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EVALUATION OF SOLAR PHOTOVOLTAIC WATER PUMPING SYSTEM AND IMPROVING ITS EFFICIENCY FOR DEVELOPING AN ENERGY STORAGE DEVICE

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ABSTRACT:

An electricity demand in India is now at an all-time high. Agriculture accounts for 21.5 percent of total electricity use; according to sectoral demand patterns. Technology is becoming increasingly popular. PV cells are utilized to power electrical equipment because of their high energy output. Solar energy is a clean and inexpensive energy source. Solar powered water pumping is an important technology for conserving vital resources such as water and electricity. This experiment is to calculate the efficiency of solar pump and panel. It is evaluated by calculating the input and output energy of the pump and panel. By comparing the efficiencies of pump and panel we can be able to estimate the amount of loss of energy. For conserving the energy, we can also install battery and charge controller for the use of pump in dark without solar energy. It conserves energy even while the pump is working. At the time of 2-3pm the efficiency of solar panel is about 55-60% and for the pump is 50-55%. By installing the storage device, we can save 2-5% of the energy wastage. This proves to be a better implementation for conserving the energy and the use of pump at any time.

Keywords: solar panel, pump, battery, charge controller.

1. INTRODUCTION

Coal, oil and solid biomass are three fuels commonly fulfill the 80% of India's energy requirements. Commonly, 50% of energy is used to production of electricity. Demand for electricity in India is high. Energy's contribution in agriculture varies widely by activity, production practice, and locality. Agriculture accounts for 21.5 percent of total electricity use, according to sectorial demand patterns.

Solar energy is a clean and inexpensive energy source. Solar energy can reduces a homestead's power and warming bills. Solar powered water pumping is an important technology for conserving vital resources such as water and electricity (Shiv Lal-2013). Irrigation of farm crops is one of the important applications of this technique. After sunset, solar pump does not work. By this reason, we do this project to increase the working hours of pump. I had chosen the field nearby SULUR (AYYAN

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TIRUVALLUVAR NAGAR) to conduct my studies. First calculate the efficiency of solar pump and compare results for some days by only observe the peak time discharge and wastage or leakage energy.

2. MATERIALS AND METHODS

In that field, source of water is fully based on ground water. A profound, thin well for water that is penetrated into the ground and has a line fitted as a packaging in the upper piece of the borehole, commonly furnished with a pump to attract the water to the surface. The total foot of bore well is 300 ft in meters 91.4 m.

SYSTEM INSTALLATION AREA	**SULUR, COIMBATORE**
Latitude of location	10.9 °N
Longitude of location	77.1 °E
Altitude	299 m
Water resource system Used	Bore well to storage
system application	Irrigation
Well diameter	10 cm
Static level depth	14.4 m
Total depth	105.8 m
Maximum pumping depth	91.4 m

Table:1 Description of Study area

Materials used:

PV panel:

PV panels generate electricity directly from sunlight. PV boards are comprised of numerous singular cells that are consolidated to produce power at a particular voltage. Photovoltaic boards are DC gadgets, pv cells are mostly made by crystalline silicon.

Solar charge regulator:

A MPPT, or greatest power point tracker is an electronic DC to DC converter. The association between sunlight based chargers and your battery or the utility framework is streamlined with a MPPT (Maximum Power Point Tracking) charge regulator.

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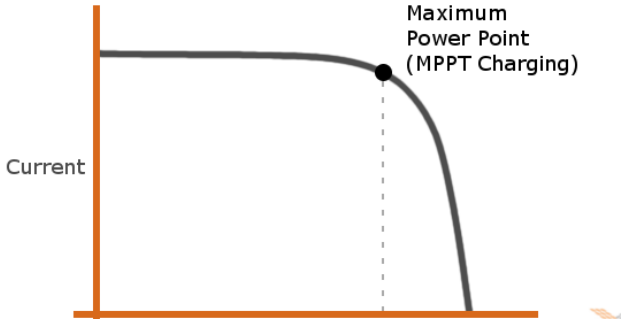

MPPT ALGORITHM

Rechargeable Battery:

A solar battery just saves the energy created by your energy framework's solar powered chargers.

