THE CHALLENGE AER-200 RESPIROMETER SYSTEM FOR ANAEROBIC APPLICATIONS

The CHALLENGE AER-200 Respirometer System consists of one or more biological reaction vessels, gas flow measuring cells, and a computer. The gas measuring base contains eight flow cells and associated interconnecting circuitry. As gas flows through each cell under the influence of a slight pressure caused by gas production in the reaction vessel, bubbles of a fixed volume are formed in the lower section of the cell. These bubbles in turn pass through a detection section where a counter is activated. Finally, the number of bubbles is registered by the computer to produce a measure of flow volume and rate. This data is stored by the computer for later data processing.

Reaction Vessels

Reaction vessels having volumes ranging from 50 to 500 mL typically are used with the AE-100 system when conducting laboratory-scale anaerobic treatability and toxicity assessments. However, the AER-200 system also can be used to measure gas flow from large laboratory-scale anaerobic reactors that provide flow rates up to about 25 mL/minute.

Flow Measuring Cell

The heart of the AER-200 respirometer is the flow measuring cell. These cells are precision milled to carefully controlled tolerances to insure production of bubbles of essentially constant size and volume. Bubble size is controlled by both the cell design and the composition and viscosity of the fluid medium contained within the cell. As gas is produced in the reaction vessel and flows into the inlet side of the cell, the fluid is forced downward until the gas reaches the lower tip of the tubes within the cell. Continued gas flow causes a bubble to form and float upward between the two detector elements. At this point, a count is registered by the computer.

System Computer

The AER-200 system computer processes and stores the data from the flow measuring cells using specially dedicated software. This software logs information about the test units, for example, titles, dates, sample numbers, and calibration factors. Gas production 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 gas production in mL and gas production rate in mL/hr. Advanced systems includes graphical display of the rate and cumulative amount of gas production 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 using the standard anaerobic cell is one bubble or about 0.15 mL; the upper range is about 25 mL/min. (High-sensitivity cells having a sensitivity of about 0.05 mL per bubble or 10 mL/min also are available from CHALLENGE). The measuring precision is quite high: test repeatability typically is better than $\pm$ 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 $\pm$ 1%. Accuracy of measurement is maintained through careful calibration.

APPLICATION

Operation of a Master Culture Reactor to prepare cultures for treatability tests.

METHOD

A seed culture from a full-scale anaerobic digester was diluted and placed in an 12-L glass vessel. 600 mL of a synthetic wastewater having 40,000 mg COD/L in a nutrient/ mineral/ buffer solution was fed daily after removing 600 mL of mixed liquor. The system was thus operated continuously at 20-day solids and hydraulic retention times and an organic loading of 2 g COD/L-d.

ANALYSIS

The daily gas production rate and volume were essentially constant over a 34-day period of operation with a standard deviation less than 6% of the average.