STUDY ON GENERATION OF ELECTRICITY USING RENEWABLE SOURCE

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Abstract: Recently, Electrical power generation from oceanic waves is becoming very popular as it is prospective, predictable and highly available compared to other conventional renewable energy resources. In this paper, we have included two basic types using which we can generate electricity with the help of ocean waves. Firstly, the float and secondly the turbine part, including the construction and working principle, explained explicity. The extensive literature survey and reports show that there is a huge potential for oceanic wave energy. Therefore, it is a highly prospective branch of renewable energy, which would play a significant role in the future.

Keywords: oceanic wave energy; wave energy converter; wave energy device; generator.

1.INTRODUCTION

Wave Energy is a non-polluting and Renewable source of Energy, created by natural transfer of wind energy above the oceans, which itself is created by the effects of the Sun solar energy. As the wind blows across the ocean surface, moving air particles transfer their energy to the water molecules that they touch. As the wind continues to blow more and more its K.E is transferred to the ocean surface and the waves grow bigger. These larger waves are called gravity waves because their potential energy in the waves generated by the wind to the point were large storm waves can lift ships high out of the water.

The consumption of electrical power is growing rapidly all over the world due to the increase of human population and technological development. Thus, it is necessary to enhance the capacity of electrical power generation to meet the global demand. The electrical power generation system is mainly based on conventional fossil fuels (natural gas, coal, petrolem, etc) that are gradually dimishing and causing environmental issues such as sea level rise, flood, storms, cyclones, etc.

2.Ocean Waves Energy

Waves can be formed through the presence of many forces that acts on the ocean surface. The gravitational forces like the one that acts between the Earth, the Moon and the Sun and the geological forces that produce sub sea earthquakes that can generate tsunamis are some of the forces that act on the formation of ocean waves. But the most common and known form of waves are the ones that are derivative of the solar energy.

When the sun heats the earth surface it generates zones with different pressures that produce winds. As those winds blows over the ocean surface the friction that is created between the wind and the water forms the waves. The increase on the speed of the winds cause that the waves increase on height and mass much faster that in depth.

The size of the waves will depend on three (3) factors:
• Strength of the winds
• Amount of time that the winds blow
• The distance (fetch) over which it blows

