SAMPLER

BACKGROUND OF THE INVENTION

This invention relates to methods and apparatus for sampling liquids under conditions that maximize precise analysis of ingredients.

In one class of methods and apparatuses for sampling liquids, the apparatus automatically draws samples of known amounts of liquids at preprogrammed intervals and deposits them into containers, which are usually bottles. The prior art automatic samplers of this class fill open containers. This type of automatic sampler has a disadvantage if used to sample liquids with volatile materials in them because substantial amounts of the volatile materials escape before measurement.

Another class of sampler includes containers that can be opened to receive liquid and closed after filling without air space within them to preserve as much of the volatile materials that are within the liquid before being drawn as possible. A prior art type of sampler of this class includes a valve in an inlet conduit and a valve in an outlet conduit. This type of valve has a disadvantage in that it is difficult to automate because of the number and types of valves, the size of the valves and the size of the plumbing associated with the valves. A system of this type is disclosed in U.S. Pat. Nos. 4,974,456 and 4,864,877.

Bladder pumps are known for drawing samples. However, bladder pumps have not been connected to automatic sample collectors to collect samples automatically. In the prior art, peristaltic pumps have been used with automatic samplers, probably because of their ability to pump with shallow liquid depth and because of the simplicity and economy that results from being driven by an electrical motor rather than compressed air as in the case of bladder pumps.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the invention to provide a novel liquid sampler.

It is a further object of the invention to provide a novel automatic liquid sampler that can preserve representative samples of liquids having volatile materials in them.

It is a still further object of the invention to provide sample containers having a single opening that serves as the inlet port, overflow port and as a closure for the containers wherein there is no air space and only liquid in a filled container after sampling.

It is a still further object of the invention to provide a novel sampler that automatically draws samples and deposits them in containers with no air space in the containers.

It is a still further object of the invention to provide a novel sampler that does not release volatile materials from the liquid so that the liquid in the container is representative of the sampled liquid.

It is a still further object of the invention to provide a volatile liquid sampling system that only requires one valve for each container to fill it so that there is substantially no air space.

It is a still further object of the invention to provide an automatic sampling system in which a needle is passed through a valve opening to fill the container to overflowing and then withdrawn, with the valve opening being closed immediately upon withdrawal.

It is a still further object of the invention to provide a sample collecting system in which a needle is within a

socket with a portion of it sealing a central outlet of the socket while the lines are purged and then the needle moves through the central opening of the socket into a bottle cap connector and valve opening to deposit a sample in a container.

In accordance with the above and further objects of the invention, a filling station sequentially fills sample containers by moving a hollow needle into each container in sequence and completely filling each container with liquid. The needle is moved into each container by moving it through a valve dedicated to. that container. After purging air from the container where this is part of the procedure, the needle is withdrawn, preferably from near the bottom of the container, as liquid flows: (1) radially outwardly from the needle to sweep bubbles from the walls of the container and needle; and (2) under the liquid in the container to avoid turbulence that otherwise could release volatile compounds.

As the needle approaches the valve before filling, the valve begins to open and a fluid socket closes the bottle cap. The shank of the needle and an end ball or plug on the end of the needle slide through the fluid socket, a cavity on the bottle cap and through the valve opening. It proceeds to a location near the bottom of the container and injects sample. The bottle may be filled with liquid for displacing air and the needle withdrawn, with liquid continuing to flow as it is withdrawn. As the needle is withdrawn, the valve outlet closes. The opening and closing of the valve, the movement of the hollow needle, the insertion and removal of the socket from a connector in the bottle, the pumping of liquid and the movement of bottles into and from a filling station are all synchronized to provide samples precisely representing the liquid in the aquafer or other body of water being sampled.

In the preferred embodiment, the valve closes by rotating, with the valve being opened when the valve inlet is facing upwardly toward the needle, and being closed when it turns so that it is sideways. Just before the needle tip is inserted, during the time the container is being filled and for a short period of time after the needle is withdrawn, the fluid socket closes the container cap and any overflow liquid flows out of the connector. As the valve closes, there is a head of liquid above the valve so that no air space is possible in the closed container.

The needle includes a ball on its end and its central opening is connected to plumbing to receive liquid. The needle is slidable in the socket and held within a central opening of the socket from which it extends into a container during filling. The ball on its end seals the socket outlet when the needle is withdrawn from the container but the socket includes a compartment that receives liquid from the radial openings of the hollow needle when the needle is in its retracted position. An outlet port from the socket housing is connected to a drain so that liquid can circulate through the hoses from the pump, into the socket from the retracted needle and out the outlet port of the socket to purge the plumbing and the needle before a sample is deposited into a container when the needle is retracted and its end ball seals the socket.

When the socket is over the cap of a container with the needle extending through the valve opening, the socket seals the cavity in the cap and liquid fills the container from the needle. Liquid overflowing the container passes through the valve and into the socket where it leaves the outlet port. When the container has been filled and the needle withdrawn through the container valve opening to seal the central outlet of the socket, the socket can be withdrawn without releasing liquid to fall in the container.