Journal of The Gujarat Research Society

ISSN: 0374-8588
Volume 21 Issue 11, November 2019

A Review to Control and Monitor Solar Ponds

Pavan Kumar Singh
Department of Physics
Teerthanker Mahaveer University, Moradabad, Uttar Pradesh, India

Abstract: Green collectors of electricity are salinity gradient solar ponds. By building a temperature gradient through the depth of the pond, energy is stored. All energy comes from an incident of solar radiation on the surface. The gradient of salinity, maintained and altered with depth, leads to temperature distinctions of up to 60 degrees. The heat produced could be used directly for a number of different purposes, or it can be converted into electricity that can be used in the plant or transported to the grid. The number of variables of the solar pond, i.e. the physical quantities, which are necessary for the proper functioning of this sort of power plant, is primarily controlled locally at the pond sites. Remote acquisition of data (DAQ) and, afterwards, regulation of the output of solar pond energy is more convenient and this is the focus of our study, as stated here. A solar pond control centre could be situated anywhere around the world with the use of wireless or wired networks, virtual private networks and the Internet, whereas the pond sites are chosen at the best solar opportunity locations.

Keywords: Design, Energy, Pond, Power, Solar, Renewable, Alternate energy source, Photo voltaic.

INTRODUCTION

Our research focuses on identifying a system in place that could be used to sustain renewable energy systems focused on solar ponds. The machine will successfully report the values of the parameters of the energy generation plant that we are looking for, as well as use a communication network system in which this information goes freely from the origin of the acquisition to the monitoring and control point. By constructing a temperature differential in the pool of water, the pond is based on the theory of zergy selection. The correct gradient pattern stops heat from escaping the pond from incident solar radiation. This is accomplished by the depth of the pool by rising the degree of salinity [1]. With the bottom layer holding the maximum temperature, the heat is transferred from layer to layer by convection. The weather conditions at the surface of the pond play a primary role in forming the parameters for the successful running of the pond during the year, the dominating variables being temperature, humidity, wind velocity.

The other variables, the in-pond unknowns, can be modified and controlled according to the desired energy collection requirement. The collection of environmental situations is not something that should be within our influence. We can't monitor environmental conditions, but we can also pick the right location for solar ponds nationally. An innovative solar pond was constructed in 1998 at RMIT University and is used by the Conservation and Renewable Energy Division of the School of Engineering. One of the latest sites chosen is Pyramid Hill. A drone, or wireless sensor network (WSN), may be used by a solar pond system to gather data from various depths in the pool and it is connected to the flow control in the pond, but a data acquisition system has to be completely designed for remote monitoring. With the standardisation of the Internet of Things (IoT) project, emerging connectivity patterns allow and improve remote surveillance and control using the technology of computer networks [1].

Solar pond principles of operation and monitoring

Journal of The Gujarat Research Society
ISSN: 0374-8588
Volume 21 Issue 11, November 2019

Experimental solar ponds, such as those in Iran, are primarily used to determine the viability of a site and its power production capacity and are thus smaller. Ponds that have already been deployed have either been established by modelling or research through a university/government project and are considered appropriate for larger-scale implementations. Circular ponds have also been found to have higher performance in collecting energy than square ponds. The general functionality of the pond is defined below, emphasising how various percentages of salinity in the layers are stacked. The pond is primarily composed of three layers: the Upper Convective Zone (UCZ), the Non-Convective Zone (NCZ) and the Energy Storage Region of the Lower Convective Zone (LCZ). The UCZ is nearest to the air above it and immediately in contact with it and is thus at room temperature. The layer under it, which is the NCZ, is what thermally separates the topmost layer and the bottom layer from each other. In this layer, the salt concentration is greater than the layer above it and it is therefore denser. The lower layer, LCZ, has the highest salt content and gradient and the highest temperature [2].

This gradient distribution method does not happen automatically and has to occur systematically. Typically, the device consists of several sensing components to detect physical variables like salinity, temperature, or turbidity, etc., influencing the pond's absorption of solar energy. To be interpreted and then used to monitor the water flow to the tank and/or brine solution, that is used to change the salinity levels in the pond or lake, the values produced from the sensor devices should be translated to a user-friendly format.

In order to understand energy transfer, conduct data acquisition and monitor, researchers at RMIT University have developed a pond on the Bundoora campus. Test studies that are generalised to a broader scale are used to develop the CARE group's competence. The device used by the university consists of a pond in which many different experiments are carried out. Scanning speeds and RMIT pond estimation outcomes for a complete list of all solar pond system variables.

