

Evolution of Solar Powered Water Pumping System

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ABSTRACT: Agriculture is one of the basic process which accounts for the sustainability of human kind. So scientific advancement in agriculture accounts directly for the economic and overall development of nation. Adaption of better irrigation methods will help in increasing the agricultural productivity. Solar water pumping was an important development in the area of irrigation. There are places where irrigation can't be dependent on electricity or other existing viable methods. In such circumstances Solar Water Pumping is an excellent alternative.

KEYWORDS: Solar Water Pumping, Solar Energy

I. INTRODUCTION

In this 21st century the value of renewable energy resource is increasing day by day because the quantity of available non-renewable energy resources such as coal, petroleum, natural gas etc. are decreasing and the end result will be a blackout for this world. The solution is by understanding the use and importance of the renewable energy resources. Non-renewable energy resources are only available finite in this earth surface but renewable energy resources are infinite. The most important form of energy now the world required is electricity, it is just produced due to the presence of charged particles but the world can't imagine a day without this energy. The production of this can be done by various means, it depends on the raw materials and economic background of each area. As a developing country like India, electricity can be developed by using water, nuclear, thermal and by using renewable energy resources. The use of renewable energy resources begin from the ancient period itself but the scientific studies carried out in the mid of 19th century.

Renewable energy resources are not able to be depleted and various types of resources available include hydroelectric power wind power solar power biomass and geothermal resources are being effectively utilized by some people. In hydroelectric projects water is stored in higher elevation and when water moving to a lower elevation it is used to turn a turbine and generate electricity. Wind power work with the changes in the atmospheric thus by turning a turbine and converting it into electricity and in solar power the sun's rays are transformed into electricity through photovoltaic cells. The most efficient and abundant renewable energy resource is solar energy. The sun shines three trillion watts of energy every day on earth and that is enough for entire world to power homes for about one year. For the utilization of this solar energy scientists developed the solar panels which is a group of cells arranged in series or parallel. These panels will receive the sun's rays and convert it into electricity for various utility purposes.

II. HISTORY OF APPLICATION OF SOLAR ENERGY

Solar energy was very important from the ancient period of history, for Greek and Egyptians Sun is like their god because for them the solar energy power is the oxygen for this world. Now a days everyone see this solar power is a new power developed within recent years, but the truth is human beings is harnessing the power of sun for just hundreds or thousands of years. In the seventh century BC men use magnifying glasses for concentrating the sun's rays

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to makes fire, later in the third century BC Greek environment began to use mirrors to light torches for village purposes and they made a new history that they use solar energy power for domestic purposes, war and for religious purposes. The new milestone is they use this energy as a mass destruction weapon, on the Roman attack to Greek. The Greek scientist Archimedes used highly polished medal sheets as mirrors to focus the sunrays to fire the roman ships, later the army developed it very efficiently and it was a great success for them. In the time period between the first and fourth century AD the large scale utilization of this solar energy is carried out by Egyptians, they use solar energy for heating up their homes. They designed and built their homes that they can store the suns heat during the day and released at night. These building techniques not only kept their homes warm at night but also help to regulate a cooler temperature on rooms on sunny days. In the sixteenth century AD Leonardo Da Vinci sketched concentrating collectors that would track sun and focus sunlight on to the central receiver and he use this in buildings for collecting energy. French scientist Edmond Becquerel discovers the photovoltaic effect while experimenting with in the electrolytic cell and he got a conclusion that production of electricity increased while it is exposed to light. This development was a new path for the scientists, thus French scientist Auguste Mouchout invented the first active solar model during the industrial revolution and he developed a steam engine powered entirely by sun but it is of high cost.

On later studies and experiments done for the development of solar panels increased and they introduced large cone shaped collectors that could receive solar power and by this that could boil ammonia for locomotion and refrigeration. Willoughby Smith discovered the photoconductivity of Selenium and William Grylls Adams find out that Selenium produce electricity when exposed to light. Thus Selenium Solar cells are developed for converting sunlight to electrical energy.

Solar powered water pumping is an important development for the entire world because till now there are places with limited or no access to electricity and large areas of world are located on rural areas where only water supply comes from the rain or distant rivers. The best example for this condition is the north part of Brazil. In these places the unavailability of electric power rules out the pumping and water treatment through conventional systems. The best and most efficient method for resolving this problem is the use of systems supplied by photovoltaic solar energy.

III. COMPARISON OF SOLAR WATER PUMPING WITH DIESEL PUMPING

In rural areas where adequate electrical power is not available for water pumping, in such places agriculture is fully depend on hand pumps or water from distant rivers. At that time the best solution is Water Pumping using Solar energy and this pumping can also be done using the diesel powered motors. The differences between these two systems are, by considering the cost and efficiency the capital cost for diesel powered motors are low but the running cost and maintenance is high. For solar water pumping the capital cost is very high but the running cost and maintenance is low.

