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Investigation of solar collector for developping dewvaporation system in Bali

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Abstract. Solar thermal energy source in the tropical zone have an availability more than the others zones in the world. Utilization of this source energy in indonesia is lower than another sources of energy even though domestic or indutrial processes. Indonesia have large maritime region and many archipelago, so desalination become main issues in remote and seaboard area. Dewvaporation system is one of methods for desalination process of sea water. This method use energy thermal and carrier gas for separation salts component in sea water. Evaporation chamber of dewvaporation system need thermal energy source for gain temperature of carrier gas. In this project, vacuum tube solar collector technology has been investigated for integration on dewvaporation system. Thermal energy that is collected from solar radiation and it is utilized to gained energy in evaporation chamber of dewvaporation system. Active direct water flow system of the solar collector been measured their capability for collected of solar thermal energy. After 5 days of testing, rate of water temperature output is 56ºC and rate of thermal energy outputs is 456 watts/m^2 **.**Water flows in the tube of solar collector is 1,4 bar. This project results meets requirements for integration solar collector in the dewvaporation system.
Keywords: solar, thermal, energy, dewvaporation

INTRODUCTION

Sea water desalination process grows rapidly to increase energy efficiency and capacity for pure water production. Utilization of solar thermal energy also increase for gain their efisiencies . The prospect of developing the salt industry in production of brine solution is another factor that will have economic impacts. The method for development of sea water purification is dewvaporation. Dewvaporation is one method of evaporation of sea water which uses air flowing to the surface of the ocean water that flows so as to bring steam that is formed. Dewvaporation technology will consist of two chambers: evaporation chamber and condensation chamber. The evaporation chamber will produce residual evaporation or sea water with higher salt content (brine), while the condensation will produce destilate or fresh water. Application of solar collector technology is used as additional energy so it increased evaporation process. The rate of the evaporation and condensation processes presented as model thermal energy and also production capacity can be oftimized. Furthermore, it will be integrated with the performance solar collector. Utilization of solar thermal energy provides energy-efficient, an environmentally friendly and renewable energy. Tropical regions can provide benefits in the application of solar thermal energy but its characteristics still need to be investigated so that it can be integrated with dewvaporation system in the process of purification of seawater.

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Desalination technologies have been used increasingly throughout the world to produce the drinking water from the brackish ground and sea water for the past few decades. Among the commercially available desalination technologies, reverse osmosis (RO) and multi-stage flash distillation are the most widely used technologies globally. However, these technologies are difficult to be directly integrated with green energies without converting them to electricity. Dewvaporation, a desalination process, uses saturated steam as a carrier-gas to evaporate water from saline feeds and form pure condensate. It has the major technical benefit of reusing energy, released from vapor condensation, multiple times.

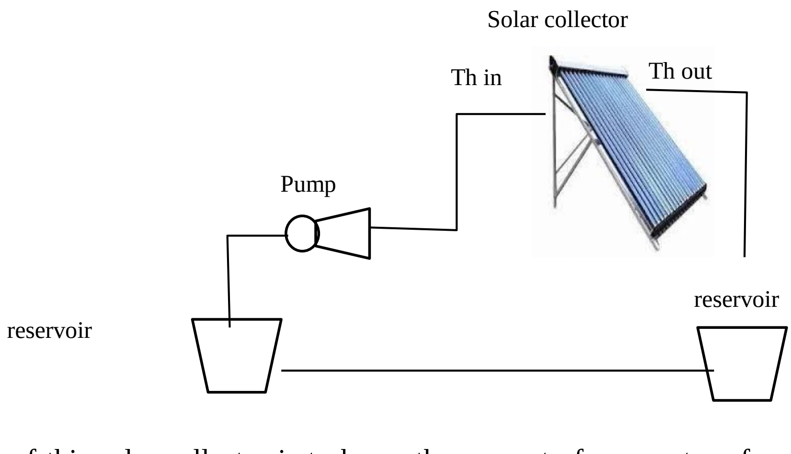
The operation of the Dewvaporation system would not be affected by the mode of heating the process water. The differences expected, on using solar energy, were in attaining steady state. Also the system would be affected due to the irregularity of the solar power. These could be caused by a number of reasons such as clouds obstructing the sunlight or the position of the sun in the sky. Sudden loss of sunlight during operation would affect operating conditions and hence the distillate production

METHODOLOGY

A simple solar collector consists of an absorber material, sometimes having a selective surface, to capture radiation from the sun and transfers this thermal energy to air via conduction heat transfer. This heated air is then ducted to the building space or to the process area where the heated air is used for space heating or process heating needs. Functioning in a similar manner as a conventional forced air furnace, solar-thermal-air systems provide heat by circulating air over an energy collecting surface, absorbing the sun's thermal energy, and ducting air coming in contact with it. Simple and effective collectors can be made for a variety of air conditioning and process applications.

