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ENVIRONMENTALLY FRIENDLY DESALINATION TECHNOLOGY FOR GENERATING POTABLE WATER IN LAKSHADWEEP ISLANDS

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ABSTRACT

Rapid urbanization, population explosion and over exploitation of ground water resources are some of the reasons for the increasing fresh water demand in regions of the country. The mismatch between increasing water demand and decline in water availability due to overexploitation and climate change is a critical resource issue for policy makers. Desalination Technologies found to viable alternative to meet the water demand of Coastal and Island communities of India. Desalination, which is the conversion of seawater to potable water through various physical and chemical methods, has emerged as a potential solution to India's and the world's looming water crisis.The most important issue is the cost-effectiveness of the methodology and the type of energy used for desalination and sustainability of plant.

Some of the most common conventional desalination technologies are Reverse Osmosis, Multistage Flashing and Multi Effect Distillation. In Reverse Osmosis (RO) system the water from a highly concentrated region is transferred to a region of low pressure by applying pressure. A semi-permeable membrane having pore diameter from 0.5 nm to 1.5 nm separates the two sections. The technology has the limitations in terms of Pre-treatment of water to protect membranes, higher pumping power proportional to feed pressure, Bio-fouling of membranes, Frequent change of expensive membranes and other maintenance/requirements and Environmental impact of the discharged water.Similarly, Multistage Flashing and Multi Effect Distillation plants are economical for higher capacity desalination plants especially when warm water above 60^oC can be produced using waste heat from power plants. However, in the Indian context there are very few plants that work with these technologies since the ultimate cost of desalination would naturally include the cost of the waste heat that is used to take the water to the required inlet temperature. The generation and maintenance of vacuum and the problems of scaling are two technical challenges associated with these technologies.

Ministry of Earth Sciences through National Institute of Ocean Technology (NIOT) has initiated research in year 2000 in developing Desalination Technologies using Low Temperature Thermal Desalination (LTTD) process, where naturally available temperature difference in the ocean layers, is used to generate fresh water. The process deals with evaporating the warmer surface sea water at low pressures and condensing the resultant pure vapour using deep sea cold water available at about 400m below sea level. The process is environmentally friendly and easy to maintain since it requires just a few components such as a flash chamber for evaporation, a condenser for liquefying the vapour, sea water pumps, vacuum system, a long pipe to draw cold water from 400m below sea level, marine structures such as sump, plant building and the bridge. The experimental plant set in lab during 2000 was taken to field and the first demonstration plant with a capacity of 1 Lakh litres/day was commissioned in Kavaratti in 2005.The plant is being operated by local islanders since 2006, meeting the drinking water requirements of the 10,000 strong local communities for over six years. Studies conducted by a team of doctors have shown an improvement in the public health with a drastic drop in the water borne diseases.

The institute has continued its efforts in islands in UT Lakshadweep and two of such plants in Minicoy and Agatti were operational.The desalination plant at Minicoy, southernmost island of Lakshadweep was inaugurated by Minister for Earth Sciences and Science and Technology on 22nd April, 2011. The operational plants at Minicoy and Agatti Islands are shown in Fig. 2. Similar such plants will be established in 6 more islands (Andoth, Amini, Kadamat, Kalpeni, Chetlat and Kiltan) of Lakshadweep through induratial partner and preparatory works were already completed.

CHALLENGES IN THE BUILDING THE PLANTS

The construction of marine structures that can withstand all-weather conditions prevalent in the remote islands was the most challengingpart of the project. The 400 tonne sump that houses the sea water pumps is initially cast inside the island lagoon, pushed into the water, floated and towed about 10 km to the eastern side of the island, as shown in Fig. 3, for its final installation at the site. The construction of piers of the bridge that connects the sump to the shore was daunting considering the fact that the piers in the breaker area witness the constant wave action at 10-15 second period, as shown in Fig. 3.

The 700m long HDPE pipe that draws the cold water from 400m below the sea level is brought to the island in 12m pieces, welded in the lagoon and towed by about 10 km to reach the site and then deployed to connect one end to the sump and leave other end at about 400m depth. The pipe is designed to withstand the prevalent all-weather conditions. The design of process equipment is optimized tofacilitate the ease in construction, transportation and erection in remote islands,while meeting the project requirements such as minimal power usage to cut down the running costs, compatibility for sea water use and containment of the total project cost.

