Firsts Underwater Potentiostat Sea-Tests in the OBSEA

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***Abstract*—Corrosion due to seawater studies are urgently required for a safe technology development. Some studies demonstrated that the corrosion rates for most alloys could be four times less than surface corrosion rates. A device for continuous electrochemical measuring of corrosion in real time and underwater has been designed. Therefore, this equipment allows improving the knowledge about long-term materials behavior in this aggressive environment for the scientific community. Also, it has been designed to allow the connection to underwater observatories such as OBSEA. In this paper we expose the first tests have been conducted in a real environment such as OBSEA.**

***Keywords*— Potentiostat; corrosion; electrochemical; real-time; sea-tests;**

I. Introduction

Corrosion studies due to seawater are very interesting for the scientific community to develop a safe technology. It is well known that the corrosion rate is influenced by the amount of dissolved oxygen in seawater, since oxygen is an active cathode depolariser. Also there are more factors, such as temperature, salinity, current velocity, wave action, biofouling, and so on [1] [2]. However, there is no electrochemical data in situ and in real time about it. The possibility to measure corrosion potential, polarization curves or others parameters open new possibilities for electrochemical measurements under the sea that never before have been done.

For this purpose a new concept of potentiostat has been developed with capabilities to allow connection to an underwater observatory such as OBSEA. It can be seen in our previous work [3]. In this paper we presented the first sea-tests carried out in the OBSEA.

This paper is organized as follows. Section II and III describes the potentiostat and electrodes cells. Section IV reports the device deployment. Finally the sea-tests are shown in section V.

II. Potentiostat

The block diagram of the potentiostat system connected to the underwater observatory OBSEA is shown in figure 1. The basis of the implemented system is formed by the Potentiostat and the Electrode under test, the OBSEA infrastructure and the PC with a specific software to control and acquire measurements from the potentiostat in real-time.

On other hand, in the OBSEA we have different instruments to monitoring the environment. Therefore, we can use these instruments to observe, compere and correlate the evolution off the electrodes under test with different parameters such as temperature, pressure, salinity and

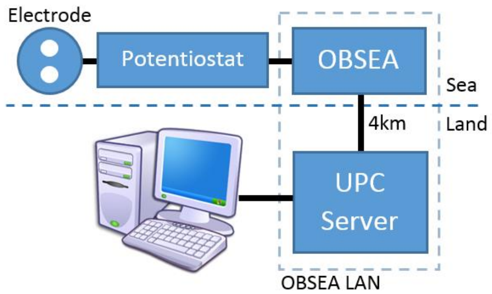
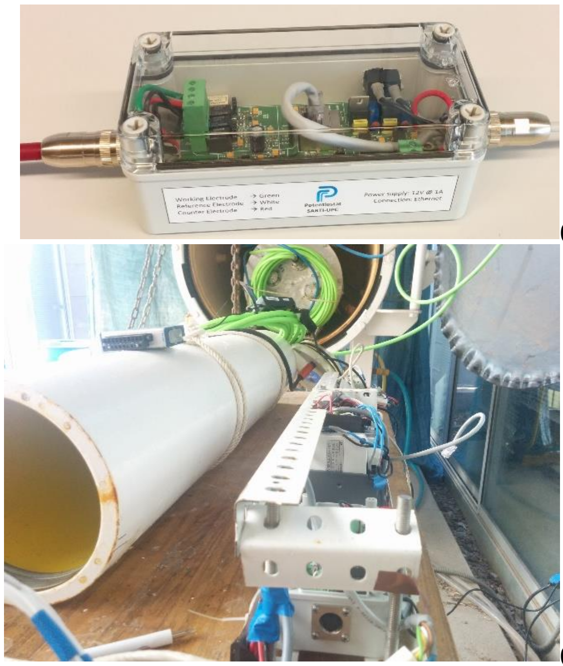


Fig. 1. It shows the block diagram of potentiostat system connected to the OBSEA LAN.

currents. Also we can observe the degradation and the effect of biofouling thanks to an underwater web cam connected permanently to the observatory (see chapter IV).

