IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Analysis of High Head Low Discharge Solar Water Pump

[1]Sachin mestry, [2]Chinmay G. Samant, [3]Dilshij J. Vellichira, [4]Jasim M. Sarang,

[5]Ziyad Rizwan Wadekar

[1]Assistant Professor, Department of Mechanical Engineering,

Finolex Academy of Management and Technology, Ratnagiri, University Of Mumbai

[2,3,4,5] Students, Department of Mechanical Engineering,

Finolex Academy of Management and Technology, Ratnagiri, University Of Mumbai

Abstract: Agrarian technology is changing fleetly. ranch ministry, ranch structure and product installations are constantly being bettered. Agrarian operations suitable for photovoltaic (PV) results are multitudinous. These operations are a blend of existent installations and systems installed by mileage companies when they've set up that a PV result is the stylish result for remote agrarian requirements similar as water pumping for crops or beast. A solar powered water pumping system is made up of two introductory factors. These are PV panels and pumps. The lowest element of a PV panel is the solar cell. Each solar cell has two or further especially set layers of semiconductor material that produce direct current (DC) electricity when exposed to light. This DC current is collected by the wiring in the panel. It's also supplied moreover to a DC pump, which in turn pumps water whenever the sun shines, or stored in batteries for after use by the pump. The end of this design is to explain and apply how solar powered water pumping systems work and what the differences with the other energy sources are. Solar water pumping systems operate on direct current. The affair of the solar power system varies throughout the day and with changes in rainfall conditions. Photovoltaic modules, the power source for solar pumping, have no moving corridor, bear no conservation and last for decades. A duly designed solar pumping system will be effective, simple and dependable. Solar powered pumping systems are used basically for three operations city and megacity water force, beast watering and irrigation.

Index Terms - Photovoltaic (PV), DC pump, Solar Water Pump.

I. INTRODUCTION

A solar-powered pumping system for irrigation needs to consider the varying demand for water throughout the year, with peak demand during the irrigation season being more than twice the average demand. The system should minimize water losses, without imposing significant additional head on the irrigation pumping system and be cost-effective. The selection of the appropriate technology depends on factors such as regional feasibility, water demand, system efficiencies, and initial and long-term costs. Solar-powered systems are often preferred in developing countries due to their durability and long-term economic benefits.

Solar-powered water pumping is a suitable solution for grid-isolated rural locations in poor countries with high levels of solar radiation, providing drinking water without the need for fuel or extensive maintenance. While small-scale solar-powered water pumping systems are useful for small-scale drip irrigation, large-scale irrigation requires a large solar PV array, which can make the system inefficient as the water may only be required during certain times of the year. Solar PV water pumping systems are commonly used for

irrigation and drinking water in India, especially in remote areas or where an alternative energy source is desired.

II. LITERATURE SURVEY

Solar Energy Conversion And Its Utilization by Nayna P. Lokhande, Nilima S. Maraskolhe, Shubham S. Lokhande, Prof. Bhushan S. Rakhonde [1] The research paper proposes a method for charging batteries with solar panels to reduce grid load and protect distribution transformers. It emphasizes the importance of using non-conventional energy sources for sustainable development.

An Analysis of One MW Photovoltaic Solar Power Plant Design by Hemakshi Bhoye, Gaurang Sharma [2] This paper focuses on the design and calculation of power production for a one megawatt (MW) photovoltaic (PV) solar power plant. The paper aims to provide recommendations and techniques for optimizing the cost of a PV solar power plant.

Modern Solar Powered Irrigation System By Using ARM by Basava Sidramappa Dhanne, Sachin Kedare, Shiva Sidramappa Dhanne [3] The main contribution of this paper is to give an overview of the project model which will greatly develop the irrigation system in India.

