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REVIEW ARTICLE

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RENEWABLE ENERGY BASED POWER GENARATION BY USING OSMASIS TECHNOLOGY IN INDIA

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ABSTRACT

Today the main power generation of India as per the current survey is 330.15GW. In that the power generated by renewable resources are only 30.8% and remaining generation of power 67.1% is from non-renewable resources (fossil fuels). But in future we don't have a chance to use those non-renewable resources so we totally depend on natural resources because it is endless and eco-friendly. Present the natural easily available resources are Water, Wind & Solar but unfortunately we are not properly use that resources because of some special reasons like heavy cost, heavy maintenance & improper losses etc. that's why we generate only 30.8%. Now the entire the world searching for some other natural resources to generate the power easily.

Now researchers are getting closer to being able to harness one of nature's most subtle, and important, phenomena–one that keeps us alive but is virtually ignored, and certainly nothing we would think of as being strong enough to power even a flashlight: osmosis. If water wants to do something, but can't, it creates pressure. And pressure can be used to do work. A new company called Oasys Water, founded on technology developed at Yale University, and the giant Norwegian renewable energy company Statkraft are both taking stabs at harnessing osmosis.

Pressure retarded osmosis (PRO) process is a renewable and green technology with zero carbon emission to the environment. Salinity gradient through a membrane is the key parameter in osmotic pressure development. Theoretically it is a pressure increment of 26 bar which is equivalent to 270 m high water column for fixed volume of salt water compartment. This hydrostatic pressure can be used to generate electricity by sending pressurized water through a turbine. According to the literature, 1 MW electricity generation requires $1m^3/s$ flow of fresh water. The country spends an immense amount of money for the thermal power generation in every year. This can be reduced by introducing PRO power generation. India has a great potential to develop this technology as it is surrounded by sea. Subsequently the country is having large number of water rich river basins over the country. Here total amount of power generation depend on number of river basins.

INTRODUCTION

In search of clean renewable energy, one of the emerging technologies on the horizon is Osmotic Energy. This form of production energy is under development in Europe by Norwegian Company Statkraft since the late 1990s. One of the benefits of developing osmotic power is that it can use of existing hydro power and desalination technology. The intension is to have large scale large scale production from these hydro osmotic power plants. These plants would most likely be placed where fresh water naturally flows into sea. The basic

for this type of energy production is the movement for fresh water into salt water through a semi-permeable membrane which creates pressure which then turns a turbine. The membrane accounts for 50% to 80% of the plant costs and therefore is the subject of majority of research into efficiency. This technology also been scaled down to create electricity in small devices which could benefit of billions of people worldwide who have no electricity.

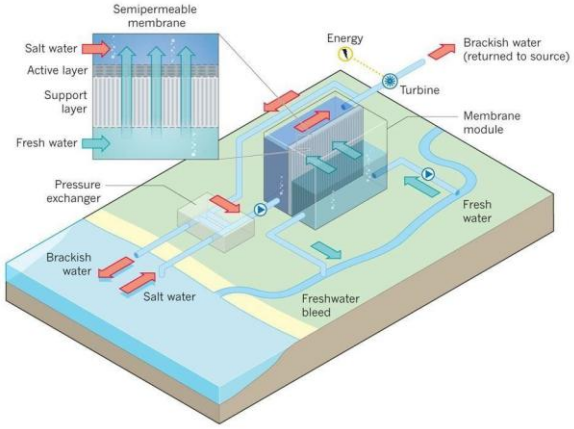

Figure 1. Schematic diagram of a PRO plant run on river water *vs*sea water

Saline water has vast potential energy in the form of osmotic pressure. The challenge in the coming years is to determine the best technique for recovering the osmotic pressure as mechanical or electrical power. Osmotic pressure is unique because it can only be achieved.Contact with lower osmotic pressure water, using semi-permeable membranes dividing the water with different salinities.

