SIBEO: Use of wave energy for coastal management.

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INTRODUCTION

As it is widely known, the use of renewable energy sources is increasing as part of man's efforts to preserve and protect the environment that surrounds us. The development of a Seawater Pumping System by means of Wave Energy (SIBEO1) is an example of these efforts. This system was recently developed by researchers from the Institute of Marine Sciences and Limnology of UNAM, Mexico (Czitrom et al., 1993).

SIBEO is able to transport seawater from the coastal zone to inner reservoirs with restricted circulation, at a rate of 85-350 l/s. Referring to Figure 1, the wave induced pressure signal at the mouth of the suction tube produces an oscillatory flow which spills water in the compression chamber with each passing wave. As the spilt water cannot return to the suction tube due to the height of the tube in the compression chamber, it descends by gravity to the receiving body of water. Through mathematical modeling and wave tank tests with models at the University of Delaware (Czitrom, 1997), the authors have confirmed the effectiveness of an electronic chip to synchronize the oscillations of the equipment and the waves, so that operation is more efficient in a resonant state. (Czitrom, et al., 1996).

A prototype of this system (1:7 scale) has already been successfully tested at the Lagartero Lagoon, located on the Mexican South Pacific, demonstrating the method is economically feasible.

According to calculations carried out by Dr. Czitrom’s research staff, the installation of the pump to activate the communication between inner waters and the adjacent sea, costs only a fraction of the cost of channel dredging, without causing serious impacts to the marine environment. The effect of dredging brings accumulated material to the water column during long time periods. Besides, it is a temporal solution because the dredged channels usually close after a few years. In the coast of Cuba, this phenomenon has a double connotation because it not only affects the inner waters, but also exposes the extensive keys and coral reef areas to serious dangers (Lapointe, et al., 1992). These reefs contour large parts of the adjacent insular shelf and sustain a great biodiversity that is also important as a tourist attraction.

1SIBEO is an acronym for the spanish Sistema de Bombeo por Energía de Oleaje
Main applications of SIBEO:

1. Cleaning of some coastal lagoons with a restricted communication to the sea. Depending on the available wave energy and the inner volume, the pump’s flow can be enough to considerably reduce the residence time of the receiving water body, thus achieving its recovery. In Tiburón and Loma del Puerto lagoons, located on the north of Coco Key, Ciego de Ávila, Cuba, the SIBEO can be used to replace the total of their aquifer capacity in only 156 days.

2. Management of fisheries and salt production. The system has no mobile parts so that it allows larvae of commercial species such as shrimp to be transported to the inner reservoir, as well as a controlled quantity of salt water. So, the SIBEO also allows the use of isolated lagoon systems as breeding grounds of species or for salt production, carrying out certain regulations in the variation of salt concentration (Czitrom and Penié, 2000). For example, with the use of this system, the production of the white shrimp *Litopenneus vannamei* in Lagartero Lagoon can be doubled to around 5,355 Kg dry weight a year (Penié *et al.*, 2000).

3. In aquaculture as well as in the production of salt, pumping by electricity or oil represents a high percentage of the operating costs. The proposed system can substitute or supplement the necessary pumping using wave energy, considerably lowering costs.

The first steps have recently begun, through bilateral collaboration programs, to implement SIBEO in Cuba. The primary objective is to mitigate the stress on many coastal lagoons of the Sabana-Camagüey Archipelago, which are isolated from the open sea. The SIBEO pump is also being considered for the primary seawater intake at three salt production coastal centers in southeastern Cuba.

Likewise, the installation of a SIBEO is planned for flushing out the Port of Ensenada, in the north of México, for environmental recovery. The port has been severely polluted by anthropogenic action, because of its very restricted water circulation. The pumping of oxygen-rich cool surf-water into the port will not only provide a flushing action but will also stimulate bottom ventilation and biogeochemical processes (Czitrom, 2000). Funds are also being sought to begin a shrimp culture project at Lagartero Lagoon using the SIBEO.

In recent years, coastal ecosystems have been subjected to intense tourist and economic development. In addition, global and local climate changes, as well as the overpopulation around many of these areas have increased the stress exerted on them. It is important in the future to protect, manage and develop with sustainability the great biological diversity of coastal ecosystems using clean energy with measures such as that proposed.

BIBLIOGRAPHY


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