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Solar Energy For Domestic Drinking Water - A Pilot Study

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Abstract: This paper consists of a proposed solar water pumping system for a single story house. The proposed system will be used to pump government's supply water stored in an under-ground water storage tank to overhead drinking water storage tank of a single story house. The pump will get the power by a solar panel. Solar energy is the best renewable source of energy. Solar panel converts solar energy to solar power. This solar water pumping system is proposed without battery backup that will reduce the initial cost. DC pump is proposed because DC pumps uses one third to one halfthe energy of a conventional AC pump this will reduce power consumption. The motive of this study is to reduce the initial cost of solar pumping system and to utilize solar energy to run pump which further results in reduction of electricity bills.
Keywords: Governments water supply; solar water pumping system; reduce power consumption.

Introduction[1-3]

Water is the most precious thing in the world. Every living creature requires water for survival. In India underground water level is going down rapidly due to unnecessary use of fresh water. India is developing country so due to fast rate of development in infrastructure and industrial sector the consumption of water is heavily increased. That's why in all of the major Indian cities the major part of the population depends on government's water supply. We know that ground water level of Indorecity is not as much as required so 80% of the population depends on government's water supply. Government supplies the water for approximately 2- 4 hours in morning or evening or both in morning and evening. We can connect a centrifugal pump to take thatwater to our storage tank. A family of 4 members needs approximately 200 litres of water for 2 days or more days depending upon the water consumption habits for drinking and cooking purposes. In Indore city sun is available approximately for 60% days in a year. Solar energy is the most popular and efficient source of renewable energy. Solar energy is far more reliable than any other source of energy. This energy is easily available across the country. This energy can be harnessed by different means. One of the most important ways of harnessing solar energyis via solar water pump. India receives average solar radiation of 5.5kwh/sq.m per day. We can utilize solar energy to pump the water from governments supply to our overhead drinkable water storage tank. A solar panel of 20 watts and a 14.5 watt, 12V DC centrifugal pump can do the required job. One time investment and we will get lifetime service. This paper describes a solar powered water pumping system. This paper includes a preliminary design of the solar powered water pump system.

Methodology[1-3]

Our motto is to fill the 200 litres water storage tank placed at a vertical height of 15 foot from the ground. We have to drive a centrifugal pump for that we need solar power. Conversion of solar energy into electricity gives us solar power. When solar cell is exposed to light, electron-hole pairs are generated in proportion to the intensity of the light. P-type and n-type semiconductors are used for making solar cell. As the solar cell exposed to light the negatively charged electrons move to the n-type semiconductor while the positively charged holes move to the p-type semiconductor. They then moves towards their respective electrodes. To get electric power the electrodes are connected by a wire and as a result current flows. It takes no time to give us the power output because solar energy is ready source of energy. The electric power is used to drive a centrifugal pump. The water from the government's water supply is first stored in underground water tank. The pump sucks the water from underground water storage tank and delivers the water at the top of the overhead water storage tank. For this we have to design the system. The design must be simple, reliable, durable and flexible and can be easily used.