There are basically two types of solar collectors:nonconcentrating or stationary and concentrating. A nonconcentrating collector has the same area for intercepting and for absorbing solar radiation, whereas a sun-tracking concentrating solar collector usually has concave reflecting surfaces to intercept and focus the sun's beam radiation to a smaller receiving area, thereby increasing the radiation flux. A large number of solar collectors are available in the market.

In this project active direct solar collector has developped for integrated to the dewvaporation system. Testing method of the solar collector can be showed in the figure 1.



The test of this solar collector is to know the amount of energy transferred to the fluid flow which is set at a discharge of 10-20 liters / min. The water temperature change measurement tool is using K type thermocouple. The data will be taken in an interval of 30 minutes from 8:00 to 16:00 hours.

Application of solar collector may be necessary to change the location, tilt angle or orientation because of shading, aesthetic reasons, lack of available space, complex roof profile or lack of structural support from the building. However, testing of solar collector will be taken orientation 10^o to the north, because of bali islands located in 10^o south latitude.

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RESULT AND DISCUSSION

Result of testing solar collector will be known the inlet (Th in) and outlet (Th out) temperature of recirculation of water. Active direct flow models in aplication of solar collector can be evaluated for increased of thermal energy of water after circulation in the solar collector. Then, calculation of data will be known number of thermal energy per metre square area of collector.

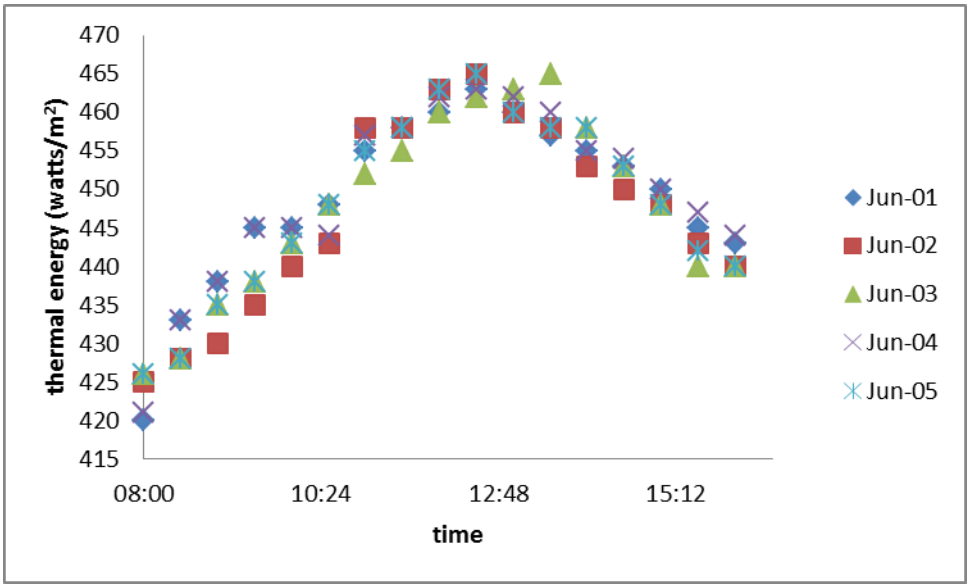

Figure 1 Thermal energy of solar collector

Figure 1 shows that solar thermal energy increased from 08:00 until 01:00 then it will be reduced until 16 00. Climate condition on days of testing is the same relatively. This solar collector can collected energy from the sun maximun 465 watts/m^2. Temperature rate of output hot water is 56^{o}C.

CONCLUSION

Active direct water flow system of the solar collector been measured their capability for collected of solar thermal energy. After 5 days of testing, rate of water temperature output is 56^{o}C and rate of thermal energy outputs is 456 watts/m^2 **.**Water flows in the tube of solar collector is 1,4 bar. This project results meets requirements for integration solar collector in the dewvaporation system.

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