Procedure

A. *How Osmotic Energy Works*

For osmotic power plants to work they must be placed in locations with easy access to both fresh water and sea water. These conditions exist where large rivers flow into the ocean. Optimal conditions for this require that there is a limited amount of mixing of the fresh water and salt water in the estuary, this maintains a high salt gradient. There are different ways of turning osmosis into electrical energy but pressure retarded osmosis (PRO) is the most common form of producing power. A PRO plant can be thought of as a desalination plant running in reverse. Desalination plants utilize reverse osmosis (RO) which operates against the osmotic force. PRO plants use the same osmotic force to produce energy.

Osmotic power is produced by separating fresh water and salt water with a semi permeable membrane. The fresh water and seawater must first go through filters to pre-treat the water for better optimization of membrane performance. Natural osmosis causes fresh water to move through the membrane into the saltwater side of the membrane. Membranes must have high water flow and salt retention capabilities, meaning the low salinity water can flow through easily but the high salinity water cannot flow through the membrane. 80% to 90% of the water with low salinity gradient is transferred into the pressurized salt water portion. This movement raises the pressure on the side with the high salinity. The pressure that is created is referred to as osmotic pressure. This pressure and increase in volumetric water flow is then used to spin a turbine which creates the electrical energy.

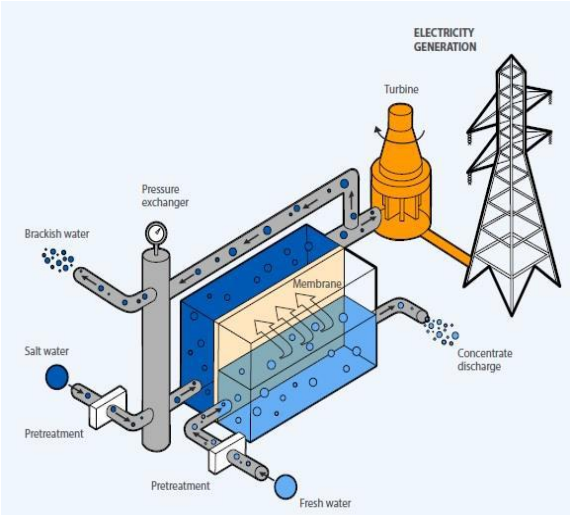

Figure 2 Simplified design of the osmotic power production process.

B. *What is Pressure retarded osmosis*

Pressure Retarded Osmosis (PRO) is a commonly used method for generating electrical energy. Pressure retarded osmosis (PRO) is the salinity gradient energy retrieved from the difference in the salt concentration between seawater and river water. In PRO, the water potential between fresh water and sea water corresponds to a pressure of 26 bars. This pressure is equivalent to a column of water (hydraulic head) 270 meters high. However, the optimal working pressure is only half of this, 11 to 15 bars. In this method, seawater is pumped into a pressure chamber that is at a pressure lower than the difference between the pressures of saline water and fresh water. Freshwater is also pumped

into the pressure chamber through a membrane, which increase both the volume and pressure of the chamber. As the pressure differences are compensated, a turbine is spun creating energy. This method is being specifically studied by a company in Norway called Stat Kraft, which has calculated that up to 25TWh/yr would be available from this process in Norway.

C. *PRO Utilization*

The pressure retarded osmosis power plant is similar to a reverse osmosis desalination plant running backwards. However, the PRO plant generates power from freshwater instead of consuming power. Freshwater is fed into the plant (greyish) and filtered before entering the membrane modules containing spiral wound or hollow fibre Membranes. In the membrane module, 80 – 90 % of the fresh water is transferred by osmosis across the membrane into the pressurized seawater (bluish). The osmotic process increases the volumetric flow of high pressure water and is the key energy transfer in the plant. This requires a membrane that has a high water flux and high salt retention. Typical membrane performance should be in the range of 4 – 6 W/m2. The brackish water (dark blue) from the membrane module is split in two flows. About 1/3 of the water goes to the turbine to generate power. 2/3 return to the pressure exchanger to pressurise the feed of seawater. To optimise the power plant the typical operating pressure is in the range of 11 – 15 bars. This is equivalent to a water head of 100 – 145 metres in a hydropower plant, generating about 1 MW/m^3s freshwater. The freshwater feed operates at ambient pressure. Some pre-treatment of the water is necessary. Experience from Norwegian water treatment plants shows that mechanical filtration down to 50 um in combination with a standard cleaning and maintenance cycle is enough to sustain the membrane performance for 7 – 10 years. Similar lifetime data are assumed for osmotic power plants.

