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A Study on a Wave and Wind Energy Hybrid Conversion System -- Part I: Output Characteristics of a Wave Energy Convertor Using a Ball Screw

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ABSTRACT

In this paper, the authors propose a new type of wave and wind energy hybrid conversion system in order to obtain enough power to run both the navigational aids and the meteorological observations. The system is composed of a rectangular solid floating body, one or two ball screw type wave energy convertors hung from the floating body and a windmill installed on the floating body. A small-scale experimental model was made and its output characteristics were measured using a wave tank. The experimental results were compared with the calculated ones. Although the improved Savonius rotor seems to be suitable for the windmill, we will reserve the discussion about the windmill for another occasion.

KEY WORDS : Wave Energy, Wind Energy, Hybrid Energy Conversion System, Wave Power Generator, Windmill

INTRODUCTION

Many commercially available wave power buoys which are designed to provide power to the navigational lights on the sea are used in many countries around the world. They are oscillating water column type wave power devices using the Wells turbines. The output power of this type of wave conversion system is not sufficient enough to provide power to both the navigational aids such as the lights and the horns and the meteorological observations. It is rational to utilize wind energy as well as wave energy to obtain more power on the sea.

In this paper, the authors propose a new type of wave and wind energy hybrid conversion system in order to obtain enough power to run both the navigational aids and the meteorological observations. The hybrid conversion system is composed of a rectangular solid floating body, one or two ball screw type wave energy convertors hung from the floating body and a windmill installed on the floating body. The improved Savonius rotor seems to be suitable for the windmill. However, we will reserve the discussion about the output characteristics of the windmill for another occasion.

In this paper, the output characteristics of the wave energy convertor are calculated and the optimum values of the braking coefficient of the generator and the moment of inertia of the gear are discussed numerically. A small-scale experimental model was made, and tank tests were carried out using a wave tank of 8 m long, 0.8 m wide and 1.6 m high. The experimental results are compared with the calculated results, and the validity of the calculation is substantiated.

CONSTRUCTION OF THE HYBRID CONVERSION SYSTEM

Fig.1 shows the construction of the wave and wind energy hybrid conversion system which we propose in this report. The hybrid conversion system is composed of a rectangular solid floating body, one or two ball screw type wave power buoys hung from the floating body and a windmill installed on the floating body. The double type which uses two wave power buoys utilizes both the heaving and pitching motions of the floating body, whereas the single type which uses a one-wave power buoy utilizes only the heaving motion of the floating body.

Fig.2 shows the construction of the wave power buoy. The wave power buoy consists of a cylindrical pipe, a ball screw, a one-way clutch, gears, a generator and a weight. The ball screw is