Role of batteries

- Store electricty for later use.
- Indicates units of electricity.

Dc pump:

A submersible changes over turning energy into motor energy and afterward into pressure energy to reach water to the surface. The water is brought into the pump in two phases: first in the admission, where the impeller turns and pushes the water through the diffuser, and afterward in the release. It ascends to the surface from that point.

METHODS:

Efficiency calculation:

Procedure

- The first process is to evaluate the efficiency of the solar pump and the panel.
- The measurement of input and output of the solar panel and pump is done by direct method.
- The input and output efficiency are calculated by the observation taken for variable time duration.
- Data collection on direct observations.
- By using formulas from (Elias M. Salilih-2020).
- Then compare the panel efficiency and pump efficiency if its panels output is more efficient than pump.
- In normal pump never used full part of energy from panel, there is it wastage occurs.

Sample graph for efficiency of panel:

Need for storage device:

- On the view of calculation, the efficient level of panel is higher than pump.
- Nearly 10% of energy is losses on every day.
- In that point, we are all decided to make a storage device to store a wastage energy at least 2-5% of energy.

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- Then operating the pump at least 1-2 hrs in night-time by using the help of battery.
- There is a calculation of storage device and results are shown below.

Storage device:

Procedure:

Step 1: First setup the solar panel on a land surface (or) where the solar radiation fully strikes on solar panel.
Step 2: Solar panel input connected to solar charge controller output.
Step 3: Using multimeter, to check the voltage from solar panel is fully supplies to charge controller output.
Step 4: Then connect the wires of positive and negative pins of battery and the wires should be connected with charge controller negative and positive pins.
Step 5: Then view the controller, there is an indication occurs, when it is fully charged, in load ON overload light blinks, when it is low level (or) high level, battery low (or) battery high light blinks.
Step 6: Then connect the pump with charge controller and runs on it whole day.
Step 7: Check how many hours taken, when battery is fully charged during working of pump.
Step 8: After battery is fully charged, check how many hours it pump works with battery power.
Step 9: Then it is required on 5 days for observing average efficiency level.

For that experiment, materials required and that specifications.

S.NO	MATERIALS	SPECIFICATIONS	REQUIRED NO'S
1	Solar panel	18 watts	1
2	Charge controller	12vor 24v, 6 Ahs	1
3	Battery	13.04v, 6Ahs	1
4	Dc pump	6v,3Ahs	1
5	Wires	-	Required no's

RESULTS AND DISCUSSION:

EFFICIENCY COMPARISON

1. Efficiency of the system

Efficiency = output power of the solar system / input power of the system * 100.

Efficiency = 4.95 / 9.96 *100

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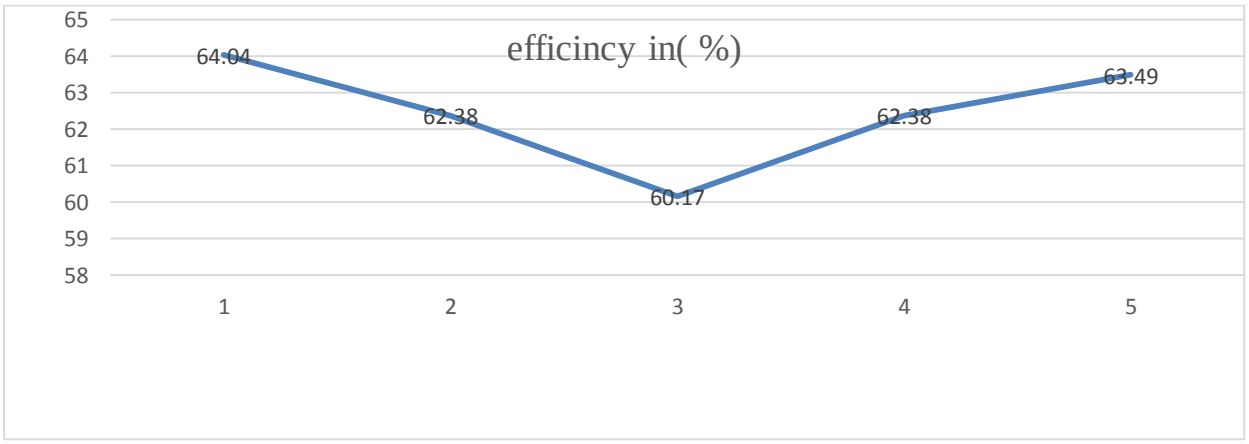
= 0.496*100

= 49.6% = 50%.