Figure 2 (A) shows the potentiostat device in his standard box. This box is not waterproof and is only designed to work in a laboratory. Otherwise, figure 2 (B)



(A)

(B)

Fig. 2. (A) Potentiostat with standard box. (B) It shows the potentiostat with waterproof cylinder and a hyperbaric chamber for tests.

shows a specific cylinder with a capability to support depths down to 200m where the potentiostat have been introduce to deploy it in the OBSEA. Also, in this picture the hyperbaric chamber and others electronics components to perform both pressure and communication final tests are shown.

III. ELECTRODES

In this first deployment we used a three electrodes cell made with two identical stain steel electrodes (as counter and working) with 0.3cm^2 and one platinum electrode (as reference). Figure 3 shows these electrodes, picture (A) is the cell for laboratory purposes and picture (B) is the cell designed to deploy it with the potentiostat in the OBSEA.

IV. POTENTIOSTAT DEPLOYMENT

The OBSEA underwater observatory (www.obsea.es) is connected with 4 km of cable to the coast of *Vilanova i la Geltrú* (Barcelona, Spain) and placed at a depth of 20 meters.

Figure 4 shows the first deployment of the potentiostat in the OBSEA. In the center of the picture is an artificial biotope on the top is the observatory and on the bottom is the potentiostat connected with a yellow cable.

V. SEA TESTS

First's tests have been carried out whit potentiostat in the OBSEA. In these tests we carried out measurements of noise, acquiring the voltage and the current between counter and working electrode.

During first test have been obtained 90 days of information. These data has compared with the information of the environment (temperature, salinity, etc.). Figure 5 (A) shows one of these comparisons, in this case between current and temperature during the test. Figure 5 (B) shows a consecutive images of the electrodes cell obtained with the web cam of the OBSEA. These images will help to correlate the electric information obtained with some biofouling or others oceanographic phenomena.

VI. CONCLUSIONS

These initial tests demonstrate the good behavior of the potentiostat system designed and his capability to do electrochemical measurements in-situ for a long period of time. In future work, we will carried out more long term studies with this new instrument.

(A) (B)

Fig. 3. (A) Three Electrode Cell. (B) Three Electrode Cell with waterproof enclosure.

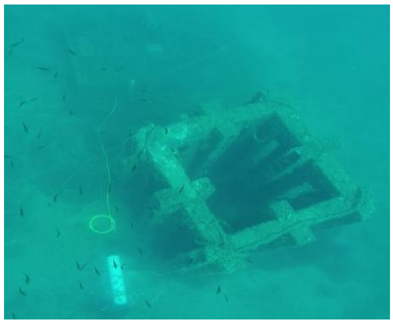


Fig. 4. Potentiostat deployment in the OBSEA.

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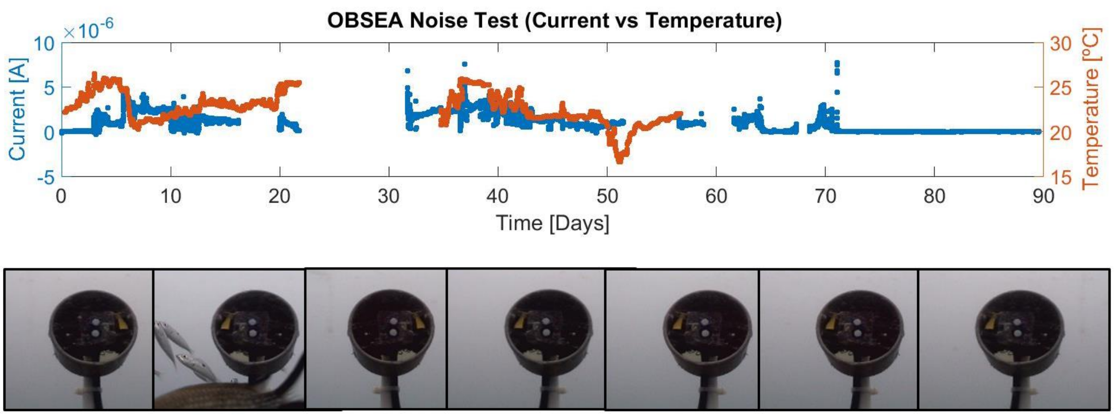

Fig. 5. (A) It shows a comparison between current of working electrode with the temperature of the water. (B) It shows a consecutive images of the electrodes cell (7 minutes between images)

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