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Design and Fabrication of Solar Water Pump

Nagarjun C. M.[1], Abhishek C. M.[2], Dhaivik M.[3] Rohan C[4]

[1]*Guide &Assistant professor, Dept. of mechanical Engineering, RNSIT, Karnataka, India*
[2] *Student, Dept. of mechanical Engineering, RNSIT, Karnataka, India*
[3] *Student, Dept. of mechanical Engineering, RNSIT, Karnataka, India*
[4] *Student, Dept. of mechanical Engineering, RNSIT, Karnataka, India*

Abstract - *Our Objective is to create a solar panel system that would be used on farms in India. This solar system will pump water from the land which means underground water or nearbycreek or river and will replace the use of gas or electric powered pumping which is a costly operation for farmers. This new solar system will aim to optimize and use less money in order to pump water to the farm for purposes such as irrigation. At present many farms in India are using gas and electric energy to lift the water from the land for their farming needs. Since these conventional methods of lifting water costing farms a substantial amount of money periodically, we envision a replacement of gas or electric energy by solar energy. Furthermore, apart from the solar energy system producing energy that will be used to pump water in the farms, the solar energy will be useful for providing light to the farm at night. Solar system energy uses an energy source that is consistently available especially in tropical regions.It will be a clean source of energy and will not do damage to the environment and to the nature. Furthermore, it is freely available renewable energy, it will last forever.*

Key Words: Renewable energy, Solar system, Solar Panel, PV array, Inverter.

1.INTRODUCTION

Generally Water pumping is dependent on conventional electricity or diesel generated electricity. Solar water pumping minimizes the dependence on diesel, gas or coal-based electricity. The use of diesel or propane-based water pumping systems require not only expensive fuels, but also create noise and air pollution. The overall operation and maintenance cost and replacement of a diesel pump are 2–4 times higher than solar photovoltaic (PV) pump. Solar pumping systems are environment friendly and require low maintenance without any fuel cost. Keeping in view the shortage of grid electricity in rural and remote areas in most parts of world, PV pumping is one of the most promising applications of solar energy. A properly designed PV system results in significant long-term cost savings as compared to conventional pumping systems**.** A solar panel of 150 KW is used in this project to convert incident solar radiation into electrical energy. An inverter converts Direct Current output of a photovoltaic solar panel into a utility frequency alternating current that can be fed into a commercial electrical grid. Based on our calculations submersible pump of 0.1 HP is used to get hydraulic energy or to lift the water.[1]

1.1 Problem statement

The solar pump is taken into consideration because of the following reasons

- In most of the farm lands in the world engine driven pumps are used for irrigation which pollutes environment.
- Despite of present short term fluctuations on oil prices, conventional oil-based engine driven power sources and mains electricity are expected to continue to increase in the longer term.
- PV water pumping is gaining importance in recent years due to non availability of electricity and increase in diesel price.
- Solar water pump uses renewable energy source which do not produces neither green house effect gases nor hazardous wastes through its utilization and also economical compared to diesel operated pumps

1.2 Objectives

Considering water as a fundamental element of rural development and food security, it is time to make wise choices in irrigation to minimize water losses. Following are the objectives of this project

- To design a pump that can lift water up to 40-45 feet.
- To operate a pump with one solar panel.
- To calculate the flow rate of water from the pump. To Save 30 to 60% water conservation and the continued deterioration in the table.
- To establish a competitive and diversified agriculture because of the weightage ofthis sector in the national economy.
- To become independent against the increasing price of oil and gas.

- To protect our environment from pollution cause by burning oil and gas.
- To encourage people to start using renewable energy which costs less and don't pollute.

2. METHODOLOGY

A solar water pump operates using the energy from the sun to power a motor that drives a water pump. Solar panels or photovoltaic (PV) cells absorb sunlight and convert it into direct current (DC) electricity. The DC electricity is sent to a controller which regulates the power flowand protects the pump from over voltage, over current, and other electrical issues.

The controller sends the DC electricity to the motor that drives the pump. The motor can be either a DC motor or an AC motor that is powered by an inverter. The pump draws water from the sources like a well or a reservoir and pumps it through pipes or channels to the desired location such as a storage tank or a field.

