FLUID CONTROLLED ISOKINETIC FLUID SAMPLER

BACKGROUND OF THE INVENTION

The present invention is a fluid controlled isokinetic fluid sampler for obtaining a sample of a flowing fluid and material suspended therein from a flow stream to permit determination of the concentration of contaminants in the flow stream, such as sediment and other water quality constituents in the effluent from an industrial plant or in a river or stream. More particularly, the present invention is a sampler for obtaining a sample of a flowing fluid from a flow stream such as a river or the effluent of an industrial plant or a waste water treatment plant, with the sample entering the sampler at a flow rate equal to the flow rate of the flow stream so that the concentration of contaminants in the sample is representative of the concentration in the flow stream.

Samples of flowing fluids and material suspended therein, such as flowing water in a river or stream or the discharge water from an industrial plant or water treatment plant, are often desired for testing to determine the make up and quality of the flowing fluid. However, to provide meaningful test results, such samples must be representative of the flow stream. Further, it is necessary that the sampler not contaminate the sample.

Obtaining a representative sample can best be done isokinetically, that is without a change in the fluid speed or flow direction as fluid from the flow stream enters the sampler. Samples of flowing liquids which are collected in a non-isokinetic manner are frequently biased relative to the concentrations of material such as sediment suspended within the liquid. Sampling under isokinetic conditions also permits the sample to be flow weighted so that a single sample can be collected and analyzed to provide a measure of the amount of sediment passing a given cross section of the flow stream per unit time.

The desirability of obtaining isokinetic samples has been known for many years. Many early attempts to obtain isokinetic samples have involved pumping a sample of a flowing liquid to the surface of the flow stream with a pump having a pumping rate controlled electronically by a flow sensor. However, the pump components frequently are contaminated and so can contaminate the sample, with the result that the sample is not representative of the flow stream. Various non-pumping isokinetic sediment samplers have been developed, but most of these cannot be used at fluid depths greater than about 17 feet. Further, most of these samplers permit the sample to be contaminated as it is obtained.

In order to reduce such contamination, bag samplers have been developed, which can be operated at any depth. However, at a flow rate below about three feet per second, such bag samplers do not obtain samples isokinetically, since the dynamic pressure of the fluid entering the sampler is not sufficient to inflate the bag.

Isokinetic samplers have been developed for lower fluid velocities, but such samplers are initially filled with air. As a consequence, these samplers are limited to depths of operation of less than about 17 feet, and the rate of vertical descent during the placement of these samplers is very low. Further, the buoyancy of the air makes it necessary for such samplers to have a very heavy frame or other weighting system in order to provide stability.

An additional problem with many existing samplers is that the inflow of the fluid into the sampler cannot be started or stopped while the sampler is in the flow stream. As a consequence, such samplers cannot be utilized to obtain a point sample, i.e., a sample at a specific depth.

SUMMARY OF THE INVENTION

The present invention is a fluid sampler overcoming these deficiencies of the prior art. In accordance with the present invention, an inflatable bag is provided within a hollow fluid-tight housing which is filled with water or other appropriate liquid. An inlet tube permits a sample of a flowing fluid to be introduced into the inflatable bag from the exterior of the housing to inflate the bag within the housing. A pump is provided to pump the water from within the housing through an outlet tube to the exterior of the housing, and a control device responsive to the flow rate of the flowing fluid causes the pump to pump the water from within the housing through the outlet tube to the exterior of the housing at a flow rate proportional to the flow rate of the flowing fluid. As the water is pumped from within the sealed housing, a sample of the flowing fluid is drawn into the bag, inflating the bag to replace the water that is pumped from within the housing. The flow rate at which the pump exhausts the water from the container is based on the ratio of the diameter of the inlet tube and the outlet tube so that the sample is drawn through the inlet tube into the container with the same flow rate as the flowing stream, providing isokinetic sampling. Since the pump is not in the inlet to the inflatable bag, contamination of the sample by the pump is avoided. Since the housing is initially filled with water, the sampler is not buoyant, and so no stabilizing weight needs to be provided. Further, a solenoid valve keeps the outlet tube blocked until the sampler is positioned at the desired location, permitting point sampling.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other aspects and advantages of the present invention are more apparent from the following detailed description and claims, particularly when considered in conjunction with the accompanying drawings. In the drawings:

FIG. **1** is a schematic sectional view of a fluid controlled isokinetic fluid sampler in accordance with one embodiment of the present invention and is taken along line I—I of FIG. **2**;

FIG. **2** is an end elevational view of the sampler of FIG. **1**;

FIG. **3** is a fragmentary sectional view depicting an alternative embodiment of a pump and pump control suitable for incorporation in a fluid sampler in accordance with the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

As depicted in FIG. **1**, the fluid controlled isokinetic fluid sampler of the present invention includes a hollow closed housing **10** made up of a cylindrical container **12** and a cap **14**. Cap **14** is securely fastened to container **12** by spring-loaded latches **16**. Preferably, cap **14** is curved substantially as depicted in FIG. **1** for laminar diversion of the flowing fluid. An O-ring **18** assures that cap **14** is sealed to container **12** in a fluid tight manner so that container **12** and cap **14** define a closed chamber **24**. An inlet tube **22** passes through cap **14**, and a fluid impervious inflatable bag **20** is secured to the end of inlet tube **22** within chamber **24**. A gasket **26** and a sealing device such as a rubber band **28** assure that