Experiments And Layout

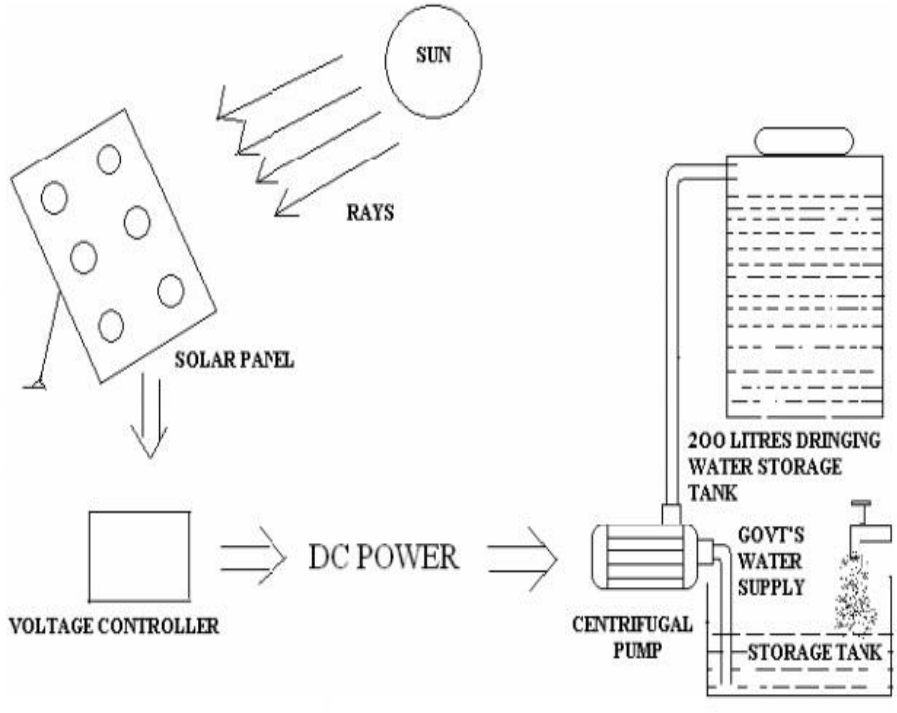

Figure 1: Solar water pump system

Components Of The System

1. Solar panel,
2. Voltage controller,
3. Centrifugal pump.
4. Support structure,
5. Tracking system,
6. Foundations,
7. Electrical connections,
8. Earthing kit,
9. Water piping.

1. Solar Panel: Solar panel is the main component in this system. Itconverts solar energy into electric power. We are using a CEL's Solar Photovoltaic Modules, type PM30 a 30 watt solar panel so that pump can get the required voltage and we can get maximum discharge.
2. Voltage Controller: The brighter the sunlight, the more voltage the solar cells produce, the excessive voltage could damage the centrifugal pump that's why a voltage controller is used to maintain the proper voltage.
3. Centrifugal Pump: DC power isdirectly produced by solar panels and this power is used to run centrifugal pumps. TOPSFLO (TL- B04/S) Pump is selected. It is a DC Centrifugal pump. It gives a maximum discharge of 7litres/minute. This pump is small and compact and easily portable. Low or no maintenance is to be done. Pump is placed at the ground level.
4. Support structure: We need anunshaded roof so that maximum solar energy can be harnessed. The panels will be positioned on the roof of the house in such a fashion that they will get full exposure to the sun. The panel will be mounted on a support structure. We have to tilt the panel at an angle 15°- 45°.
5. Tracking system: There may be fluctuation in solar power asthe sun moves from east to west .this results in fluctuation in flow rate. To minimize this tendency we can install trackers to redirect the solar panel in the direction of sun which will result in increase in power.
6. Foundations: Foundations are made to support the support structure.
7. Electrical connections: Electrical connectionsshould be made properly and the cables must be of appropriate sizes.
8. Earthening kit: To protect the solar panel from short-circuit in case of lightening an earthening kit is used.
9. Water piping: Piping is required to connect underground water storage tank and pump and then pump to the overhead drinking water storage tank. Now a days Polyethylene pipe are widely used to transport the water. They are durable, flexible and can bear extreme water pressures and environmental conditions. We will use polyethylene pipe to transport water from underground water storage tank to overhead water storage tank.

