

**WATER MONITORING, DATA  
COLLECTION, AND TRANSMISSION  
MODULE**

CROSS-REFERENCE

This application relies on U.S. Provisional Application No. 60/147,334, filed Aug. 6, 1999, (including its specification and drawings) for priority. That application is hereby incorporated into this application by reference.

FIELD OF THE INVENTION

The invention relates to an apparatus and method for sampling seawater and freshwater characteristics. More specifically, the present invention concerns the automated acquisition and transmission of data from a sea-going vessel.

BACKGROUND OF THE INVENTION

Traditional observation and measurement of physical, chemical and biological properties of bodies of water including coastal and open ocean environments, lakes, rivers, and reservoirs has been carried out historically by at least two techniques.

First, a single sensor (or a limited number of sensors) may be embedded in a device immersed in the water (in drifters, buoys, or devices dragged behind vessels) to periodically sample the water. However, drifters are expendable with a limited lifetime and costly, and because they move with the currents, are capable of collecting data only from limited areas of oceans and other bodies of water. Buoys are stationary and can only collect data from a fixed location. Dragg devices are very difficult to use and are often lost.

Second, research vessels (which are very large and expensive to operate) may be equipped with various sensing devices and computers for collecting and storing water condition data. However, vessels of this sort are very expensive. Not only are they costly to build, but, because of the large, technically-trained crews they require, they are also very expensive to operate. In addition, because of the manner in which the data is collected, vessels of this type often require a considerable amount of time to assemble and disseminate the information.

Accordingly, due to a lack of observational resources and effort, broad, synoptic coverage of much of the world's oceans (particularly coastal areas), as well as other bodies of water, has remained elusive.

Historically surface water sampling for ships underway has been accomplished by drawing the water into the vessel through a sea chest, through a temporary hose over the side rail, through an open hole in the vessel's hull, in some cases with a pipe projecting through the hole into the free water away from the ship's hull, or by means of a pail thrown over the vessel's railing. All of these approaches give rise to any number of difficulties which make routine underway sampling of unadulterated surface water problematic. Such difficulties include contamination from the ship's hull or plumbing, limitation on the vessel's speed for which sampling can be performed, excessive bubbling or cavitation problems, excessive bio-fouling which modifies the sampled water, and inaccurate temperature measurements due to temperature modification along the water's flow path from the sampling point to the measurement point.

Accordingly, a need has developed for an apparatus that overcomes many of these difficulties. Specifically, a need has developed for a sampling apparatus that is largely automated, requires little or no technical training to operate

and maintain, can accurately sample water with little or no contamination or degradation of that water during the sampling operation, and is relatively inexpensive.

SUMMARY OF THE INVENTION

It is, therefore, an object of the present invention to provide an automated testing apparatus that can autonomously sample water with little or no contamination of that water during the sampling operation.

It is a further object of the present invention to provide a solution to the problem of rapid deterioration of traditional monitoring and testing devices (and the related deterioration in the accuracy of their data) utilized (submersed or floating) in oceans and other bodies of water.

It is another object of the present invention to provide an apparatus that avoids the immense expense associated with current methods of monitoring the oceans and other bodies of water (e.g., \$ 10,000+ a day for a research vessel and \$ 30,000–50,000 for a drifter or buoy collecting only one or two types of data).

Another object of the present invention is to provide a solution to the need for large technically trained staff to man the water monitoring devices, such as on a research vessel.

Also, it is an object of the present invention to provide an apparatus that permits broad monitoring coverage of ocean or other bodies of water worldwide.

Moreover, it is an object of the present invention to provide an apparatus that can be effectively used by private individuals who wish to assist in ocean monitoring efforts to effectively utilize their own vessels as a research tool.

It is still another object of the present invention to provide an apparatus that may be widely deployed and may be capable of carrying many and various sensors that are easily and interchangeably used (snapped into) the sampling module.

Also, it is the objective of the present invention to provide a standard system that is compatible or can readily be made to be so, to operate with new or existing sensors from various companies, agencies, or individual research personnel.

Another object of the present invention is to provide an apparatus (or module) that encompasses a wide scope and breadth of data collection and transmission capabilities (multiple types of data).

One further object of the present invention is to provide a water monitoring module that is small and compact in size and, accordingly, is low in cost (e.g., \$ 10,000–25,000), making it attractive to owners of private boats.

Another object of the present invention is the provision of a water sampling module that is durable and operates over a long lifetime.

Further objects of the present invention include the module's ability to operate autonomously without technically trained personnel, its ability to function in various areas and types of water including coastal areas of oceans, open ocean areas, aquaculture facilities and fresh water reservoirs, its ability to be directed by two-way communications, and its ability to accommodate many and various sensors, all operating off the module's standard power, light, anti-biofouling, calibration and software systems.

To accomplish these objectives, the present invention provides a water sampling apparatus that includes a water inlet and water collection device (scoop). A pump, in fluid communication with the water inlet, draws a water sample from a body of water through the water inlet. A plurality of