III Membrane Technology

A semi-permeable membrane is an organic filter with extremely small holes. The membrane will only allow small molecules like water to pass through. In an osmotic power plant the semi-permeable membrane is set up with fresh water on one side and salt water on the other. Through the process of osmosis, the fresh water moves through the membrane into the salt water creating an increased pressure on the salt water side. This increased pressure can be used to power a turbine which then creates electricity. There is a theoretical maximum pressure produced from this process of 26 bars, which is the equivalent of a 270 meter high water column. It is estimated that half of the osmotic energy produced can be converted to electrical power.

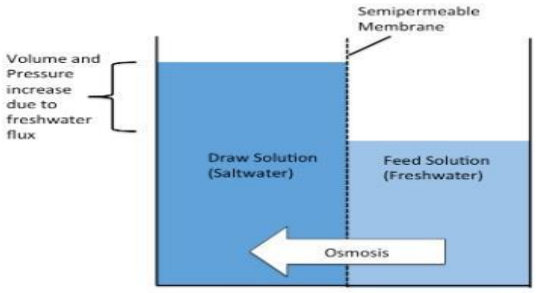

Fig.3 Semi permeable Membrane

The semi permeable membrane in an osmotic power plant consists of one thin non-porous layer, the diffusion skin and at least one layer of porous material which must be designed to avoid salt build up. Water going into the membrane is filtered and with regular cleaning they can last up to 7 years. These membranes are made up of spiral wound or hollow fibres and in an osmotic power plant they are set up in parallel modules.

IV Possible locations

Site selection for osmotic power plants is based on access to both fresh water and salt water with minimal mixing of the two.In India, we have more locations suitable for this project. Especially in South India is more suitable for this Project Like in Andhra Pradesh some many rural areas have Sea and River facilities and Tamil Nadu State also very Suitable for This Project. Osmotic power plants can be designed for installation in a number of coastal sites. A sea level PRO power plant can be designed as a run- of-the-river hydropower plant, as it takes freshwater in from a river outlet. Another is a combined conventional SHP and membrane plant that is buried in appropriate geological sites near the coastline, utilizing gravity for extra pressure. Many other flexible applications are possible.

V Osmotic Power Generation Prototype

Fresh water at sea level flows vertically downward through a penstock. The lower end of the penstock is situated about 90 meters below the sea

surface where the pressure is 9 bars. This pressure forces a turbine to rotate and the pressure drops to 0 bar. Seawater is pumped from the surface to a barrier of semi permeable membranes (an osmotic unit). By osmosis the fresh water is driven through the membranes, trying to even out the amount of dissolved salt in the seawater. The flushing solution is pressurized to 9 bars and is pumped up to the surface. The diluted solution returns to the seawater by the osmotic pressure.