The application Of Solar Technologies for Sustainable Development or Agricultural Sector S. Mekhilef, S. Z. Faramarzi, R. Saidur [4], Zainal Salam The application of solar energy in the agricultural sector was reviewed and presented in this paper

III. PROBLEM DEFINITION

The ongoing cost to pump water from below ground level to the ground level is very high that is the common farmer has to pay a bulk amount so that he can water his plantation our contribution is to reduce this cost and to make the water pumping system easy by using freely available solar energy and small pumps that can serve the need

IV. METHODOLOGY

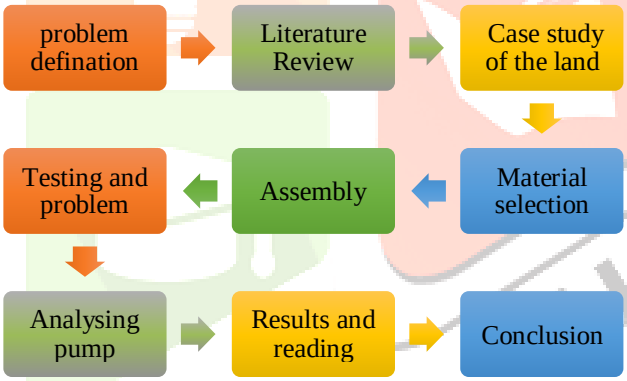

Fig 4.1 Flowchart of process

4.1 Case study and land survey

- The location was surveyed and found irregular shaped land with steep slopes, less than 1 acre in size, and random distribution of trees including coconut, banana, mango, areca nut, and other juicy fruits' trees that require a good amount of water.
- The analysis of the daily sunlight was done and a suitable spot was determined where there was adequate availability of 6-8 hours of sunlight per day and peak hours from 10 am to 3 pm for a good 5 hours of peak performance
- The source of water was properly constructed which was 50 feet deep, and had a water level 40 feet down from the land surface, requiring a head of 45 feet. The overall study was done to get a proper idea of the location and the required input parameters for the installation of the system.

4.2 Design of experimentation

- Multi-staging of pump:
  A multi-staging of pump is commonly used to achieve high head and low discharge in water pumping. It involves connecting several pumps in series to increase the pressure and lift of the water. The number of stages required depends on the TDH and pump efficiency, and professional consultation is necessary to ensure optimal performance.This system was thus used in order to meet the basic requirement
  .

4.3 Material Selection

1. Submersible pump
   The SHAFI 12V DC surface pump is a type of water pump designed to operate using a 12 volt DC power source. It is manufactured by SHAFI, a company based in China that specializes in the production of submersible and surface pumps for various applications It can be used for a variety of water pumping applications, such as transferring water from one location to another, It has maximum flow rate of 8 litres per minute and a maximum head of 5 meters.

Fig.4.2 SHY HY-5800 Submersible pump

2. Surface pumps
   The SHAFI 12V DC surface pump is a type of water pump designed to operate using a 12 volt DC power source. It is manufactured by SHAFI, a company based in China that specializes in the production of submersible and surface pumps for various applications. It can be used for a variety of water pumping applications, such as transferring water from one location to another, filling tanks and containers, and providing water for irrigation systems. The pump has a maximum flow rate of 10 litres per minute and a maximum head of 5 meters

Fig.4.3 SHAFI 12v DC Surface pump

3. Solar panel

Exide Eco Poly 150Wp Solar Panel is installed which has a module efficiency of 18.68% and is of 12v. It is a photovoltaic solar panel

Fig.4.4 Solar Panel

4.4 Design calculation

1.Submersible Pump
Voltage = 12V
Current = 3A
Power = 12×3 = 36 watt

2. Surface Pump (2 nos.)
Voltage = 12V
Current = 1.5A
Power = 2×12×1.5 = 36 watt

•Total Consumption
= (36) +(36)
=72 watt

Considering wire resistance and change in pump efficiency due to different working conditions and passing time, we take the total consumption as 80 watts. So a single panel of 15 watt rated output will be more than sufficient to successfully run the system without any disturbance.

4.3 3D model

A CAD file is created in solidwork.