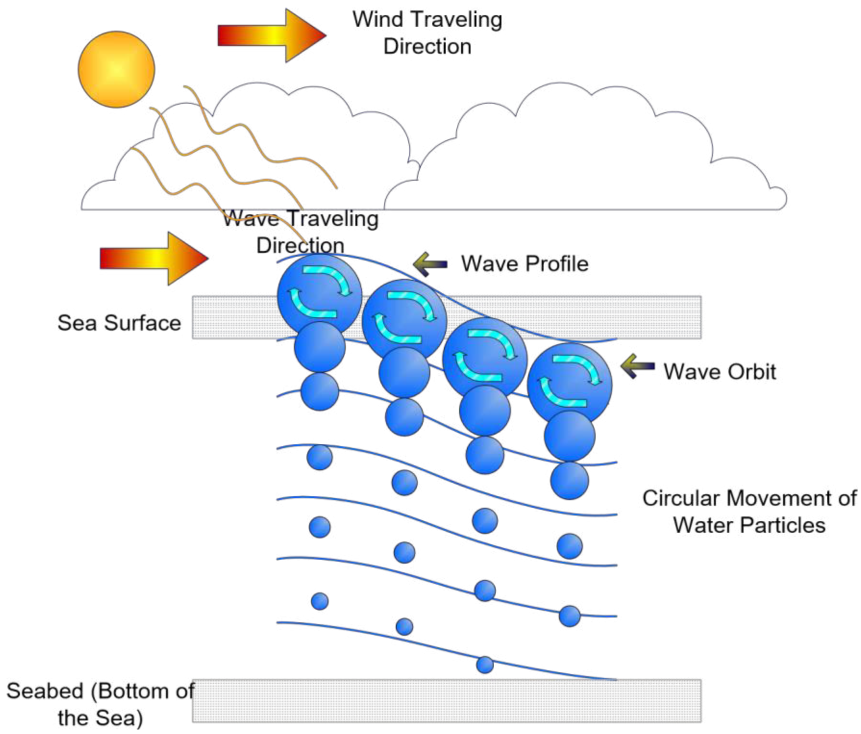

Fig. Water particle Movements in a Wave

3. Classification of Wave Energy Devices

Wave energy converter (WEC) and wave energy device (WED) almost stand for each other. Usually, WED means a physical structure which mainly receives the mechanical power from the oceanic wave and drives it in a specific direction. This is because of facilitating electrical generators to produce electricity. On the other hand, WEC generally means a converter used in wave energy conversion system. Irregular mechanical energy obtained from the wave is first converted into regular mechanical motion. The motion could be rotational or linear/translational. Rotational motion usually drives a turbine, which further drives rotating electrical generator. On the other hand, translational motion drives a linear electrical generator. The WED is required to materialize the principle of wave energy conversion. In this section, some non-identical wave energy devices are discussed. WED is classified into many different types, which are based on operational concept such as oscillating water column. It could be on basis of location of the WED that can be situated nearshore or onshore, or based on vertical position it can be fixed, floating, or submerged, and the other point of view is orientation.

There are different types of WEDs, and it can be classified based on the site they are mounted. However, in most cases, there are three areas for which wave energy converters are represented, as shown in Figure where the average and exploitable amount are expressed in percentage of the maximum wave power. Onshore implies shoreline regions in which the water depth is 10–15 m and the maximum wave height has the ability to reach up to 7.8 m, as the wave trough would be about to touch the sea bed. Nearshore has intermediate water regions, and the water level can reach up to 15–25 m. According to the water depth, it can be classified as deep water, intermediate water, and shallow water.

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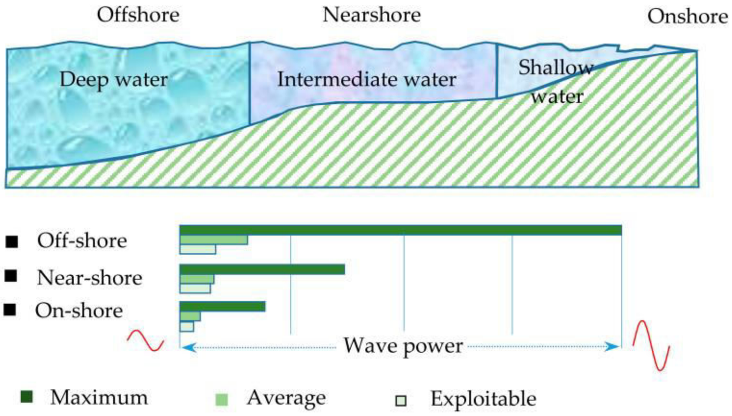

Fig. Position of the wave energy converter system in the ocean.

Offshore is in deep-water zone, and the water depth is higher than 50 m, and the wave height can reach up to 30 m or even more. Wave power devices are less dense in onshore and nearshore areas than offshore as wave energy loses its power density when approaching the coastal area, as stated in Figure. Thus, building offshore devices are much easier than building onshore and nearshore devices. Because, it is very challenging to construct any large structure in the intermediate and shallow water regions due to violent wave breaking. In addition, these are the regions where the waves almost touch the sea bottom.

4.Wave Energy to Electricity Conversion

There have been several wave energy conversion devices developments over the past years. The developments can be divided in four principal groups: the oscillating water column, the attenuators, the overtopping and the point absorbers. These devices are on the state of development and test and companies have plans on building small power plants in different countries especially on Europe.

4.1 FACTS OF OWE: Among RESs, the energy conversion from OWE, which is performed by converting mechanical wave energy into the electrical from of energy is considered as being able to generate more than 1000-10,000 GW electrical power, which could greatly contribute to the increasing demand of electrical power in daily life.

The wave energy density of oceanic wave has a range of 50-100 kw/m, depending on whether it is shoreline, nearshore or offshore. The availability of OWE is nearly 3-4 times higher than that of the traditional RESs. In addition, it is predictable has the highest energy density among other RESs.

