A Review on Tidal Power Plants

A.Navya[1], J.Sree Naga Chaitanya[2], Dr .K. Chandramouli[3]

[1]B. Tech student Department of civil Engineering, NRI Institute of Technology, Perecherla, Guntur, AP, India.
[2]Assistant professor of civil Engineering, NRI Institute of Technology, Perecherla, Guntur, AP, India.
[3]Professor and HOD of civil Engineering, NRI Institute of Technology, Perecherla, Guntur, AP, India.

Abstract: The phenomenon of rise and fall in the ocean waters, called tides, is due to the attractive forces between the celestial bodies; Sun, Earth and the Moon. With progress in technology, the usage of electric and electronic devices is exponentially increasing and there is a need to produce extra power, in order to meet the future demands. Tidal energy can be considered as one of the best existing source of renewable energies. Tidal energy is clean and not depleting. Because of these features it is unique and suitable to use it as a power generating source in the future. There are various types of tidal power plants across the world with varying tidal elevation. Also, the method of conversion of tidal energy into electrical energy is site specific. But generally, the method followed for extracting energy from tides is similar to the conventional hydroelectric power plants. In this paper, the tides at some locations across the world and along the Indian coast, tidal power plants across the world, resource allocation of tidal power plants, advantages and of tidal power will be reviewed from the literature.

KEYWORDS: Tides, tidal energy, tidal power.

DOI of the Article: https://doi.org/10.46501/IJMTST0707040

Available online at: http://www.ijmtst.com/vol7issue07.html

As per UGC guidelines an electronic bar code is provided to seure your paper

To Cite this Article: A.Navya; J.Sree Naga Chaitanya; Dr .K. Chandramouli. A Review on Tidal Power Plants. *International Journal for Modern Trends in Science and Technology* 2021, *7*, 0707079, pp. 241-245. https://doi.org/10.46501/IJMTST0707040

Article Info. Received: 14 June 2021; Accepted: 12 July 2021; Published: 21 July 2021

INTRODUCTION

Many forms of marine energy are being explored as potential sources of energy extraction. Some of them are Ocean Current Energy, Tidal Energy, Wave Energy, Offshore Wind Energy and Thermal Energy. Although tidal energy is still an immature concept, it is certainly the main reason for power generation from renewable sources in the near future.

The occurrence of tides was witnessed from Roman times and this energy was used on rivers such as the delta of the Tigris, the Tibet River in Rome and Euphrates River seven much earlier. The flow of water in the form of tides, induced due to the relative positions of the planets Sun-Earth-Moon can surely be considered a some of their liable sources of energy if suitable systems are designed with an economic plan.

Tides:

Tides are the periodic motion of the waters of the sea due to the inter-attractive forces between the celestial bodies. Tides are very long period waves that move through the oceans in response to the forces exerted by the moon and sun. Tides originate in the oceans and progress toward the appear as the regular rise and fall of the sea surface. The difference in height between the high tide and the low tide is called the tidal range. Tide is the vertical rise and fall of the water and tidal current is the horizontal flow. In simple words, the tide rises and falls, the tidal current floods the principal of tidal forces are generated by the Moon and Sun. The Moon is the main tide-generating body. Due to its greater distance, the Sun's effect is only 46 percent of the Moon's.

Energy from the tides:

There are three types of tides: diurnal, semidiurnal and mixed. Tidal Energy is one of the new and evolving technologies, which is commercially not viable and still in Research & Development (R&D) stage. Tidal energy is unlimited and can be considered as a renewable energy source (Shaikh and Shaikh, 2011). It is an advantage because it is less vulnerable to climate change; while the other sources are all vulnerable to the random changes in climate.

METHODS OF TIDAL ENERGY EXTRACTION

* The authors suggest various methods for extracting tidal energy. But the basic principle behind the methods remains the same. However, there are two basic methods to extract energy from the tides.

a. Due to the high tidal range, large amounts of seawater esters are trapped behind barrages and the turbines are rotated using stored water power. Ocean water flows in due to high tidal range are captured behind barrages and the turbines are rotated by utilizing the potential energy of the stored water.

b. The kinetic energy of moving water can be used to extract energy similar to the principle of extraction of wind energy.