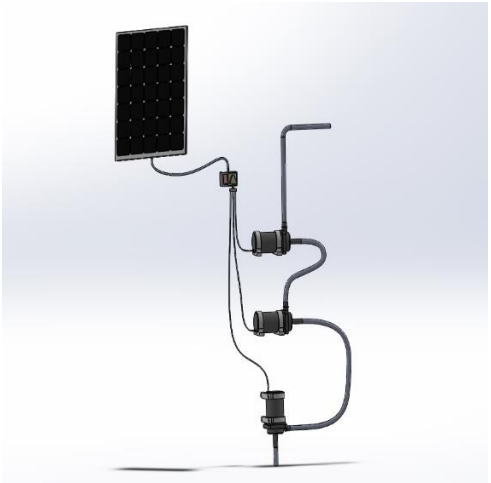

Fig. 4.5 Multi-staging CAD model (side view)

Fig. 4.6 Multi-staging CAD model (Front view)

The above figure() shows the side view of the CAD design of the model of the actual project. In this the main components the solar panel, the pumps, the wire, the pipe is shown. The setup is arranged in the exact manner that was used while installation and gives a very clear idea of the project setup. The figure() shows the front view of the CAD design of the model of the actual project. In this the main components the solar panel, the pumps, the wire, the pipe is shown. Here, using the pumps and panel the construction of the high head and low discharge solar pumping system is shown.

4.4 Assembly and working

Aa thorough survey was conducted of the location before installing a solar-powered water pumping system. The terrain was examined, land area, tree placement, and daily water requirements for the trees. Several factors were assessed such as the amount of sunlight the region received and searched for any sunlight blockages caused by large trees. The solar panel were then installed at the selected location providing maximum power output, which is roughly 6 to 8 hours of direct sunlight from morning till evening, with peak performance from 10 am to 3 pm. The water source that is a well in this case is also evaluated thoroughly which was 50 feet deep and properly constructed. The water level was 40 feet down from the land surface, requiring a head of 45 feet. Overall, the necessary input parameters were analyzed to install an efficient solar-powered water pumping system

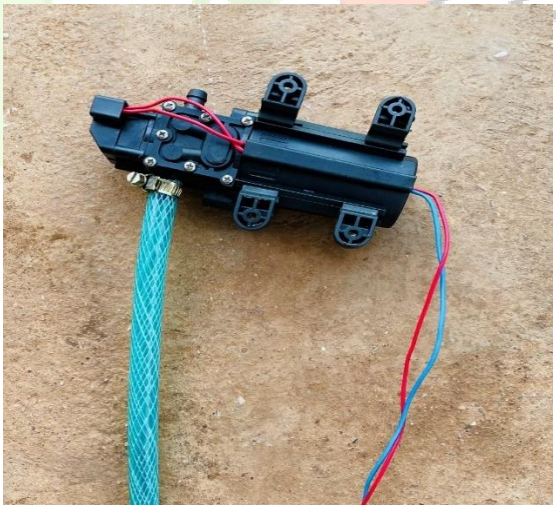

Fig. 4.7Assembled submersible pump

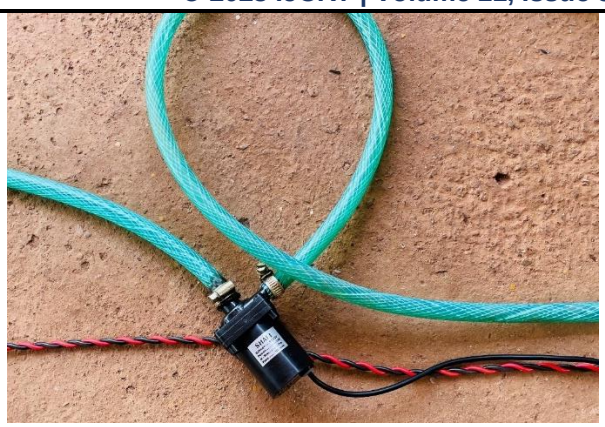

Fig. 4.8 Assembled surface pump

The figures show assembly of the submersible pump and the surface pump with the pipe and connection with the twisted wire pair are shown in the figure. Clampers that were tightly positioned above the pipe were used to link the suction and discharge sides to it

4.5 Bill of material

Table Bill of Materials

Sr.No	Part Name	Qty	Unit Cost	Cost
1	Submersible pump	1	₹550	₹550
2	Surface pump	2	₹640	₹1280
3	Solar panel	1	₹7200	₹7200
4.	Wire	40m	₹15	₹600
5	Pipes	18m	₹18	₹324
6	Clamps	8	₹12	₹72
Total Number of Parts		**14**		**₹10026**