Solar installations worldwide

To highlight the diversity of how the principle expresses itself in diverse contexts, several solar ponds from various parts of the world with different environmental and climatic conditions are briefly treated. The solar pond installed in the arid environment of Jordan is a great match for its site, where studies have found the mathematical modelling behind the plant and the energy storage efficiency gains in the various layers of the pond, respectively the NCZ and the LCZ. With the atmospheric temperature in the atmosphere touching a height of 40°C near the UCZ, temperatures reach elevated values. Desalination is the main function of the reservoir, which is like the one on Pyramid Hill. Neither of the study points to the pond's method of tracking or the precision of the measurements. The Dead Sea region is considered to have high salinity levels and a suitable and economically feasible solution for the area is solar ponds [3].

The El Paso pond in Texas is currently the world's most popular solar pond installation and acts as a benchmark for Salinity Gradient Solar Pond technology (SGSP). Via a scanner that has measurement points along the depth of the reservoir, the DAQ device tests pond-related properties such as temperature, turbidity, density and pH. The collected data is logged from a location nearby using a computer. A sixteen-year research focused specifically on this pond reveals how temperature readings were done twice a day to track the pond and maintain its smooth activity, with other data logged at various frequencies.

The other pond, in Tibet, is unusual in its position because it exists at such a low temperature that the maximum temperature is far below 50 ° C, but the positive temperature differential of 29°C indicates prospective growth and desalination in locations in which the minimal atmospheric temperature is negative throughout winters. A distinguishing characteristic of this pond is that it uses a spectrum of salts mostly from magnesium salts to produce the salinity gradient. A drawback of the study carried out tells us that the period of the course doesn't really produce definitive findings as it only lasted for 105 days and not for the entire year [4].

Due to the size of the project, the system at El Paso is diverse; the sensors operate much better and can record physical amounts in a shorter time period relative to other systems. In this facility, the level of automation is also higher, enabling measurements to be obtained and analysed more rapidly. Nevertheless, the data collected at this plant is only processed locally and analysed at the University of Texas A&M. From a data protection viewpoint, this is positive but restricts potential research into the crop so the real-time data will not be forwarded on to scientists in other countries which might actually boost the results of the plant [5].

In order to examine the influence of the use of various salts in the ponds as a brine solution, scientists in Algeria have developed experimental solar ponds at Annaba University. Using the law of energy efficiency, the heat flow between the pond and the atmosphere has been analysed. The theoretical outcomes were then compared with experimental outcomes with almost zero error levels. Using a thermocouple, the temperature control was conducted at a frequency of three hours. One of the key achievements of this research was the detection, owing to its high conductivity, of the thermal conductivity of salts like sodium carbonate and the use of calcium chloride as a brine solution for new locations [6].

In Turkey, solar ponds with surface areas and just about standardized depths were built in two different charges to research the impact of the quantity of sunny areas in the solar pond region, primarily the LCZ. It is calculated as a percentage of the gross area of the area to the incident of solar radiation. This study makes it possible to model solar ponds with greater precision prior to development, as we researchers go beyond the computational modelling of the pond and it is a very critical feature of every climate. The research could establish a new strategy to thermal efficiencies gathered from ponds in various areas of Turkey by understanding the temperature variation in a region coupled with the cloud cover for various times of the year.

Cyprus researchers have developed a pond by using the dynamics of Computational Fluid to analyse the pond utilizing Ansys as a programme. The goal of this research was to equate the data achieved from the pond with other types of solar harvesting, such as flat plate collectors and panels. As time elapsed and environmental patterns in the region improved, the analysis also revolved around the comparison of salt concentrations at various pond depths. As this model has not been discussed in the past, this model has a fascinating take on solar ponds and therefore no basis for comparison unless taken out under varying conditions [7].

The one in Catalonia is one of the earliest examples of a solar pond. There's a 50 sq m circular pond. The depth of the pond is 3m and NaCl is the salt used. The profile of the pond's density along the depth varies from 1.12g/cm3 to just over 1.2g/cm3. When filling up the pond, which was achieved with the aid of a diffuser, the salt concentration was around 25 percent by weight. It is one of the most productive ways to establish the gradient of salinity related to solar ponds. The use of the Froude number to calculate the inlet flow velocity that is helpful to take into account when planning solar ponds at any location around the world, was an essential part expressed in this study. The Froude number is given as the flow inertia ratio to the field of the

ISSN: 0374-8588
Volume 21 Issue 11, November 2019

external world. Based on monthly averages, the pond reported a peak temperature differential of around 16°C. In the paper, the whole list of sensors used for calculating other parameters is outlined. The analysis discusses the devices used, but does not discuss how the data collected was analyzed and where the UCZ's predominant circumstances were [8].