Both methods that are mentioned above have been suggested and followed and each has its own advantages and disadvantages.

* The devices that are used in the energy generation vary in size, shape and specifications. ISSC (2006) has classified the devices into three types:

a. Tidal barrages that store tidal flow and generate power through discharge.

b. Tidal fences which block a passage and extract energy in either or both directions of tidal flow.

c. Tidal current devices which are fixed or moored within a tidal stream.

2.1 Tidal barrage

Tidal barrage is a structure generally built across the mouth of the estuary through which the water flows in and out of the basin. The tidal barrage has sluice gate that allows the flow of water in and out of the basin. The water flows in to the bay during high tide and the water is retained by closing the sluice gates at the beginning of low tide. The barrage gates are controlled by knowing the tidal range of the location and operating at right times of the tidal cycle. There are turbines located at the sluice gates which produce electricity when the gates are opened during the low tide. Using this principle, authors have mentioned different ways of extraction of energy like ebb generation, flood generation, ebb and flood generation, pumping, two basin schemes etc. Figure 1 shows the Plan view of a hypothetical tidal barrage. Even though the barrage method has high theoretical efficiency, only one large scale tidal barrage has been constructed at France. The advantage of using barrage to method to generate electricity in comparison with fossil fuels is that it reduces the greenhouse effects, to provide a better environment. La Rance tidal power plant, France is an example for barrage method .On the top of the barrage there is a four-lane highway that cuts

35 km of distance between the towns of Saint Malo and Dinard representing

It is the world's first Tidal power plant opened in 1966. And it is also the second biggest tidal Power plant in world.

Figure 1. A view of La Rance tidal power plant barrage

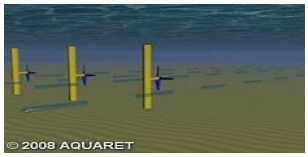
2.2 Tidal energy device

a. Horizontal Axis Tidal Turbines (HATT)

They have a design that can be compared to horizontal axis wind turbines, the difference being that the energy is converted from a water flow instead of an air flow. Importantly, water has about 800 times the density of air. Marine energy is a very powerful resource and so allow-current speed can still be useful. The turbine has to face the currents in order to produce electricity, and that is why a bidirectional turbine design is preferable. It is the most common tidal turbine design. Variations between HATT designs can include the turbine size, number of blades, shape of blades, etc.

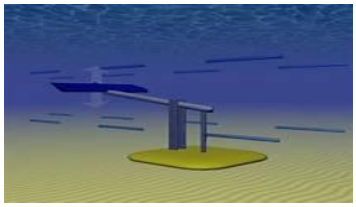
b. Vertical Axis Tidal Turbines (VATT)

They rotate around a vertical axis in the same fashion as vertical axis wind turbines. This device works with currents coming from any direction. It is, with the vertical axis tidal turbine, a popular design.



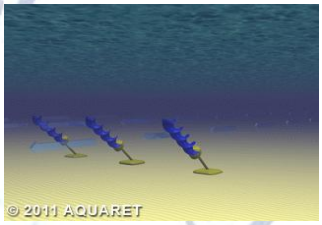
c. Hydrofoil Devices Oscillating

Oscillating hydrofoil devices are housed in a foil attached to the tip of the mobile arm. The currents put pressure on the foil, forcing it to rise and fall in an oscillating motion. Electricity is generated by a hydraulic system.



d. Archimedes Screw devices

Archimedes Screw devices have an helical screw shape that will enter into rotating motion as the water flow (currents) is forced to go up the spiral shaped device.



e. Tidal Kite devices

Tidal Kite devices are tethered winged devices (with a small turbine beneath the wings) that move in an "8"shape with the help of the tidal stream.

II. ADVANTAGES OF TIDAL POWER

Advantages:

1. Has a Great Potential to Generate Clean Power

2. Tidal Power Has High Energy Density

3. Tidal Power Plants Have Relatively Low Maintenance Costs

4. A Tidal Power Station Provides Clean Electricity for a Very Long Period of Time

RECOMMENDED SITES FOR INSTALLATION OF TIDAL POWER PLANT

Couch and Bryden give some basic criteria for identifying sites suitable for the development of tidal energy extraction. Important variables commonly considered are:

1. Native water depth: Existing device technical features are usually limited to 25-45 m operating water depth

2. The location of the nearest exploitable grid connection: For an immature industry, the economics of tidal energy extraction require easy access to a nearby grid connection with spare capacity; otherwise the capital cost cannot be viably recouped across the life of the project.

