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INSTRUMENTAL METHODS USED FOR ENVIRONMENTAL MONITORING

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ABSTRACT

The present paper discusses the various instrumental methods used in water pollution studies. These methods are pH meter, potentiometry, voltametry, amperometry as electroanalytical techniques. The paper also discuss optical methods such as spectroscopic method, chemiluminisce atomic adsorption spectroscopy, flamephotometry etc. Paper also describes nuclear methods.

INTRODUCTION

Recently there are increased focus on using instrumental methods for monitoring and estimating environmental pollution. Various instruments are used to check the quality of air, water and soil. The instruments are having their own limitations as well as advantages. In the present paper we are describing use of few instruments with their basic principles.

Electroanalytical Techniques

These techniques are based on interaction of electrical energy with matter. Various electroanalytical techniques such as pH meter, potentiometry, cyclic voltammetry is used to monitor environmental pollution.

Potential of an electrode deeping into a solution of an electrolyte depends on the activity of ions with which it is in equilibrium, therefore potential measurement can be used to monitor water pollution.

By the application of electrochemical oxidation or reduction many of the pollutants can be removed or rendered harmless. There are various types of ion selective electrodes used in environmental monitoring. Fluoride ion selective electrode is used to monitor concentration of fluoride in ground water. Excessive fluoride in drinking water causes harmful effects on the human health. Severity depends on the concentration. Permissible limit of fluoride in potable water is 1.0 ppm, which is acceptable up o 1.5 ppm in scarcity of other water sources (Iyer, 2002). The metal ion selective electrodes are used to estimate metal ions present. All these estimations depends on the potential developed by the electrode in contact with solution Cu^{+2}, Ag^{+2}, Pb^{+2}, Cd^{+2} ions can be monitored by these electrodes.

Voltammetric methods such as anodic stripping voltammetry is used to monitor presence of heavy metal ions such as pb^{+2} and Zn^{+2}. In this techniques the deposition of metal on to a hanging mercury drop electrode is carried out at 0.3 to 0.4 V more negative than the reduction potential of the metal concerned, under force convention. The deposition is followed by a voltammetric scan towards more the potential during which the metal in the mercury is oxidised and the resultant current is measured.

Amperometric titrations are used for the estimation of Pb^{+2} ions, its principle is identical to the voltammetric measurement at a fixed potential. In this titration the voltage applied across the electrodes in kept constant and diffusion current passing through the cell is measured and ploted against the volume of reagent added. Amperometric titration is used to estimate pb^{+2} ions present in the solution. It is more sensitive and can be used to detect metal ions at concentrations of 10^{-5} M or less.

Another health hazard is associated with the ignition of toxic compound in foods and their gradual contamination of ground water, methyl mercury in fish is the standard example. It has been proven that mothers eating fish containing polynuclear hydrocarbons produce children of reduced intelligence(Manivasakar, 1991).

Optical methods

These methods are based on interaction of eletromagnetic radiations with matter. Spectroscopic methods are most commonly used in environmental monitoring.

Various organic and inorganic pollutants can form coloured complex with suitable reagents. Such species can be detected and estimated using spectophotometer. For example Cr (VI) is toxic metal which is present in tannery effluents, can be estimated using diphenyl carbazide reagent. Ni (II) which is used as a catalyst is also toxic and can form coloured complex with DMG. (Dimethyl glyoxime) phenols present in the effluents of organic or pharmaceutical companies can be estimated using ferric ion solution. Phenols are common pollutants in waste water discharged from various industries especially from coke oven, coal, gasification and coal tar plants.

Petrolium refineries and synthetic resin and dye manufacturing units (Sharma and Kaur, 1994). They are determined to water for they creates bitter taste and undesirable odour even at low concentration. Moreover, they are harmful to mankind and other organism causing pain, renal irritation, severe shock and possibly death at higher concentration (Dey, 2002).

Relatively non toxic Fe (II) can be estimated using 1,10 phenonthrolin, pesticide residue are vary harmful and can be extracted by using suitable solvent and estimated using U.V. or I.R. spectrophotometry (Meshram *et al.,* 2002).

Chemiluminescence occurs after excitation of a molecule or ion by the energy emitted during a chemical or biochemical reaction, in which the excited species is a product. In many cases the chemically excited energetic level of a molecule is identical to the energetic level that could have been attained by absorption of electromagnetic radiation. In some molecules, however the excited levels are not identical. Chmillimine scence can occur in the ultraviolet, visible or near- infrared region. The atmospheric nitrogen compounds that are environmentally of the greatest interest are ammonia, amines, nitrogen monoxide and nitrogen dioxide, some instruments are designed to monitor Nox. In addition to being used to assay air pollutants, chemiluminescence has been used to monitor air flow in the upper atmosphere above 10 km. A chemiluminerscence substance is ejected into the atmosphere from a rocket and the path of chemiluminescence is monitored as a function of time after the ejection. Usually time lapse photography against a twilight or night sky is used to detect the chemiluminescence (Dube *et al.,* 2002).

Atomic absorption spectroscopy is widely used for the estimation of metal ions. The basic principle of A.A.S. is that a monochromatic light is beamed through a long flame in to which is aspirated the solution to be analyzed. The heat energy dissociates the molecules and converts the components to atoms. Although some atoms are activated, most atoms remain in the ground state at the temperature commonly used. The ground state atoms of the same elements as in the hallow cathode cup. absorb their own resonance lines. Mercury in air is collected by bubbling through an acid potassium permanganate solution. Mercury vapor is swept into a quartz ended call where its atomic absorption is measured using the 253.6 nm mercury line.

For the estimation of Na and K flamephotometry is widely used. In emission flame photometry, volatilization of a molecule in a flame produces free atoms and then excited atoms return to their ground state, a characteristics emission spectrum of the element is produced. This is the principle of Flame photometry (Koshy and Nayaar, 2002).

Nuclear methods

Scientilation counter, G.M. Counter are used to measure radioactive materials present in the environment. The radioactive materials are very harmful, the workers who are directly in contact with nuclear radiation should monitor their exposure to radiation. They can wear a film badge on their lapel. The

badge holds a photographic film which when developed at a regular interval can provide an estimate of the exposure by the degree of blackening of the film one may also carry a pocket dosimeter. This instrument is a miniature electroscope. Its scale is directly calibrated in dose units and therefore one can determine the dose of exposure at any given time. It's size makes it easy to carry, it is roughly of the size of a fountain pen.

Apart from this sequential plasma spectrophotometer, neutron activation analysis, isotope dilution method, nuclear tracers, turbidometry, nephelometry, choromatographic techniques, themogravimetric analysis etc. are used for the environmental monitoring.

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