Solar pond schemes may be contrasted to other systems of storage of green resources that may or may not require solar energy. Usually, each device has its own specific features, but can include the calculation of equivalent physical quantities that may need to be distributed and evaluated away from the source. The server client process over a TCP/IP protocol is one such device that uses data transfer and processing that has been researched. This research is a general study of renewable energy sources used for energy generation, which is commendable since the effects of renewable energy sensors can be seen in a user-friendly format using only a Java applet on the client computer. The programme is also written in Java for the device which preserves the readings. Even so, this article doesn't go to the details of how exact the readings are or the plethora of implementations that may be added, but simply discusses them.

Solar ponds site selection and infrastructure considerations

The location of solar ponds, in the best places chosen for solar activities during the year, is primarily in remote areas with limited access to utilities. This is the case for the location in Leitchville, in metropolitan Victoria, along the border with NSW. The key power infrastructure and wired telecommunications are not available. Wireless networking coverage is steadily improving every year, because of that. With a 2Mbps speed of up to 75Mbps, the city has 4G coverage. Given the specifications of the communication channel for the transmission of all solar pond data, as has been provided and including live video of the pond, site and atmosphere, we can see that communication infrastructure is currently not a problem in the selection of a new solar pond site. Telstra 4GX provides two times higher speed compared to the normal 4G in the Leitchville selected site. It is focused on the 700MHz band of Telstra and delivers higher rates of data transmission. Also 4G was more than capable of satisfying our connectivity criteria for the tracking and control of solar ponds that were mentioned in paragraph 1 of this article, i.e. around 24 Mbytes of data for the entire year. Other service providers often serve the same regions, meaning that the telephone system at the chosen site is not a limiting factor. We may use data collection concentrators of various kinds, such as wireless or wired National Instruments, wired Thermo Fisher DataTakers or others, locally attached to a PC in the process of data acquisition. We might still use the new technologies and imbedded networking features like the Internet of Things. Using terrestrial wireless contact from the PC or PC on the local area network (LAN) at the pond site the Internet is open to all. Eventually, for security purposes, we use the Virtual Private Network (VPN) over the Internet.

CONCLUSION

We also discussed the fundamental operating process of solar ponds in this article, and also introducing some of the locations where they are run across the globe. We also clarified the methods of data monitoring and control used on these pages. We have eventually evaluated solar and maintenance specifications for the location of the proposed solar ponds. Data gathered with multiple sensors using DAQ is packed in the required data form, provided here. It can be easily processed locally and transmitted via a protected Internet link to the remote monitoring and control centre, i.e. Uh. VPN. We also incorporated the availability and specifications of communication systems. There are no limitations on the placement of solar ponds and power systems anywhere around the world at this level of the data transmission and data storage networks and facilities. The power grid that may be lacking is not a concern, since we are working with green power generation plants.

REFERENCES

[1] M. Elbanhawi and M. Simic, "Robotics application in remote data acquisition and control for solar ponds," 2013, doi: 10.4028/www.scientific.net/AMM.253-255.705.

[2] E. Elsarrag, O. N. Igobo, Y. Alhorr, and P. A. Davies, "Solar pond powered liquid desiccant evaporative cooling," *Renewable and Sustainable Energy Reviews*. 2016, doi: 10.1016/j.rser.2015.12.053.

[3] E. Busquets, V. Kumar, J. Motta, R. Chacon, and H. Lu, "Thermal analysis and measurement of a solar pond prototype to study the non-convective zone salt gradient stability," *Solar Energy*, 2012, doi: 10.1016/j.solener.2012.01.029.

[4] Z. Nie, L. Bu, M. Zheng, and W. Huang, "Experimental study of natural brine solar ponds in Tibet," *Solar Energy*, 2011, doi: 10.1016/j.solener.2011.04.011.

[5] V. V. Tyagi, S. C. Kaushik, and S. K. Tyagi, "Advancement in solar photovoltaic/thermal (PV/T) hybrid collector technology," *Renewable and Sustainable Energy Reviews*. 2012, doi: 10.1016/j.rser.2011.12.013.

[6] P. M. Slegers, M. B. Lösing, R. H. Wijffels, G. van Straten, and A. J. B. van Boxtel, "Scenario evaluation of open pond microalgae production," *Algal Research*, 2013, doi: 10.1016/j.algal.2013.05.001.

[7] "THE IMPORTANCE OF RENEWABLE ENERGY SOURCES IN TURKEY," *International Journal of Economics and Finance Studies*, 2010.

[8] C. Valderrama *et al.*, "Solar energy storage by salinity gradient solar pond: Pilot plant construction and gradient control," *Desalination*, 2011, doi: 10.1016/j.desal.2011.06.035.