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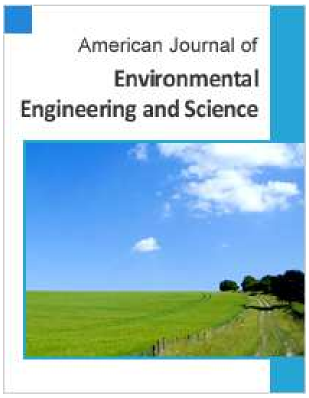

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A Device to Harness the Power of the Tides and Waves off Every Coast

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Abstract

There are three basic ways to tap the ocean for its energy. We can use the ocean's waves, we can use the ocean's high and low tides, or we can use temperature differences in the water. Using the temperature of water to make energy actually dates back to 1881 when a French Engineer by the name of Jacques D'Arsonval first thought of ocean thermal energy conversion.[1,2] The tidal wave energy can be harnessed by using a device based on Seebeck Effect. It was discovered by a German Physicist Thomas Johann Seebeck who discovered the phenomena of thermoelectric effect in the year1821. The conversion of the temperature difference between two non-similar electrical conductors or semiconductors directly into electric potential is known as thermoelectric effect. When these conductors with a difference in potential are brought in contact using an electrical connection, it results in the flow of charged particles that generate a current. The reverse case is also applicable where an application of potential difference to the two dissimilar electrical conductors will give rise to a difference in temperature at their junction. The feasibility of large scale power plants based on thermoelectric effects and increasing the power factor by designing thermoelectric composites has been studied thoroughly by Liu Liping of Rutgers University in 2014 [3]. In this paper, we will be explaining the method of collecting the charges by storing the charges with the help of capacitors and later on use these charges as current for running various devices.

1. Introduction

Solar energy warms the surface of the world’s oceans. Nearly 71% of our Earth’s surface is covered by water. The temperature of water near the surface can be much warmer than the temperature of water deep in the oceans. The difference in temperature at different depths is referred to as a temperature gradient. If temperature gradients are large enough, they can be used to generate power using ocean thermal energy conversion power plants (OTEC). Differences in temperature between warm surface water and cooler deep water can be over 20° C (40° F) .There are other methods to derive electricity from the ocean waves and tides [Fig.1]

For example, the Pelamis wave energy converter.The feasibility of a large-scale power plants based on thermoelectric effects have been systematically explored by Liu Liping of Rutgers University in 2014[3]. One can generate power from water when it moves from a higher potential energy state to a lower potential energy state. A sinusoidal waveform results from its high crests and trough formations, when water is in the form of ocean waves. The amplitude of this sinusoidal wave depends on the weather conditions. Small amplitude will result during calm sea conditions and large amplitudes will result during hurricanes, cyclones etc. Any change in potential energy can be usefully harnessed for deriving electrical energy, in our case. The motion of the wave can be converted into electrical charges and used to store this energy for an immediate or a future use. Typical average wave power along a coastal line has been estimated to be around 25 Megawatts per kilometer. The efficiency of power production using charge separation method is expected to be 20% and therefore an equivalent of 200 Km of coastal line is required to generate 1000MW of electrical energy. The areas around the globe where coastal lines are prevalent include the Indian Ocean, South China Sea, Arabian Sea, Caribbean Sea, Gulf of Mexico, Atlantic Ocean and Pacific Ocean. The world potential renewable energy map given below gives an idea of high potential area for tidal resources that we can possibly obtain from various places [Fig.2].