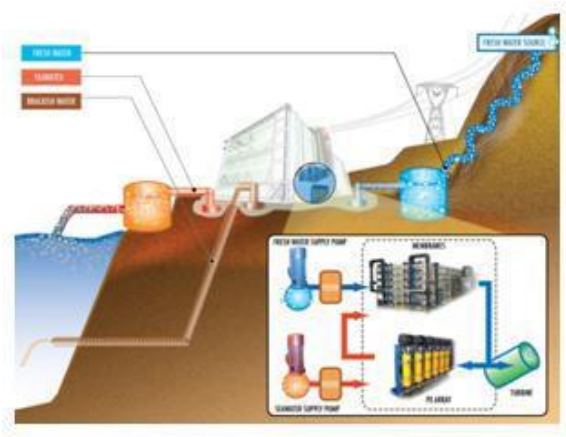

Fig.4 Proto Type Model

The osmotic effect is thus used to force the turbine to move. When the water is pressed out through the membranes due to a sucking effect, a stream appears. It is that stream, created by osmosis that makes the turbine spin. Thus, in neither of these plants osmosis is used for the direct generation of electric power. It is the sucking effect of the flow, which generates electric power. Improving the efficiency of output per square meter of membrane is the main challenge for the prototype.

VI Environmental Impacts

Overall, osmotic power with PRO is claimed to have very limited to non-existent environmental impacts in comparison to current power production methods. This is mainly attributable to emission-free energy production and to the fact that the brackish water discharged from the plant would mimic the natural discharge of a river into the ocean. The water from the river diverted into the plant would not be consumed, but only cycled through the plant. However, as PRO is still an immature technology, it should be recognized that a large research gap persists regarding its actual environmental impacts, and that any application ofPRO on a large scale would require thorough study to quantify the actual impacts on the local receiving environment.

VII. Pron's& Con's

*Pron's:*It produces electricity reliably.

Not expensive to maintain.

Offshore turbines and vertical-axis turbines are not ruinously expensive to build and don't have a large environmental impact.

A plant is expected to be in production for 75 to 100 years

Uses an abundant, inexpensive fuel source (water) to generate power.

Con's:

Pose same threats as large dams, altering the flow of saltwater in and out of estuaries, which Changes the hydrology and salinity and possibly negatively affects the marine mammals that use the estuaries as their habitat.

The average salinity inside the basin decreases, also affecting the ecosystem.

A barrage across an estuary is very expensive to build, and affects a very wide area –the environment is changed for many miles upstream and downstream. Many birds rely on the tide uncovering the mud flats so that they can feed.

Barrage systems require salt resistant parts and lots of maintenance

Effects on marine life during construction phases.

VII Conclusion

The need to reduce greenhouse gas emissions has led to research into alternative energy sources such as osmotic power. Renewable energy produced by osmotic power is available 24 hours a day all year long, unlike wind and solar which has problems with interruptions in power production. There are some major challenges before osmotic energy can become cost competitive with other renewable energies. One of the biggest challenges is the development of efficient and cost effective membranes. Most renewable energies such as wind and solar power started out as being inefficient and not very feasible, but through continued development they were able to become some of the top renewable energies used today.The need of new energy sources has led to a number of alternatives. Some better than others. However in the future if the technology is further developed and the costs will decrease, osmotic energy might be an alternative to the energy sources we use today.

Osmotic energy isnot something we can use in the nearest future. The disadvantages, the obstacles, are too big tobe overcome at the moment.

VIII FUTURE PROSPECTS

The possibility to use the salinity gradient in the ocean for power lies within the technology that needs to be developed. There are currently two hurdles to overcome, which includes the membrane water part and sunlight. If we could develop the membrane to use saltwater as freshwater and brine with a higher salt concentration as the concentrated solution, then it would be more feasible to use salinity for power. Or, the vapour pressure technique could be further developed. However, the biggest hurdle that needs to be overcome is the cost. Salinity power is not economically feasible compared to fossil fuels currently, more effort is being put into developing salt-gradient solar ponds for energy (where osmosis is used). Therefore in the world of salt, there is more potential in using salt from the solar ponds as opposed from the ocean.

The salt percentage will be much higher, which will increase the osmotic head pressure andmore energy can be extracted. In Future Power Demand is increased rapidly but with current

Sources like renewable and non-renewable are not fulfil that demand so we have to search for available endless sources, Osmosis Power Generation is one of the best Renewable Sources itis mainly based on Two Types of Water (Salt & Fresh Water). India has large amount water sources so we have to develop this technology in future, we have to solve the power problem with Eco-Friendly.

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