At the end of the 18th century, generation of electricity from oceanic waves was introduced but OWE conversion started receiving attention in many countries in 1973 due to the oil crises. The ocean covers around 70.8% of Earth's surface. OWE is considered one of the best alternative to be the primary source of electricity. This paper addresses almost all the key facts regarding wave energy conversion methods including rotating machinery and linear electrical generator which are operated by electromagnetic induction. Moreover, section illustrates control technologies of the OWE converters.

4.2 Trapping wave energy

To capture the waves various devices are used such as float and turbine. It captures the movements of the waves and tides and convert it into potentional energy. A floating structure is created with a float whose shaft is connected to a generator which is then connected to the suspended load. The suspended load helps this float to gain its original position once it do the up down movement. We have used the float system to utilize energy of Tidal wave. Due to waves, the float will move in up and down direction which is then connected to the shaft of generator. The generated energy will then be converted using converter.

Next is the turbine part, here we are using Turbine which is connected to another generator using speedometer cables. Both the Turbines rotate due to waves and is then converter to electricity using Generator

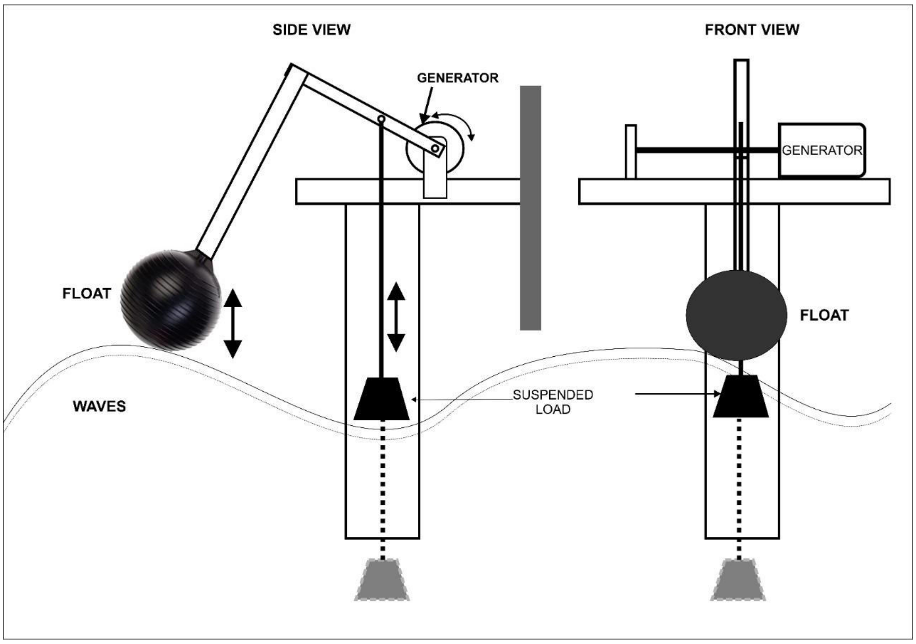

Fig. Arrangement of Prototype

As aforesaid the float move in response to the shape of the incident wave or, for submersible devices, it movies up and down under the influence of the variations in underwater pressure as a wave moves by. The generated energy will then be converted using converter. The next half of the flow chart shown below states the utilization of underwater the turbine will rotate and it is converted to the rotational generator which is kept above in vertical direction and it will generate energy. Both the output are combined and derived from system.

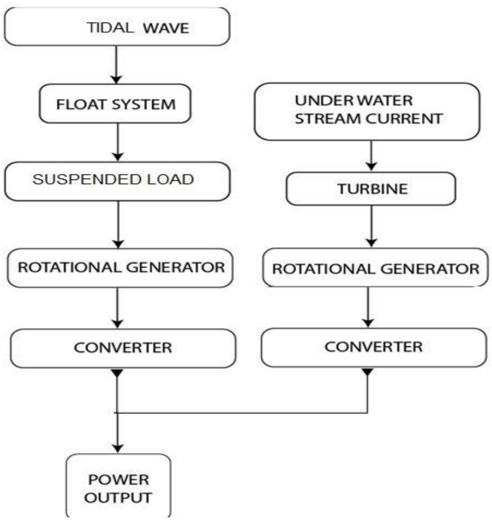

Fig: Flow Chart of Float Based Ocean Wave Energy

5. ENERGY CALCULATIONS

Various turbine designs have varying efficiencies and therefore varying power output. If the efficiency of the turbine "Ǐ" is known the equation below can be used to determine the power output of a turbine.

