Proceedings of the Eighth (1998) International Offshore and Polar Engineering Conference
Montréal, Canada, May 24-29, 1998

ISBN 1-880653-34-6 (Set); ISBN 1-880653-37-0 (Vol. III)

Open-Cell Conductivity Probe for Laboratory and Oceanic Use

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ABSTRACT

An optimum conductivity sensor suitable for the measurement of the micro structure and internal waves in the oceans has been developed. An electronic control circuit for the new probe was developed and incorporated inside a stainless steel fairing for the tow cable for oceanic use. The overall system was successfully checked out in the laboratory channel experiments as well as in the field experiments in coastal water. For a total data of almost 4 hours of recording during a three-day field experiment, the sensors did not show any sign of biological fouling, nor did they show any spike response to small particulate meter in the seawater. The whole system was very stable; it did not show any long-term drift problem.

KEY WORDS: Open-cell conductivity sensor, in-fairing package, micro structure, internal waves, four-electrode probe, biological fouling

INTRODUCTION

A conceptual optimum open-cell conductivity probe has been successfully realized through in depth theoretical analysis, engineering designs, and laboratory experimental verifications. An electronic control system for the probe has been designed, fabricated and incorporated into a stainless-steel in-fairing housing in a tow cable. The overall system has been successfully checked out in the laboratory channel experiments as well as in the field experiments in coastal water.

Our objective is to design an array of conductivity sensors that can be stringed along a tow cable for use by surface ships or submarines to monitor the environmental conditions and for other oceanic research applications; i.e., the sensors and their electronics are packaged as a miniaturized in-fairing device or as a CTD sounding device.

THEORETICAL ANALYSIS OF OPEN-CELL PROBES

In the past years, we have conducted a search for an optimum conductivity sensor suitable for the measurement of the microstructure in oceans. This work resulted in an open-cell four-electrode probe design, as shown in Fig. 1. The probe has two hemispherical current electrodes, C_1 and C_2, mounted in opposition on two parallel insulating probe supports, as shown. Coaxial to the two current electrodes is two equipotential ring-electrodes V_1 and V_2, respectively. Fluid, whose conductivity is to be measured, flows between the electrodes. The probe mount is designed, as shown, to be free from fouling by seaweed and other biological matters in the ocean.

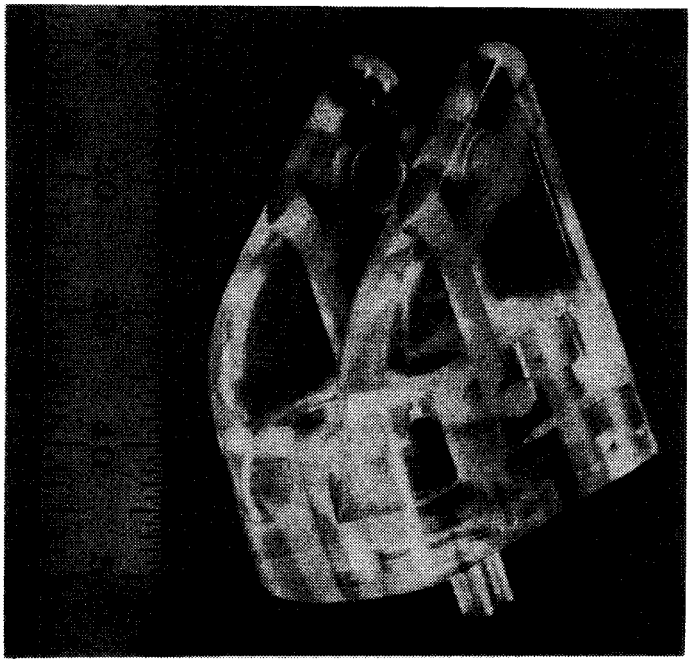

Fig. 1 Photo of an open-cell conductivity probe; flow is from left to right; on the left is a center scale

In operation, an alternating current I is developed by the