Proceedings of The Eighth (2009) ISOPE Ocean Mining Symposium
Chennai, India, September 20-24, 2009

ISBN 978-1-880653-75-3; ISSN 1946-0066

Low Temperature Thermal Desalination Plants

Phanikumar V S Sistla, Venkatesan G., Purnima Jalihal, Kathiroli S.
National Institute of Ocean Technology
Chennai, India

ABSTRACT

Low Temperature Thermal Desalination (LTTD) process utilizes the temperature gradient between two water bodies to evaporate the warmer water at low pressures and condense the resultant fresh using the colder water to obtain high quality fresh water. National Institute of Ocean Technology (NIOT) has been working extensively on LTTD process since 2004. A land based 100m^3/day capacity desalination plant was established in 2005 in Kavaratti Island, 400 km off the west coast of India, to demonstrate the utility of the process for the islands. An experimental floating barge mounted 1000m^3/day desalination plant was established in 2007, about 40km off Chennai coast to demonstrate the utility of the process for the mainland applications. Another land based 150m^3/day capacity desalination plant is established in 2009 in North Chennai Thermal Power Station (NCTPS) to demonstrate the utility of the process for any coastal thermal power plant that discharges huge amounts of condenser reject water into the near by sea.

The paper discusses the salient features of these plants. Apart from the potable water, the process can also provide the intangible benefits, like aqua culture if used in the context of the ocean thermal gradient and reduction of thermal pollution if used in the context of power plant discharge. A review of various aspects of the process is also presented in the paper.

KEY WORDS: low temperature thermal desalination; risers; off-shore structures.

INTRODUCTION

Thermal gradient between different layers of the ocean water column provides huge reservoirs of warm and cold water that can effectively be utilized for power generation, desalination and air-conditioning. The deep ocean cold water is rich in nutrients and is highly beneficial for aquaculture. Many attempts were made in the past to produce energy and fresh water using ocean temperature difference. The part of this technology that deals with desalination is known as 'Thermocline Driven Desalination' or 'Low Temperature Thermal Desalination' (LTTD). The available thermal gradient between warmer surface water and colder deep seawater is utilized by flash evaporating the warm water at low temperatures and condensing the resultant vapour with cold water.

Sea water desalination is attaining increasing attention of present day policy makers, especially with the growing demands that urbanization, population explosion, irregular rainfall and ground water contamination place on the fragile natural resources. LTTD is one process that uses the availability of a temperature gradient between two water bodies to obtain fresh water. While ocean, with its temperature variation across its depth presents one such scenario of two water bodies, a coastal based thermal power plant discharging huge amounts of condenser reject water into the nearby ocean represents an alternate scenario. The simplicity of the LTTD process also enables to control the quality of product water in order to provide either good quality drinking water or boiler make-up water as the situation warrants. Kathiroli et. al (2008) showed that the concept of LTTD used in the context of a Barge Mounted Offshore Plant provides a clean and environmentally friendly way to obtain fresh drinking water at a competitive price.

National Institute of Ocean Technology (NIOT), India, has embarked on a program to implement a cost effective desalination technology that utilizes ocean thermal gradient to produce desalinated water. NIOT has successfully demonstrated the process with three desalination plants, a 100 m^3/day land based desalination plant at Kavaratti, India, meant for islands, a 1000 m^3/day barge mounted desalination plant 40 km off Chennai coast meant for mainland usage and a 150m^3/day Coastal Thermal Power Station based LTTD plant working with heat available from the power plant condenser reject water.

The main components that are required for LTTD plant are the evaporation chamber, the condenser, pumps and pipelines to draw warm and cold water, and a vacuum pump to maintain the plant at sub-atmospheric pressures. A schematic of the process is shown in Fig. 1. One of the advantages of the process is that it can be implemented even with a low temperature gradient of about 8-10^{o}C between the two water bodies. Even though flash distillation is a commonly used desalination process worldwide and especially in Middle East, very few of the established plants work with the temperature gradient as low as 8^{o}C that exists in the NCTPS (Rognoni et. al 2008). More over the concept of single stage flashing and condensation that the LTTD process