USING THE CHALLENGE AER-200 RESPIROMETER SYSTEM FOR AEROBIC APPLICATIONS

The CHALLENGE AER-200 Respirometer System consists of reaction vessels, an oxygen generation unit, flow measuring cells, and a computer for data processing and storage. As oxygen flows through each cell under the influence of a slight vacuum caused by oxygen uptake and carbon dioxide adsorption in the reaction vessel, oxygen bubbles of a fixed volume are formed in the lower section of the flow measuring cell. Each bubble in turn passes through a detection section where a counter is activated. Finally, the number of bubbles is registered by the computer to produce a measure of cumulative oxygen uptake and oxygen uptake rate. This data is stored for later data processing.

Reaction Vessels

Reaction vessels holding 250 to 500 mL samples typically are used or conducting laboratory-scale aerobic treatability and toxicity assessments but the AER-200 system also can be used to measure oxygen uptake by larger laboratory-scale reactors. An insert containing potassium hydroxide is placed inside each vessel to absorb the carbon dioxide produced by the biological reaction.

Oxygen Supply

Oxygen is supplied from a pressure cylinder and is channeled through an oxygen input manifold to an oxygen flow control unit which provides an atmospheric seal and maintains a slight but constant pressure on the input side of each cell.. Oxygen is pulled from the manifold through the flow-measuring cells as needed to satisfy the demand of the microorganisms in the connected test vessels.

Flow Measuring Cell

The heart of the AER-200 respirometer is the flow measuring cell. Each cell is precision-milled to insure production of bubbles of constant volume. Oxygen uptake causes oxygen to enter the inlet side of each cell. When oxygen reaches the lower tip of the tube within each cell, a bubble is formed and floats upward between two detector elements. At this point, a count is registered by the computer. Bubble size is controlled by both the cell design and the composition and viscosity of the fluid medium contained within the cell. An electolytic oxygen generation unit is used for calibrating the flow-measuring cells.

Computer System

The AER-200 system computer processes and stores the data from the oxygen flow measuring cells using specially dedicated software. This software logs information about the test units, for example, titles, dates, sample numbers, and calibration factors. Oxygen uptake data is stored on a data disk for subsequent processing by most commercial spreadsheet programs. On Basic systems, the computer monitor displays the test data in a convenient tabular format including sample number or title, cell number, accumulated counts, accumulated oxygen uptake in mg O_2, and oxygen uptake rate in mg O_2/hr. Advanced systems include graphical display of the rate and amount of oxygen uptake for each test reactor. Advanced systems also contain connections for adding up to three 8-cell bases or 24 flow measuring cells per computer station.

Accuracy and Precision

The lowest volume of measurement is one bubble or about 0.06 mg of oxygen (at 20^{o}C); the oxygen can be passed through each cell at rates in excess of 10 mg O_2/min per cell or 14,000 mg O_2/day (larger-capacity cells are available). Flow measuring precision is quite high: test repeatability typically is better than +- 3% C_V As long as the flow cell is maintained at a constant temperature and in a clean condition, bubble size varies less than +-1% from average. Accuracy of measurement is maintained through careful calibration.