The energy available from these kinetic systems can be expressed as:

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$$P = \frac{\xi \rho A V^3}{2}$$

Where:

Ĭ = the turbine efficiency *P* = the power generated (in watts)

ŏ = the density of the water (seawater is 1025 kg/m³)

A = the sweep area of the turbine (in m²)

V = the velocity of the flow

Relative to an open turbine in free stream, depending on the geometry of the shroud shrouded turbines are capable of as much as 3 to 4 times the power of the same turbine rotor in open flow.

6. EXAMPLE CALCULATIONS OF OCEAN WAVE POWER GENERATION

Calculates the power of a water turbine from size, water flow speed and water density.

The radius is the length of a rotor blade. The flow speed refers to one point in time, not to an average speed. Water density, which is the mass of water per space, depends on air pressure. 1.2 is a good average value at sea level. The efficiency factor tells, which part of the water blowing through the area spanned by the rotor blades is converted into electric energy. The theoretic maximum for the efficiency factor is 16/27, respectively 59.26 %.

The formula for the electric power is $P = \pi/2 * r^2 * v^3 * \rho * \eta$,

One watt is calculated as

$1 W = 1 kg * m^2 / s^3$.

P = m x g x Hnet x η

Where:

P = power, measured in Watts (W).

m = mass flow rate in kg/s (numerically the same as the flow rate in litres/second because of 1 litre of water weighs 1 kg)

g = the gravitational constant, which is 9.81m/s2

Hnet = the net head. This is the gross head physically measured at the site, less any head losses.

To keep things simple head losses can be assumed to be 10%, so

Hnet=Hgross x 0.9

η = the product of all of the component efficiencies, which are normally the turbine, drive system and generator.

For a typical small hydro system the turbine efficiency would be 85%, drive efficiency 95% and generator efficiency 93%, so the overall system efficiency would be:

0.85 x 0.95 x 0.93 = 0.751 i.e. 75.1%

Therefore, if a relatively low gross head of 2.5 metres, and a turbine that could take a maximum flow rate of 3 m3/s, the maximum power output of the system would be:

First convert the gross head into the net head by multiplying it by 0.9, so:

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Hnet = Hgross x 0.9 = 2.5 x 0.9 = 2.25 m

Then convert the flow rate in m3/s into litres/second by multiplying it by 1000, so:

3 m3/s = 3,000 litres per second

Remember that 1 litre of water weighs 1 kg, so m is the same numerically as the flow rate in litres/second, in this case 3,000 kg/s.

Now to calculate the hydropower power:

Power (W) = m x g x Hnet x η

= 3,000 x 9.81 x 2.25 x 0.751

= 49,729 W

= 49.7 kW

Two main instruments are used to trap the energy from waves i.e float and turbine

1) A float is placed vertically, parallel to the wave direction. The waves cause this float to move in up and down motion and is then connected to the shaft of one generator.

2)Similarly we have used a turbine. The waves drive the turbine and the turbine a generator. Because the direction of water flow changes the plates of the turbine, that is a bio directional water turbine is used.

3)A proper structure is created at the bottom to prevent the whole structure from sinking.

9.CONCLUSION

Tidal wave power generation is a kind of renewable energy with large potential. It has many advantages over solar and wind energy. For example, the availability of tidal energy is highly predictable and not subject to the impact of weather condition. The energy density of tides is also higher than solar and wind energy. However, the high demand in technology and capital investment has hindered the development of tidal energy so that the tidal energy projects are much less than those of solar and wind energy. With the development of innovative tidal turbine system and coastal infrastructure, the popularization of tidal energy worldwide can be expected.

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