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**CONTINUOUS SLURRY SAMPLER AND
 DEAERATOR**

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ABSTRACT OF THE DISCLOSURE

In a system for the analysis of various sample streams, an apparatus for cutting a sample from a fluid stream including an open ended conduit movable in a horizontal path and positioned above a stationary variable opening cutter during part of the path, a suspended deaerator tank through which the cut sample passes, a counterbalance for the deaerator and sample, and a linkage to open and close the cutter opening in response to vertical movement of the deaerator tank. A single sample analyzer incorporating one of the above apparatus for each stream to be analyzed wherein a manifold selects one stream at a time to be fed to the analyzer.

The present invention relates to an apparatus for forming a continuous fluid sample stream from a main stream with subsequent tank deaeration of the sample stream. More particularly, it involves utilizing variations in the weight of the fluid in the deaeration tank to adjust the flow rate of the sample stream.

Control of chemical and metallurgical processes is preferably based upon measurement of appropriate physical and chemical properties of the various process streams involved. Continuous automatic on-stream measurement of these characteristics is highly desirable, and progress has been made in developing such systems for application to fluid process streams. Most such systems cannot make measurements directly upon the main process stream when it is large but require a sample stream representative of it. This sample stream should be identical to the process stream in terms of the physical and chemical characteristics to be measured. In particular, it should be free of air bubbles which would reduce the apparent density of the stream and thereby produce errors in measurements. Because the sample flow chambers of the measuring systems must be kept full to exclude air, and because they are generally systems of fixed resistance to flow, they require a sample stream of nearly constant flow rate, whereas process streams generally have variable flow rates dictated by production requirements. As the analytical sample chambers used in connection with instruments such as the X-ray analyzer necessarily employ materials of construction which are of limited strength, the hydraulic head of pressure within the system must be controlled to prevent rupture of the chamber.

When the process stream is a homogeneous liquid, nearly any means employed to divert part of it as a sample stream will provide a sample of the same composition as the main stream. Any of a variety of known devices may then be used to remove air from the sample stream. A simple open surge tank with the bottom connected to the analytical system and an overflow return to the process or to waste is adequate for flow rate adjustment and hydraulic head control.

But, when the process stream is a slurry of solid particles in a liquid, the problem becomes more complicated and such systems are not entirely satisfactory. Slurry

streams are notoriously non-homogeneous because each individual solid particle tends to settle in the liquid phase at a rate dependent upon its own size, shape, and specific gravity, as well as upon the slurry flow rate, solids concentration, and other hydrodynamic characteristics. As a result, samples taken from one part of the stream may have properties quite different from those taken from another part, and both may differ from the bulk of the stream. It is well known to those skilled in the art that, for these reasons, simple diversion of a portion of a slurry stream cannot be counted upon to produce a representative sample.

Many kinds of samplers have been devised to cut periodic batch samples from slurry streams and it is known that, if certain principles are adhered to, the samples will be representative. The basic principle in all of these devices is that a cutter of fixed dimensions be passed into, through, and out of the stream at a constant rate of speed in such a manner that each and every portion of the stream flows into the cutter for the same interval of time.

It is well known to use batch samplers of the above mentioned type, operating on a short time cycle, to produce practically continuous representative slurry sample streams for automatic on-stream analytical systems. Unfortunately, the design features necessary to produce a representative sample stream also produce one in which sample stream flow rate variations are in direct proportion to flow rate variations in the main process stream. In order to compensate for these flow rate variations, the sample stream flow rate has been adjusted to that accepted by the analytical system by using a head tank or deaeration tank with an overflow outlet for excess sample, similar to that which has proved satisfactory for homogeneous fluid streams. However, the use of such a tank results in distortion of the sample which tends to become nonhomogeneous in the head tank. Attempts have been made to maintain homogeneity in these tanks, and thus avoid sample distortion, by equipping them with agitators and various kinds of baffles. But, these systems using a tank with an overflow have been found to be unsatisfactory for several reasons.

Firstly, sample distortion frequently results, with the material flowing out the bottom of the tank to the analytical system being different from either the overflow stream or the feed stream. These errors stem from the tendency of solid particles, particularly large or heavy ones, to settle and concentrate in the underflow. In flotation process applications they also result from the tendency of some chemically treated mineral particles to stick to and rise to the surface with air bubbles. These kinds of errors are particularly great, for example, in the analysis of flotation process concentrates and have led to unsatisfactory results with such streams. See Fuller, M. L., et al., "X-ray Assaying and Reagent Control at Friedensville," in the Mining Congress Journal for April 1967, at pp. 108-112.

Secondly, this overflow arrangement can cause errors in some analytical systems, such as X-ray fluorescence analysis, simply because the size of the particles in the two streams are different, even though the chemical compositions of the streams are identical. See Berstein, F., "Particle Size and Mineralogical Effects in Mining Applications," a paper presented on Aug. 10, 1962, at the Eleventh Annual Conference, Applications of X-ray Analysis, University of Denver.

Thirdly, the tank overflow arrangement is unsatisfactory in that the strong agitation necessary to keep the solid particles in suspension is detrimental to effective deaeration, so that the final design is at best a compromise between the degree of sample distortion allowed and the completeness of deaeration achieved, without a completely