CONCLUDING REMARKS

LTTD is very new with significant scope for cost reduction as the technology matures. The technology deals with the use of just three sets of major pumps for its 24 hr operation, facilitating its successful maintenance by local help in a remote location with minimal reliance on the mainland technical capabilities. The process involves about 1% conversion resulting in no problems of brine disposal and hence makes it environmentally friendly. The discharge cold water that is let out at about 17^{o}C is rich in nutrients and attracts a variety of fish. This results in spin offs like air conditioning for land based plants and mariculture due to the high nutrient content in the deep sea cold water. Considering the projected demand for drinking water in the near future, it is worthwhile to promote a clean technology like low temperature thermal desalination using ocean thermal gradient.

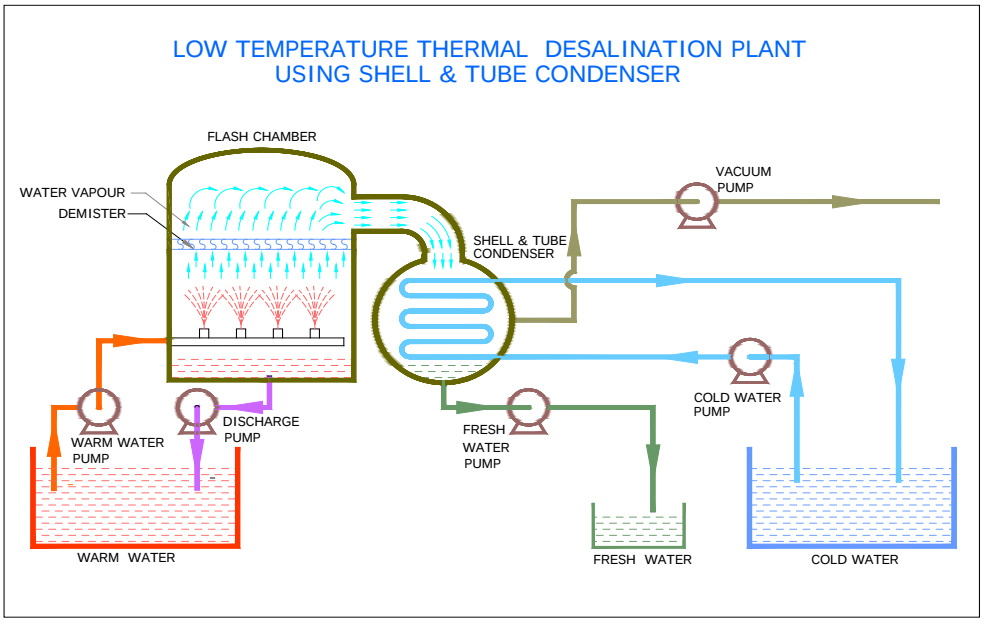
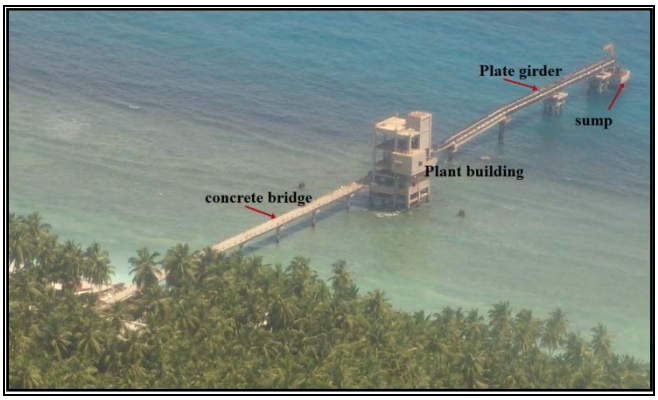


Fig. 1 Schematic Diagram of LTTD working principle

Minicoy



Agatti

Fig. 2 An aerial view of Minicoy and Agatti Desalination Plants

Fig. 3Views of Sump during its Tow (left) andWave activity in the Breaker Area (right)