For solar water pumping it requires high initial investment and the system requires proper maintenance because the panels should be cleaned properly. The maintenance can be done by local workman and this system completely ecofriendly. For diesel motors the investment is low at initial stage but it becomes costlier on running and it requires proper lay man for maintenance and working. The diesel powered system is hazardousness to environment and there are chances for fire. The diesel powered system requires high storage area. By considering all these factors the best method for water pumping in isolated areas is solar water pumping.

IV. WORKING OF SOLAR WATER PUMPING SYSTEM

The working of solar based water pumping system is, an array of solar power absorbing panels are connected in series or parallel. The array of solar panels generates the power and voltage required for the motor to work through a driver circuit. Normally DC motors are used for solar water pumping because no conversion is required for this and it is very simple in connection The MPPT algorithm of solar drive extracts maximum power available from the solar panels during the day time and it also helps the motor to operate at variable speed based on the power input to the drive. The type of pump configuration will change according to the source of water, it can be either submersible, surface mount or floating.

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Types of Solar powered Water Pumping Systems:

Mainly there are two different types of solar powered Water pumping systems such as Battery coupled and Direct Coupled.

In Battery Coupled Water Pumping Systems it consists of solar panel, control regulator for charging, batteries, water pump and controllers for pump. The working of the system is, the electric current produced by the photovoltaic panels during the day time, charges the batteries which will supply power to the pump anytime when water pumping is needed. The benefit of using batteries extends the pumping over a long period of time and we can use the water pump during the night and low light periods. The model of this Battery Coupled Water Pumping System is shown in figure 1.

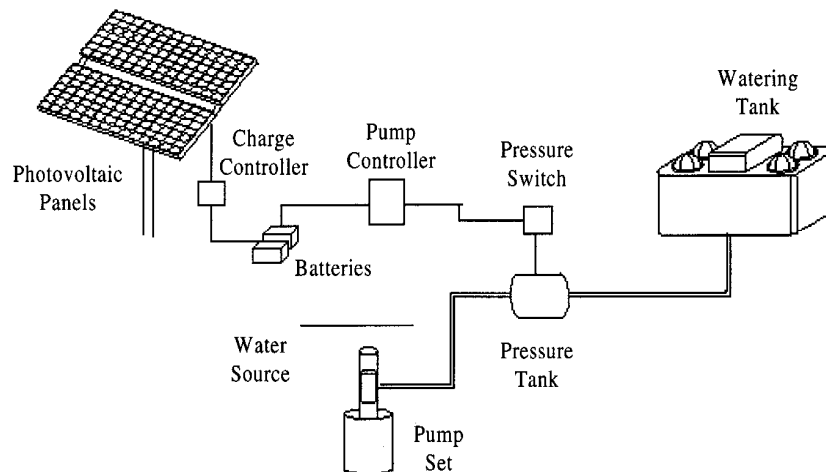


Fig.1 Battery Coupled Water Pumping System

The use of batteries has its own drawbacks such as it reduce the efficiency of the overall system because the operating voltage is dictated by the batteries and not the photovoltaic panels. Supply voltage of the batteries is one to four volts less or lower than the voltage produced by the panels during maximum sunlight conditions. The reduced efficiency can only be increased by using proper pump controllers and converters that boosts the battery voltage supplied to the water pump.

In Direct Coupled Water Pumping System, as no batteries are using the electricity from the photovoltaic modules is directly given to the water pump and this design is followed only during day time due to the absence of battery. The amount of water pumped is fully depend on the insolation or the amount of sunlight that falls on the solar photovoltaic panels. The intensity or insolation of the sun and the angle at which it strikes the photovoltaic panel changes throughout the day. The main problem of direct coupled water pump is during cloudy days, pump efficiency will drop out. This can be compensate by using proper boosting converters and good match between the pump and the photovoltaic modules is necessary to achieve an efficient operation of the system. The design of the Direct Coupled Water pumping system is shown in the figure 2.

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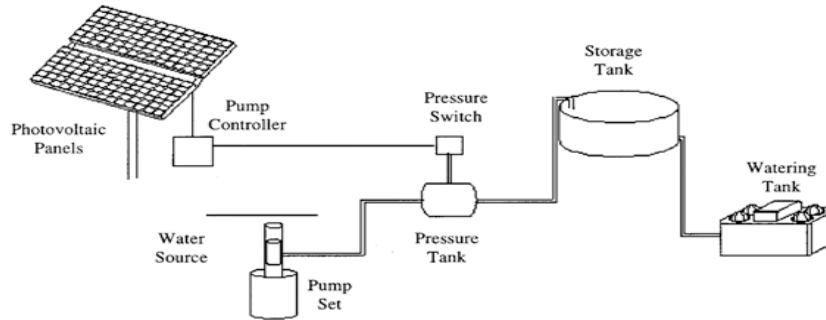


Fig.2 Direct Coupled Water Pumping System

IV. DESIGN CRITERIA

While designing a solar panel for water pumping we have to consider a lot of parameters such as its electrical characteristics, design and orientation characteristics, environmental factors etc. Depending on these parameters the overall system efficiency should be calculated because how much irradiance does the panel can convert depends on these factors.

