

BIOSENSORS & ENVIRONMENTAL MONITORING – AS AN USEFUL TOOLS FOR STUDY ECOLOGICAL PARAMETER

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ABSTRACT:

Environmental Monitoring is a very Important to study the health of the Environment. The Chemical monitoring of Environment has been so expensive and hazardous for the environment & the use of Biological Sensor has prove to be less expensive & Environment Friendly. In Modern Context a lot of Research & Development made in the field of Biosensor Technology.

Key Words: Environment, Biosensor, Water, Pollution, Pesticides etc.

INTRODUCTION:

Biosensors are an analytical device, incorporating a biological entities (e.g enzyme, antibodies, microorganism, or DNA), either intimately associated with or integrated or integrated within a physiological transducer (e.g. electrochemical, optical, or piezoelectric)

Components of Biosensor:-

1. Analyte
2. Biological material
3. Transducer
4. Amplifier
5. LED screen/ PC

1. **Analyte** –Analyte consists of the materials whose concentration has to be measured. It may consist of any environmental components like heavy metals, pesticides, toxic chemicals , water pollution etc. The nature of interaction between the analyte and the biological material used, is of two types The analyte may be converted into a new chemical molecule , such biosensor are called CATALYTIC BIOSENSOR

The analyte may simply bind to the biological material, these biosensor are known as AFFINITY Biosensor

2. **Biological materials**- These are the biological entities which are immobilized and specifically reacts with the analyte. These biological materials may consist of enzymes, nucleic acid, antibodies, whole cell or organism or tissue .
3. **Transducer**- The biological component interacts specifically to the analyte, which produced a physical change close to the transducer surface
Transducer detects & measures this change and converts it into an electrical signal. Transducer work in a physicochemical way, optical way, piezoelectric way, electrochemical way etc.
4. **Amplifier**- These convert low signal currents into high signals
5. **LED screen**- These are the read out device onto which the signal can be read

Working principle of biosensor







- ✓ The analyte diffuses from the solution to the surface of the biosensor
- ✓ Reacts specifically with the biological component of the biosensor
- ✓ This reaction change the physicochemical properties of the transducer surface
- ✓ Leads to a change in the optical/electronic properties of the transducer surface
- ✓ The change in optical/electronic properties is converted into electrical signal, which is amplified, processed and displayed

Features of biosensor-

- + Highly specific for analyte.
- + Independent of factors like stirring,
- + Linear response, tiny and biocompatible.
- + Cheap, easy to use & durable/repeated use.
- + Cost is lower than that of conventional tests.
- + Require small sample volume.
- + Rapid, accurate, stable, & sterilizable.

Types of biosensor

- **Calorimetric** – changes in heat used to determine concentration
- **Potentiometric** - pH-meter used for measuring reactions generating or absorbing hydrogen ions

- **Amperometric** - function by the production of a current when a potential is applied between two electrodes
- **Piezo-electric** – measures quartz vibrations under the influence of an electric field
- **Immunosensors** - to detect and amplify an antigen-antibody reaction
- Optical - involve determining changes in light absorption between the reactants and products of a reaction, or measuring the light output by a luminescent process
- **Applications of Biosensor**
 -  Detection of industrial toxins, food contamination
 -  Agriculture and food industry
 -  Environment monitoring
 -  Toxicology tests
 -  General industry
 -  Military and defense industry

Biosensor for Environment Monitoring

Biosensor for Monitoring BOD

- The biosensor system is based on micro-organism which are immobilized behind a membrane.
- When organic matter is introduced into the system, it is consumed by the micro-organism which results in a decrease in oxygen the solution.
- This decrease in oxygen is monitored by a Clark electrode which is then correlated with the amount of organic material present.
- The response time is 50 seconds with the BOD measuring range of 2-22 mg/l BOD

Biosensor for Monitoring Pesticides

- Many pesticides biosensors are based on the inhibition of the enzyme cholinesterase by organo phosphorous compounds
- For OP & carbamate compounds is based on two enzyme acetyl cholinesterase and choline oxidase
- Acetylcholinesterase acts on acetylcholine to form choline, while choline oxidase oxidises choline with production of hydrogen peroxide

- The inhibition of acetylcholinesterase by pesticides is monitored amperometrically at 700mV Vs Ag/AgCl reference

Biosensors for Monitoring Phenols

- For monitoring phenols tyrosinase enzyme is used
- Tyrosinase catalyses the oxidation of phenols to catechols and then to quinones
- Quinones generation depletes oxygen which is measured by Clark oxygen electrode

Biosensors for Monitoring Heavy Metals

- ✓ Heavy metals biosensors using immobilized oxidases & dehydrogenases are used for the detection of Hg, Zn, Ag, Cd, & Cu salts
- ✓ The enzyme gets covalently bound with gluteraldehyde onto an affinity membrane & coupled with a Clark Oxygen electrode
- ✓ Clark oxygen electrode measures the oxygen depletion

Biosensors for Monitoring Polluting Gases

- Carbonic anhydrase catalyses the formation of HCO_3^- and H^+ from CO_2 and H_2O was hydro gel polymer electrolyte.
- When CO_2 was absorbed in the gel there is increase in the pH of the gel .
- The change in pH was proportional to the amount of CO_2 was measured by using a thin film of Iridium oxide which function as pH electrode

Commercial Market of Biosensor:-

- Still in its infancy & has been rather slow, although research in this area predicts their use for solving many problems
- A medical diagnostics has a worldwide market of US \$ 9 billion per annum.

Constraints of Biosensors

- Analyte preparation.
- Longer applicability-Use of immobilised biological entities prevents its longer applicability.

- Limited range of analyte to be sensed by biosensor

CONCLUSION

Biosensors find its applicability in diverse field. Its application may change out traditional method of analysis. Its popularity has risen in many European countries and many new researches have prompted its growth. The vast array of field including nanotechnology, biotechnology, and microbiology has given a future thrust in the field of biosensors.

But in India there seems to be a wide gap between the need and users. Hopefully in future we find a good market of biosensor in India.

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