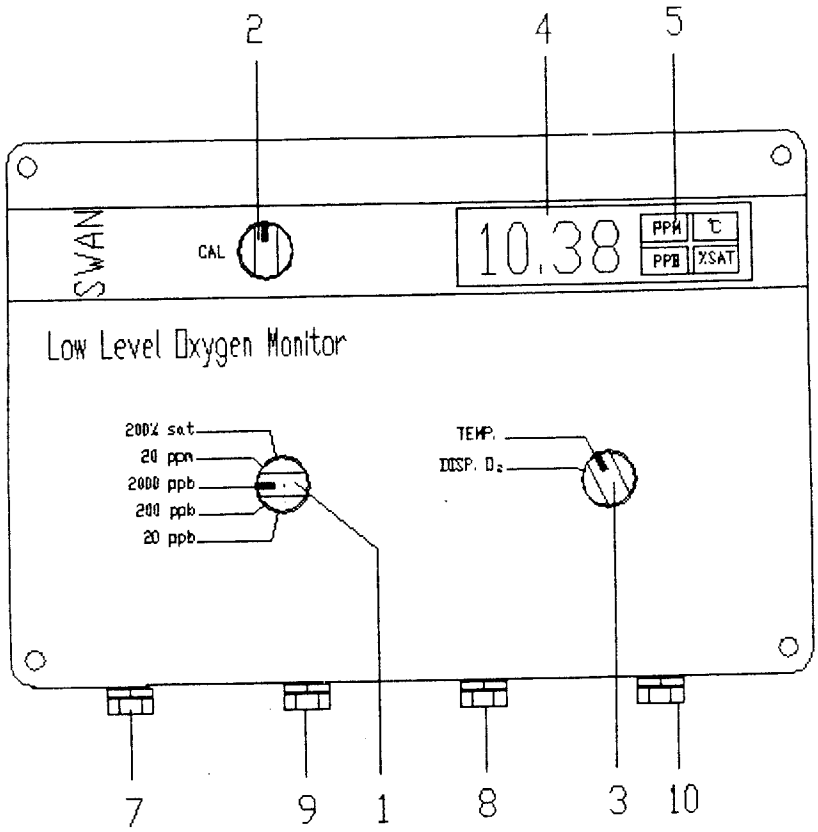
The monitor has a detection limit of less than 1 ppb dissolved oxygen and four measuring ranges: 0..20, 0..200, 0..2000 ppb, and 0..20 ppm oxygen. Monthly calibration in air is adequate even for measurements at part per billion level. High reliability and low maintenance requirements result in economic operation.

The Oxy-Trace electrode is based on the proven Clark electrode and employs a gold/silver cell to detect oxygen which enters the cell through a PTFE membrane. Sample temperature is continuously monitored and automatic temperature compensation is performed using a unique digital compensation technique. The sensor is specifically designed to exhibit a fast response to changes in concentration. Typically, a reading of 8 ppb is reached within 50 seconds after several hours of exposure to air or saturated water. Both oxygen concentration and temperature can be recorded in parallel. Instrument outputs are compatible with standard recorders and alarms.

The amplifier is built into a waterproof aluminum housing (IP65, DIN 40050) and the oxygen sensor connection is watertight (IP67, Din 40050). Calibration and range switching can be done without exposing the instrument to the environment. Electrode materials and filling solution provide stable, linear, reproducible measurements and require very little maintenance.

II PRINCIPLES OF OPERATION

DESCRIPTION OF OXY-TRACE



1 Range Selector
2 Calibration knob
3 Mode switch
4 LED numeric display
5 Mode display
6 Cover screws
7 Electrode conduit
8 Temperature output
9 Oxygen output
10 Power conduit

The Oxy-Trace analyzer uses a Clark type polarographic electrode separated from the sample stream by a PTFE gas-permeable membrane. At constant temperature, diffusion rate of the Oxygen is directly proportional to the concentration gradient across the membrane. As oxygen gas diffuses into the electrolyte solution, it is reduced to hydroxide ions at the gold cathode. At the silver anode, silver ions are produced to close the electrical circuit. The driving force is the external voltage, supplied by the electronic amplifier, across the electrodes.

The chemical reactions at the electrodes can be described as follows;

$$O2 + 2H2O + 4e- \rightarrow 4OH(-) \quad \text{at golden cathode}$$

$$Ag \rightarrow Ag(+) + 2e- \quad \text{at silver anode}$$

Current flowing through this cell is determined by the amount of oxygen reduced at the cathode and is directly proportional to sample concentration.