The efficiency of solar panel o 8.00 am is approximately 50%.



Date in(1.3.2022&5.3.2022)

GRAPH : Efficiency of solar panel for 5 days differnece

Pump

Efficiency of the pump

Efficiency – input power of the pump / hydraulic power of the pump or output power of the pump*100.

Efficiency = 1.97 / 4.95 *100

= 0.4014*100

= 40%.

The efficiency of the pump on 8.00 am,40% only.

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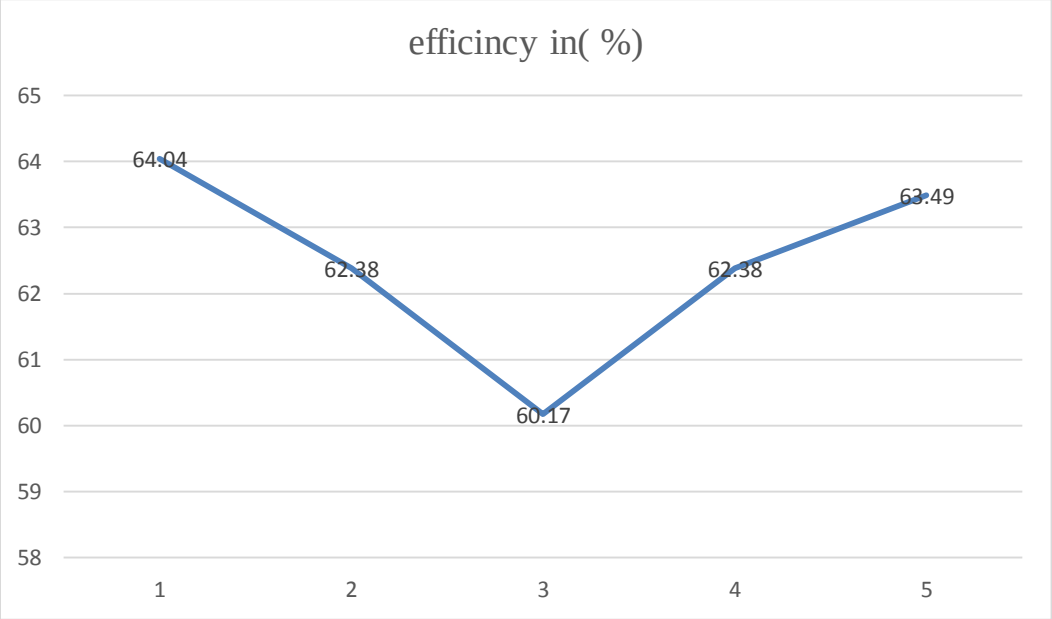

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GRAPH : Efficiency of pump for 5 days differnece

STORAGE DEVICE:

- For a 12v lead acid battery taking 5 hrs to charge fully in the time pump operating.
- And the battery power used to drive the pump for 20 mins only.
- It should be calculated for 1 kw solar panel.
- It gives a good result and the pump works for anytime using the battery power.

CONCLUSION

Evaluation of efficiency level is successfully completed. Comparison of efficiency level gives a good result, to make a storage device. A storage device for storing energy is generated. The preliminary test of storage device is analyzed with small setup. It gives 2-5% efficiency in night-time. The setup is only suited for dc pumps. It may be an AC operating pumps, using solar inverters it converts dc to ac power. It discussed in materials list above in the paper, Eco friendly. It attains profitable output but cost-wise is high.

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