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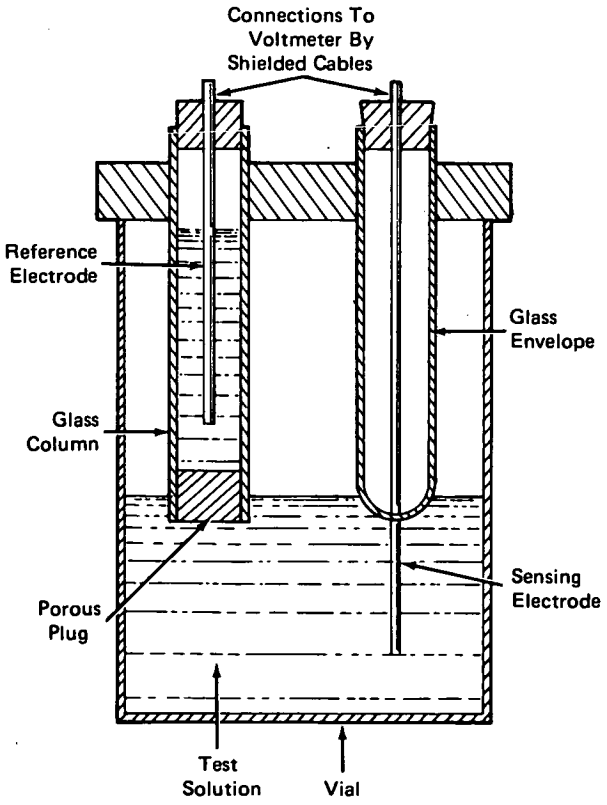
NASA TECH BRIEF

Goddard Space Flight Center

Rapid Detection of Bacteria in Foods and Biological Fluids

The problem:

Detection of bacteria is one of the primary concerns in food processing and medicine. It is constantly applied in the food processing industry to avoid distribution of products that may threaten the health of consumers. In medicine, on the other hand, the presence of bacteria must be detected in human biological fluids such as blood, urine, cerebrospinal fluid, etc., to determine the presence and nature of infections. Techniques and equipment used in bacterial detection are many and varied; however, they are all time consuming and costly.



The solution:

A simple and inexpensive apparatus, called the "redox monitoring cell", has been developed which rapidly detects the presence of bacteria.

How it's done:

The apparatus detects bacteria by measuring a drop in oxygen content in a test solution. Basically the apparatus (see figure) consists of a vial with two specially designed electrodes connected to a sensitive voltmeter.

Before the test is conducted, a fluid sample is poured into a vial and mixed with a suitable culture medium to permit bacterial growth. In general, foods do not require such media because they themselves are sufficient for bacterial growth. To maintain bacterial growth, the test solution temperature should be kept near that of the human body (37° C). This can be done by placing the vial into any commercially available heating block designed for this purpose. Bacteria are then detected by observing a voltage drop across the two electrodes immersed in the test solution. This drop occurs as a result of oxygen consumption by bacteria present in the solution.

Construction of the apparatus is shown in the figure. A plain 5/8-inch (1.6-cm) test tube may be used as the vial. The two electrodes, connected by shielded cables to a voltmeter, are different in composition and structure.

The sensing electrode uses a noble metal wire, such as platinum, gold, etc., to prevent chemical reaction with the test solution. This electrode provides a half-cell reaction whose potential is proportional to the oxygen content of the test solution. To prevent its exposure to oxygen outside the solution, part of this electrode is covered with a glass envelope which is sealed at the top with a resilient plug.

(continued overleaf)

The reference electrode, on the other hand, is designed to produce a constant half-cell potential using calomel or silver-silver chloride wire. The wire is enclosed in a glass column which is filled with a saturated solution of silver chloride and potassium chloride in ethylene glycol containing 5% water. Both ends of the column are plugged, with the bottom plug allowing ionic flow between the electrode and the test solution. The porosity of this plug is approximately 40 angstroms.

Voltmeters for measuring the potential difference between the electrodes are commercially available but are carefully selected. Sensitivity should be 1 millivolt. Because the electrodes have impedances of approximately 100 kilohms, while the typical impedance of a test solution is 500 kilohms, a suitable voltmeter input impedance should be at least 10 to 50 megohms to detect a 1-millivolt change. Most voltmeters, however, may be interfaced with the "redox monitoring cell" by use of a suitable integrated-circuit operational amplifier of the field-effect transistor type.

Note:

Requests for further information may be directed to:

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Reference: TSP73-10045

Patent status:

This invention is owned by NASA, and a patent application has been filed. Inquiries concerning non-exclusive or exclusive license for its commercial development should be addressed to:

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