Observation Table

Table 1: Solar Panel

MAXIMUM POWER RATING	30 WATT
MINIMUM POWER RATING	28 WATT
RATED CURRENT	1.82A
RATED VOLTAGE	16.5V

Table 2: Centrifugal Pump

POWER	14.5 WATTS
VOLTAGE	12V
OPERATING CURRENT	1.2A
MAXIMUM DISCHARGE	8 LITRES/MIN
MINIMUM DISCHARGE	1LITRE/MIN
TOTAL HEAD	15 FEET
TIME TO FILL 200	200 MINUTES

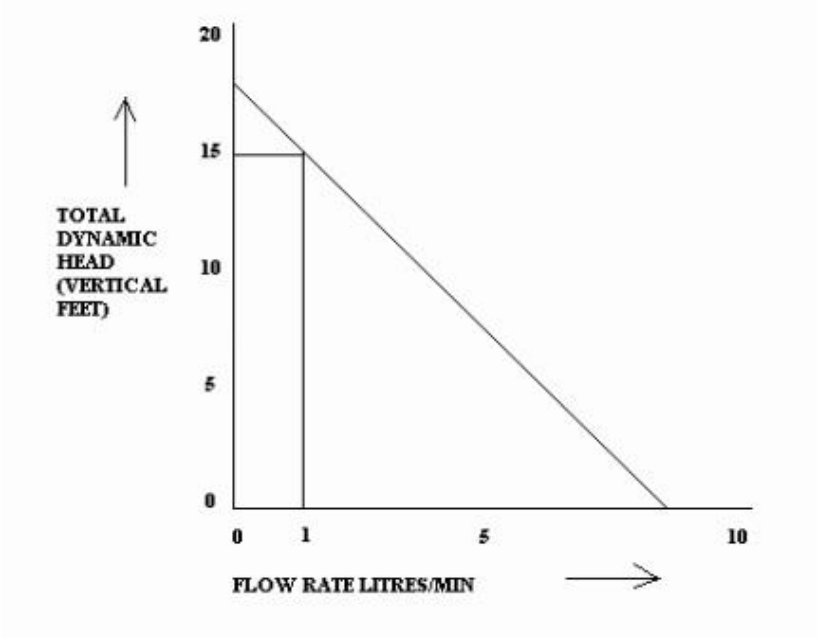

Figure 2: Variation in rate of flow with respect to head

Result

We can store 200 litres water in an overhead storage tank with a flow rate of 1 litre/minute in approximately 200 minutes by using a solar panel of 30 watts and pump of 14.5 watts.

Discussion

1. Why only 200 litres?
   Reason- Because 200 litres of water are sufficient for 3-7 days of drinking and cooking purposes for a family of 4 members.
2. Why solar panel of only 30 watts is used.
   Reason- to minimize the initial cost of the system and we need only 14.5 watt power.
3. Why dc centrifugal pump?
   Reason- because it can work directly on the outputof solar panel. We need inverter if we have to use ac pump that will increase the cost of the system.
4. Why this system is battery less?
   We have to store only 200 litres of water and no need of battery backup for this.

Limitations Of The System

1. High initial cost. But there is no running cost and maintenance cost and also government gives subsidy for that. In India a solar panel can be purchase at the rate of 1-1.5 per watt. We need 30 watt panel it means 30-45 or Rs1500-Rs2250.
2. More space is needed. This problem can besolved by installing high stands by this we can use roof for other purposes.
3. No solar power at night. This problem can be rectified by installing batteries.
4. Efficiency depends upon weather. We can use battery in such a way that when the solar system is producing excess powerthen the excess power is stored in battery and can retrieved at the time when the system is not producing less power. After pumping the water the system will become idle. We can use electricity to run various appliances like fan, bulbs, can charge our batteries as well. This way we can supply water to our gardens and other house hold works.

Conclusion

This paper described solar powered water pump system. Components required for the system are Solar panel, Voltage controller, Centrifugal pump, Support structure, Tracking system, Foundation material, Electrical wires, Earthing kit, Water piping. The pump selected for the study is the TOPSFLO (TL- B04/S) DC Centrifugal pump. This pump can give a maximum flow rate 8litres/min at approximately 14.5 watts of power. It will be kept on ground level and will pump the water up to a water storage tank approximately which is at a height of 15 feet from ground.

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