V. RESULTS AND DISCUSSION

5.1 Results of analysis of water discharge

Table 4.1 Observation table

Date	Sunlight Duration	Avg. Discharge per minute	Total Water Discharge
31-03-2023	6 hours	6	2160 L
01-04-2023	7 hours	5.1	2142 L
02-04-2023	7 hours	6.2	2604 L
03-04-2023	7 hours	5.5	2310 L
04-04-2023	6 hours	5.8	2088 L
05-04-2023	6 hours	5	1800 L
06-04-2023	7 hours	5.3	2226 L
07-04-2023	6 hours	6	2160 L
08-04-2023	6 hours	6.2	2232 L
09-04-2023	7 hours	6.4	2688 L
10-04-2023	7 hours	4.9	2058 L
11-04-2023	7 hours	5.5	2310 L
12-04-2023	7 hours	5.4	2268 L
13-04-2023	7 hours	5.8	2436 L
14-04-2023	6 hours	5.7	2394 L

This table shows the discharge of the water during different time of the day. The analysis was done was 15 days and it was found that average of 2000 liters of water is achieved which meets the requirement of the assembly. Although the discharge may differ if the availability of sunlight decreases.

5.2 Benefits

1. High head low discharge: The actual basic requirement of high head low discharge can be achieved with higher efficiency using this solar water pumping system with multi staging of different pumps.
2. Economic: Using economically affordable and easily available pumps we can get higher efficiency that has significantly low maintenance and repair.
3. Less power consumption: Using solar energy, the power consumption from commercial grid can be zero thus again reducing the cost of energy consumption.

5.3 Limitations

1.Limited water output: High head low discharge solar water pumps have a low discharge rate, which means they may not be suitable for applications that require high water output.
2.Dependent on sunlight: High head low discharge solar water pumps require direct sunlight to operate, which means they may not be suitable for areas with limited sunlight or during cloudy weather.
3.Cost: High head low discharge solar water pumps may be more expensive than traditional pumps, especially for those with a high head lift and low discharge rate.

VI. CONCLUSION

High head low discharge solar water pumping systems are cost-effective and reliable solutions for providing sustainable water supply in remote locations and rural areas with limited access to electricity. These systems have low maintenance requirements, as they have fewer moving parts than traditional pumps, reducing the risk of breakdowns and increasing their lifespan. Additionally, the absence of fuel, oil, and filters eliminates the associated costs of changing or disposing of these materials. This makes them a more attractive option for farmers and communities who may lack the resources or skills to maintain more complex and expensive pumps..

VII. FUTURE SCOPE

Integration of smart technology can optimize pump performance, reduce maintenance requirements, and enable remote monitoring and control.
Energy storage systems can ensure continuous operation of the pump during periods of low sunlight or at night.
Advancements in materials science and manufacturing processes can lead to pumps that are lighter, more durable, and easier to install and maintain.
Solar water pumps can be used for various applications beyond rural and remote areas, such as urban agriculture and landscaping.
Continued innovation and development can lead to improvements in efficiency, performance, and cost-effectiveness.
Adding more pumps to the system can increase efficiency and durability

REFERENCE

[1] Solar Energy Conversion And Its Utilization by Nayna P. Lokhande, Nilima S. Maraskolhe, Shubham S. Lokhande, Prof. Bhushan S. Rakhonde

[2] An Analysis of One MW Photovoltaic Solar Power Plant Design by Hemakshi Bhoye, Gaurang Sharma

[3] Modern Solar Powered Irrigation System By Using ARM by Basava Sidramappa Dhanne, Sachin Kedare, Shiva Sidramappa Dhanne.

[4] The application Of Solar Technologies for Sustainable Development or Agricultural Sector S. Mekhilef, S. Z. Faramarzi, R. Saidur, Zainal Salam **[5]** Ossi Martikka et. al. “Mechanical Properties of 3D-Printed Wood-Plastic Composites”. (2018) vol. 777.499

[5] Solar Powered Water Pumping System for Agriculture by Vishweshwar Machivale, Rajkumar Gosavi, Nachiket More, Hrisheekesh Aayare, Prabodh Horambe , Sumit Malusare