Figure 1. *Ocean waves and Tides.*

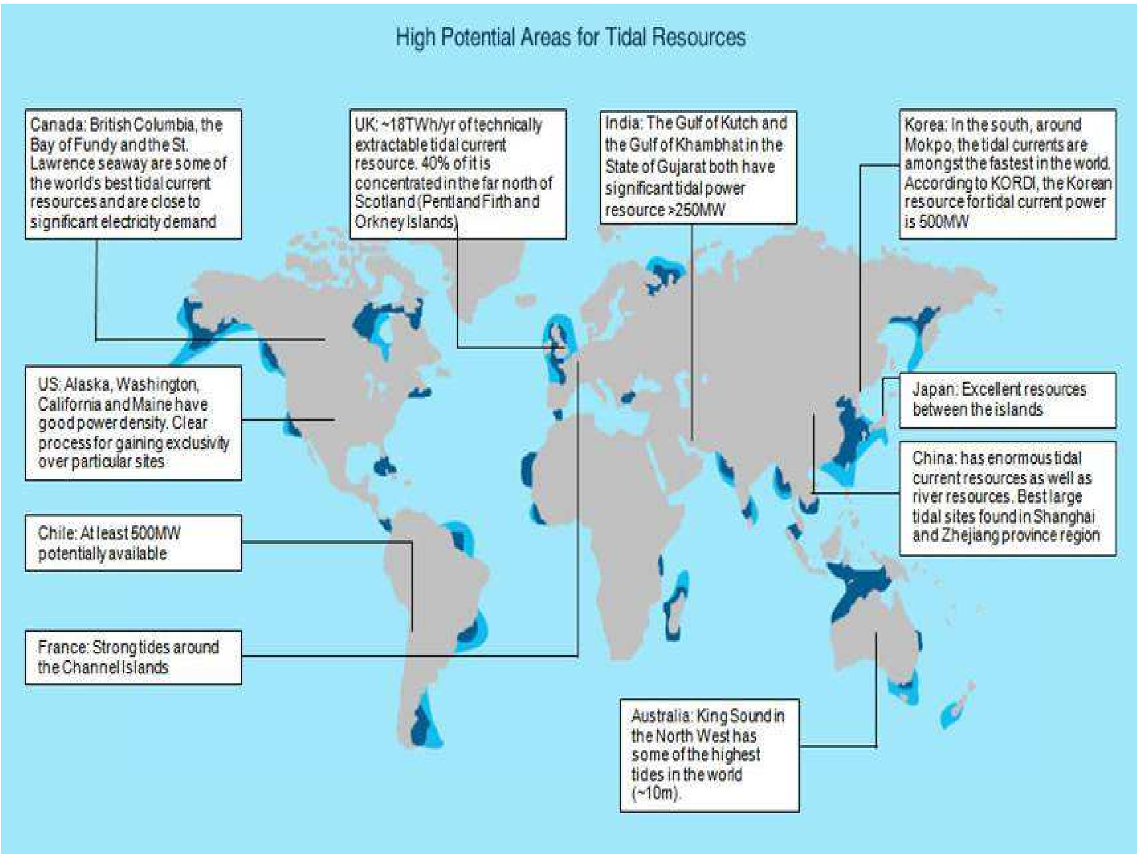

Figure 2. *Tidal Resources from places around the world.*

In India, OTEC has been adopted to turn the solar energy trapped by the ocean into renewable energy. OTEC has a potential installed capacity of 1, 80,000 MW in India.

2. Methodology

A thermocouple can produce current to drive some processes directly, without the need for extra circuitry and power sources. For example, the power from a thermocouple can activate a valve when a temperature difference arises. The electrical energy generated by a thermocouple is converted from the heat which must be supplied to the hot side to maintain the electric potential. A continuous transfer of heat is necessary because the current flowing through the thermocouple tends to cause the hot side to cool down and the cold side to heat up (the Peltier effect).In our method we first define the working of a thermocouple generating two types of electrical charges, namely the positive charge (+) and the negative charge (-) using the Seebeck effect associated with generation of thermoelectricity. The thermoelectric effect is the direct conversion of temperature differences to electric voltage and vice versa. A thermoelectric device creates voltage when there is a different temperature on each side. Conversely, when a voltage is applied to it, it creates a temperature difference. At the atomic scale, an applied temperature gradient causes charge carriers in the material to diffuse from the hot side to the cold side [Fig 3].

Seebeck Effect 'couple' showing one set of *n* and *p* type semiconductors using bismuth telluride material.

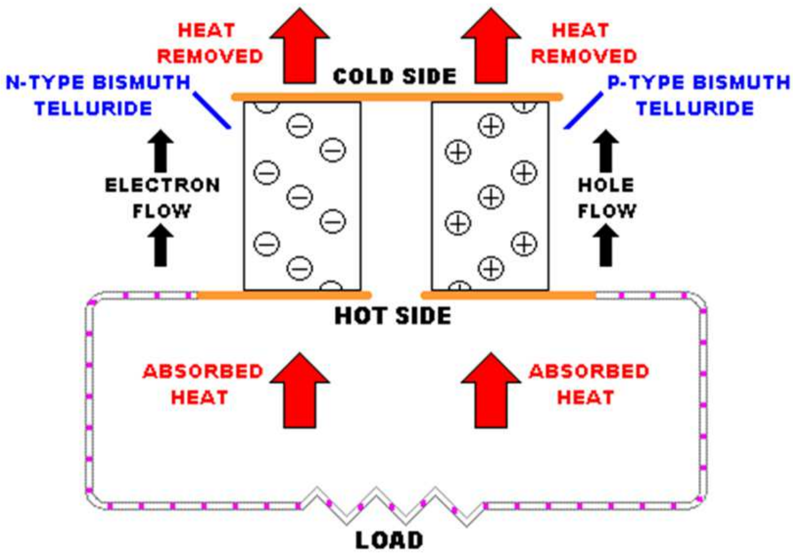

Figure 3. *Thermoelectric Effect.*

This effect can be used to generate electricity, measure temperature or change the temperature of objects. The term "thermoelectric effect" encompasses three separately identified effects: the Seebeck effect, Peltier effect. and Thomson effect. We intend to use a thermocouple to measure the temperature difference between two regions, namely, surface of the sea or an ocean and another place at least ten feet below the sea or ocean water level where the temperature differences are expected to be around 20° C (40° F). Both the probe leads are guided with the help of a wires covered by PVC insulation except at the contact points, from a depth of ten feet for the lower temperature detecting probe, and the other higher temperature detection probe kept at the surface of the sea or an ocean surface level to capacitor parallel plates and stored there as electric charges. Depending on the requirement and the collection of charges accumulated, one can derive electricity almost instantaneously from this arrangement of multiple capacitors kept in parallel.

3. Applications

Energy harvesting devices converting ambient energy into electrical energy have attracted much interest in both the military and commercial sectors. Some systems convert motion, such as that of ocean waves, into electricity to be used by oceanographic monitoring sensors for autonomous operation. Current interest in low power energy harvesting is for independent sensor networks. In these applications an energy harvesting scheme puts power stored into a capacitor then boosted / regulated to a second storage capacitor or battery for the use in the microprocessor. [Ref 7-10].

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