The pump is designed to operate efficiently with the varying power output of the solar panels,which can change depending on factors such as cloud cover, time of day, and season.[2]

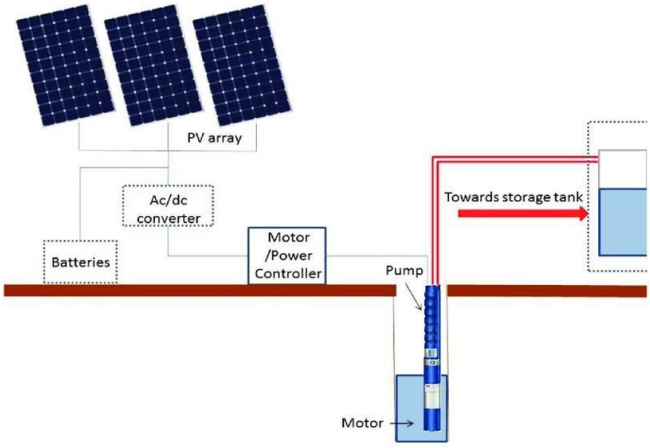

Fig-1 Circuit connection of solar pump

3. CALCULATIONS

Size of pipe = 1 inch

Material of pipe = PVC

Cross sectional area of pipe

1 inch = 0.0254m

$A = \pi d^2/4$

$= \pi(0.0254)^2/4$

$=5.067x10^{-4}m^2$

Assuming average pressure of 20- 100PSI [3][4]

Let velocity of water V=12f/sec or 3.6576m/sec

Volume of flow per hour q=37GPM or $8.4036m^3/hr$

Height h= 3m at which water has to b delivered.

Density of water $\rho = 1000kg/m^3$

3.1 Power of the pump

$P = (q\times\rho\times g\times h)/(3.6\times10^6)$

$= (8.4036\times1000\times9.81\times3)/ (3.6\times10^6)$

= 0.0686 KW

= 0.091HP

Hence 0.1 HP pump has been selected

3.2 Design of Motor and Solar Panel

Motor drives only 60% of power to the pump

Power of motor

$P_m = P_p/0.6$

= 0.1/0.6

= 0.1666HP or 124.2 Watts

Hence a solar panel of 150 Watts capacity is selected.

4. ACCESSORIES

- Solar Panel
- Inverter
- Submersible Pump
- Cable wire
- PVC pipe

4.1 Solar Panel

The solar panel includes sixty solar cells which are known as PV module. It is assembled as a pre-wired, field-installable unit. The specifications of solar panel are given below.

Length: 65 inches

Width: 39 inches

Height: 2 inches

Output: 150 watts

4.2 Inverter:

It converts the direct current (DC) output of a photovoltaic solar panel into a utility frequency alternating current (AC) that can be fed into a commercial electrical grid or used by a local, off- grid electrical network. It consists of one input

port, three output port. It is also provided with one USB port. This inverter can also be used for mobile charging and also it consists of one LED light which is helpful for the farmers during night time.

4.3 Submersible pump

As per the calculations 0.1 HP is selected. This Pump runs at 300rpm.Its power output is about 120 to 130 watts.

4.4 Cable wire

Single core 3mm electric cable is used in this project. It can be used for cabling of solar modules and also for connecting DC/AC inverters.

4.5 PVC pipe

PVC pipes are lightweight, durable, and corrosion-resistant, making them a popular choice for both residential and commercial applications. They come in various sizes and thicknesses to suit differentplumbing needs. In our project 1 inch pipe is selected based on our design calculations. Figure-2 shows the assembly of all these components.

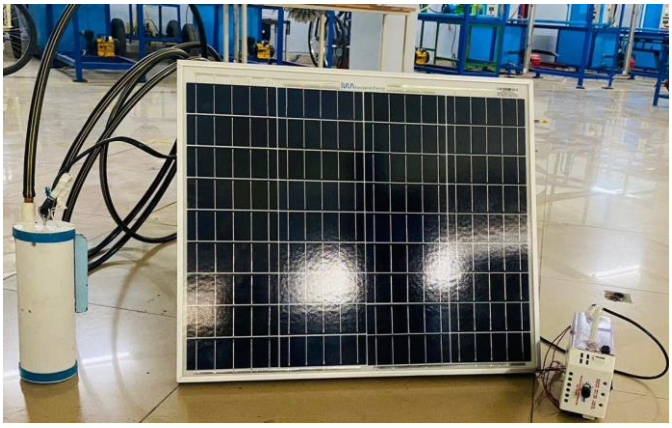

Fig-2 Assembly of solar pump accessories

3. CONCLUSIONS

Solar water pumps for drip irrigation systems are an excellent way to provide a sustainableand efficient source of irrigation for small to medium-sized farms. They are cost-effective, environmentally friendly, and reliable, making them an ideal choice for farmers in remote areas where access to grid electricity is limited. With solar water pumps, farmers can save energy costs, increase crop yields, and reduce water usage. Additionally, solar water pumps can also help to reduce greenhouse gas emissions and mitigate climate change impacts.

In conclusion, solar water pumps for drip irrigation systems are a great investment for farmers looking to improve their crop yields while minimizing their environmental impact.

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