When considering the electrical characteristics of the photovoltaic panel the solar irradiance should not be constant for every time, it will change according to the sun's rays. So depends on the solar insolation power the energy will be produced in the panels. If the insolation is constant for a long time there will be an appropriate voltage and current is produced, if sudden changes occur in the insolation the current will be reduced but the terminal voltage should be constant across it. While designing a solar water pumping system then consider a series or parallel number of panels in the input side for matching the required power of the water pump. The specialty in series and parallel wiring technique is while we are designing the panels in series arrangement the net output voltage of the panel is the sum of individual ones and net output current is same. When solar panels are arranged in parallel combination the terminal voltage should not change but the net output current will be the added sum of the current of each panel. The product of total output voltage and current should be the net output power of the solar panel. The efficiency of this can be increased by using Maximum Power point Tracking System and how it is taking place is there should be a maximum power for the solar panel the tracking system will adjust solar operating voltage close to the maximum power point under changing environmental conditions and the waveform is shown in figure 3.

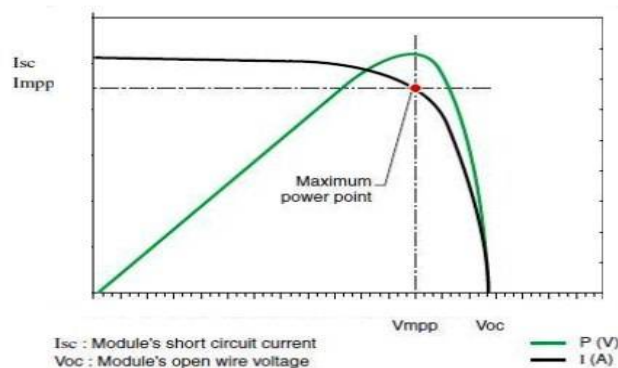


Fig.3 Maximum Power Point of Solar Panel

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The orientation properties of Solar panel is also important for solar water pumping because, the solar system should be close to the water pumping mechanism and the panels should be facing continuously or directly the solar energy. The tracking of solar panels can be arranged by using the LDR circuits and the tilting of the panels can be done by using stepper motors and all. Now a days there are systems with automatic tilting solar panel systems depending on the suns insolation are available.

The environmental factors are also a big challenge for the solar panels such as high temperature, dust, snow, ice falling etc. Due to these issues while designing the proper location of placing the panels are important depends on the environmental factors and climatic changes. When the dust rate increases the panel efficiency got reduces because the amount of light falling on the panels got reduced, so proper placing of the panels are also important in designing the Solar Water Pumping System

V. CONCLUSION

Photovoltaic power for irrigation is cost-competitive with traditional energy sources for small, remote applications. In the future, when the prices of fossil fuels rise and the economic advantages of mass production reduce the peak watt cost of the photovoltaic cell, photovoltaic power will become more cost-competitive and more common. The solar water pumping system is an eco-friendly project for the sustainable world.

REFERENCES

1. Anonymous, Uni-solar, Solar energy produces catalog and brochures, USA, 2001.
2. Anonymous, Solar Cells EIE Department of Research on electricity applications, Ankara, Turkey, 1992
3. Eker, B and A.Akdogan, Protection methods of corrosion on solar systems, TMMOB Machinery Engineering Society, Mersin, Turkey, 2005.
4. Anonymous, Solar Powered Livestock Watering Systems, <http://www.utextension.utk.edu>
5. B. EkerTrakia, Solar Powered Water Pumping Systems, Journal of Sciences, Vol. 3, No. 7, pp 7-11, 2005
6. M.Abu-Aligah, Design of Photovoltaic Water Pumping System and Compare it with Diesel Powered Pump, Volume 5, Number 3, June 2011 ISSN 1995-666
7. Prof. G. M. Karve, Solar Water Pumping System, ISSN 2250-2459, ISO 9001:2008 Certified Journal, Volume 3, Issue 7, July 2013
8. Solar Photo Voltaic Water Pumping: Harnessing Maximum Power, ACEEE Int. J. on Electrical and Power Engineering, Vol. 4, No. 1, Feb 2011
9. Helikson, H J, Pumping water for irrigation using solar energy University of Florida, USA, 1995
10. A. Safari, and S. Mekhilef, Simulation and Hardware Implementation of Incremental Conductance MPPT with Direct Control Method Using Cuk Converter, IEEE Transactions on Industrial Electronics, vol. 58, pp1154 -1161, April 2011.
11. Xue, Y., Chang, L., Baekhj Kjaer, S., Bordonau, J. and ShimizuT., "Topologies of single-phase converters for small distributed power generators: an overview," IEEE Trans. Power Electronics, vol. 19, pp1305-1314, Sept. 2004.
12. Tseng Ching-Jung and Chen, " Novel PWM converters with active snabbers", IEEE Transactions on Power Electronics, Vol-13, No.- 5, sept 1998 pp.861-869