3. Powerful and sustainable resource: Large average spring and fine tidal speeds are required. Some sites have the added advantage of minimizing the low velocity period of the tidal cycle because local dynamics ensure that the tidal flow is reversed at a faster rate over a slower period. Sites that developers are interested in collecting power have a maximum spring tidal speed of 3+ m / s.

4. This area should not interfere with the normal flow of shipping traffic, as it would interfere with the economic cycle of the area.

5. It is possible to build a barrage that will store the maximum amount of water with minimal construction cost.

WORLD'S BIGGEST TIDAL POWER PLANT

Sihwa Lake Tidal Power Station is the world's largest tidal power installation, with a total power output capacity of 254 MW. It is operated by the Korea Water Resources Corporation. It is located in Sihwa Lake, Gyeonggi province in South Korea. It was opened in August 4, 2011.

CONCLUSION

•The tidal energy industry needs to develop a new generation of efficient, low cost and environmentally friendly device for power extraction from free or minimal head water flow.

•The negative environmental impacts of tidal barrages are probably much smaller than those of other sources of electricity, but are not well understood at this time. It is important to consider the influence of energy extraction while estimating the available energy.

• Concern over the future costs of other power sources and their environmental implications will ultimately determine whether mankind makes extensive use of the moon's gravitational force.

•Yet most of this tidal energy resource is not utilized; however, if effectively extracted using appropriate engineering systems, it can make a major contribution to our future energy needs.

REFERENCES

1. Bahaj AS, Myers LE.(2003), Fundamentals applicable to the utilization of marine current turbines for energy production. Renew Energy;28(14):2205–11.
2. "A Study on E-Highway-Future of Road Transportation" by Dr.K.Chandramouli in International Journal of Engineering and Advanced Technology (IJEAT); ISSN: 2249 – 8958, Volume-8, Issue-2S2, January 2019; SCOPUS INDEXED
3. Binnie, Black & Veatch (2001),The commercial prospects for tidal stream power. Technical report ETSU T/06/00209/REP, Department for Trade and Industry.
4. "A study on Water Bulb-used as a day time light" North Asian International Research Journal of Sciences, Engineering & I.T.; ISSN: 2454-7514; Vol.4, Issue 10; October-2018.
5. Bryden I G, Bullen C, Baine M, Paish O. (1995), Generating electricity from tidal currents in Orkney and Shetland. Underwater echnol ; 21(2).
6. A Review on Programmable Cement" is by Dr.K.Chandramouli on International Journal of Current Advanced Research ISSN: O: 2319-6475, ISSN: P: 2319-6505, Impact Factor: 6.614, Volume 7; Issue 11(C); Page No. 16302-16303; November 2018.
7. Tidal current energy extraction: hydrodynamic resource characteristics, Proc. IMechE Vol. 220 Part M: J. Engineering for the Maritime Environment. Cresswell N.W., Ingram G.L., Dominy R.G., (2015), The impact of diffuser augmentation on a tidal stream turbine, Ocean Engineering, Volume 108, pp 155–163

8. "A Study on Smog Filtering Tower" is published inJournal of Advanced Cement & Concrete Technology Volume 2 Issue 1, HBRP Publication Page 1-5 201
9. ETSU, (1993), Tidal stream energy review. Technical report ETSU-T-05/00155/REP, Harwell Laboratory, Energy Technology Support Unit, DTI.
10. A Study on Transparent Concrete" by Dr.K.Chandramouli in International Journal of Modern Engineering Research (IJMER); ISSN: 2249-6645; Vol. 8, Issue. 12; PP:1-4; December 2019.
11. Frankel PL.(2002), Power from marine currents. Proc Inst Mech Eng, Part A J Power and Energy, 216(A1):1–14.
12. "Study of Importance of Road Network in Rural Economic Sector" Review of Research; ISSN: 2249-894X; Volume- 08, Issue- 1; October-2018