BRANDSTOFNAVORSINGSINSTITUUT

VAN SUID-AFRIKA

FUEL RESEARCH INSTITUTE

OF SOUTH AFRICA

TEGNIESE MEMORANDUM
TECHNICAL

NO. 10 OF 1972.

AN APPARATUS FOR DETERMINING THE STABILITY OF SUSPENSIONS

OUTEUR: G.A. VILJOEN.
AUTHOR:

Cosmi 7043 — B 56

FUEL RESEARCH INSTITUTE OF SOUTH AFRICA

TECHNICAL MEMORANDUM NO. 10 OF 1972

AN APPARATUS FOR DETERMINING THE STABILITY OF SUSPENSIONS

BACKGROUND

When a homogeneous aqueous suspension of solids is left undisturbed, settling of the solids occurs, resulting in two distinct phases, viz., a clear phase above a turbid phase. The rate at which settling of the solids occurs can be taken as a measure of the stability of the suspension.

The settling rate of the solids can be determined by measuring the rate of movement of the interface between the clear and turbid planes. In the practical situation the transition from the turbid to the clear phase is gradual and no clearly defined interface is obtained, so that the reproducibility of the results will depend to a large extent on subjective interpretation of the interface.

An alternative approach to the problem of determining the settling rate is based on the following principle. The specific gravity of a suspension is proportional to the concentration of solids. Accordingly, if a body is immersed in a suspension and maintained at a given plane, the buoyant force acting on the immersed body will change with progressive settling of the suspended solids in the suspension.

The prerequisite that the immersed body remains stationary with the vertical plane is of utmost importance. Due to the different settling rates of differently sized suspended solids, a specific gravity gradient results in the vertical plane. Vertical movement of the immersed body thus introduces an error.

/INITIAL ...

INITIAL APPARATUS

The first apparatus operating on the principle of a change in the buoyant force with progressive settling was constructed along the following lines.

A suitably shaped glass cylinder was suspended from one arm of a chemical balance so that it was submerged in the test suspension. The other arm of the chemical balance was attached to a coil suspended within a magnetic field. Current was passed through the coil to counteract the net downward force acting on the glass plunger. (See F.R.I. report No. 12/1958: "A method for determining the settling rate of heavy-medium suspensions.")

As settling progresses the buoyant force on the glass plunger changes, causing an inbalance, i.e., movement of the balance arm. This movement is detected by means of a photocell. Thereafter balance is restored by suitable adjustment of the current through the coil. This current adjustment is accomplished by means of a valve amplifier of which the input is fed by the photocell and the output coupled to the coil on the balance arm. Consequently the rate of change of coil current is a function of the settling rate. The former variable can be readily recorded.

This system, however, proved cumbersome to use, because oscillation of the mechanical system occurred almost every time when the apparatus was used.

IMPROVED APPARATUS

When the semi-conducter strainguage became available, its possibilities to improve the apparatus were realised. The entire chemical balance, amplifier and optical system were replaced by such a strainguage. The present apparatus consists of a strainguage mounted on a suitable structure, with the glass cylinder suspended from its hook. The input diagonals of the strainguage,

/arranged ...

arranged in bridge form, are connected to a stable direct current source, and its output diagonals to a suitable line recorder. Again, as previously described, the buoyant forces acting on the glass cylinder change with settling of the solids in the suspension, thus producing a proportional change in the electrical output from the strainguage. The change of electrical energy is then recorded against the time axis of the recorder. The strainguage has the advantage that elongation under stress is negligible, so that the glass plunger remains stationary for all practical purposes. Thus any errors resulting from plunger movement and inertia are eliminated.

EXPERIMENTAL PROCEDURE

A standard test suspension is made and homogeneously assured by thorough stirring. At the onset of the steady state condition, the plunger is immersed to a standard depth. The time taken for the electrical output to reach a fixed level is recorded. This is a measure of the stability of the suspension.

NOTE

Technical details of the apparatus are kept under separate index and are available from the secretary, F.R.I., upon request.

(SIGNED) G.A. VILJOEN.
PRINCIPAL TECHNICIAN.

PRETORIA.
21st February, 1972.
/MS