

Design of an Onshore Wave Energy Converter Device for Electricity Generation

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Abstract: Demand for renewable energy is growing faster due to its cleaner nature. Sri Lanka is blessed with renewable energy sources and, currently renewable electricity is mainly produced from hydro power, Solar and Wind. Since, Sri Lanka is surrounded by sea; it has huge Sea Wave energy potential and can be harnessed in the future. Wave Energy Converters (WEC) are the devices, which are used to produce electricity using sea wave energy. Wider range of WEC prototypes have been presented worldwide. However, most of the technologies are still at research level because they are expensive and practically challenging. Oscillating Water Column type WEC are matured technology and installed in few places but, they require very high initial investment and big in size because a huge air chamber in the device.

This paper contains description and the laboratory results of a scale model of a new shoreline Wave energy Converter. It has many advantages such easy to build, less maintains is required and moving parts (DC generator) are isolated from sea water. Where the proposed device contains three major parts those are single acting pneumatic pump, Air storage tank and a turbine coupled with DC generator. Sea Wave is used to drive the single acting cylinder which will pump the air into the storage tank. Then the air is used to rotate the turbine. Finally the DC generator will produce electricity.

This prototype device could generate 15W peak power across 25 ohm load when the air storage tank pressure is 3.2 bars. It can produce huge power when we scale up the device. Also, proposed device can be used to harness wave energy by installing at onshore. Future works can be done to analyse the proper mooring system.

Keywords: Renewable Energy, Sea wave energy, Wave Energy Converters, Scale model device Onshore device

1. Introduction

Nowadays demand for renewable energy sources for electricity generation is very high for many industrialized countries to meet increased demand and to reduce CO₂ emission further renewable energy sources are clean, safe and sustainable sources [1]. Ocean has several forms of renewable energy resources such as waves, tides, currents, temperature gradients, and salinity gradients. Especially wave energy is concentrated energy source compared to other renewables [2]. Capacity of wave power is comparable with other major energy sources like nuclear or hydroelectric because estimated available wave power resources globally is more than 1 TW, and possible production of energy annually is 2000 TWh [2].

There are various wave energy conversion concepts, and the research history of wave energy conversion is more than 200 years. More than 1500 wave energy device patents have been registered. The first wave energy patent was registered in 1799 by Girard in France. But the first application of wave energy device was built around 1910 by Bochaux-Praceique to light and power his house in France [3]. The research on wave energy were accelerated between 1970's to

1990 because of oil crisis and environmental consideration. Then again Kyoto protocol on CO₂ and oil crisis 2007 forced the world to move towards the renewable energy sources [3].

This paper illustrates about harnessing wave on shoreline. In section 1.1, background of wave energy and the available wave energy converters are discussed. Working principle of newly developed device and, design parameters are discussed in section 2. Section 3 discusses about results and observations obtained at laboratory.

1.1 Literature Review

There are several advantages of using the wave energy technology. Wave energy shows high power density; solar energy generates wind which drives the wave energy. Solar energy intensity is typically 0.1-0.3 kW/m² in horizontal surface at the same time intensity of wave energy is 2 to 3 kW/m² in vertical plane which is perpendicular to the direction of propagation of the wave [4]. Only a limited amount of environmental pollution happens, because the emission from these kinds of devices has low potential impact on nature. Waves can move large distance with minimum level of energy loss. Another important aspect is wave devices