

A REVIEW ON SOLAR POWERED RECIPROCATING WATER PUMP

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ABSTRACT - In present days, people need more power for driving instruments. A solar based reciprocating pump is a pump, running on electricity generated by solar cell, available from collected sunlight as opposed to grid electricity or diesel run water pump. Nowadays many types of pump are available such as, positive displacement pump, impulse pump, velocity pump, gravity pump, steam pump, valve less pump. A reciprocating pump is class of positive displacement pump, is used for variety of purpose such as car washing, irrigation, color spraying, extraction of oil from bottom of the earth, large fountain, garden water pump, etc. If 50% of the diesel pump were replaced with solar PV pump set, diesel consumption could be reduced to the tune of about 225 billion liter/year.

1. INTRODUCTION

A solar powered pumping system method needs to take account of the fact that demand for irrigation system water will vary throughout the year. The output of solar power system varies with changes in weather conditions (1). Peak demand during the irrigation system season is often more than twice the average demand. Now a day the most convenient available energy is a solar energy used by the photo voltaic cell that converts heat energy into an electrical energy directly from the Sun (2). The irrigation pump system should minimize water losses, without imposing significant additional head on the irrigation pumping system and be low of cost. Pumping water system using this PV technology simple and not require a lot of maintenance (3).



Fig 1 (reciprocating pump)

There are several technology alternatives for supply power including wind turbines, windmills, generators, solar arrays and hand powered pumps. When the sun is shining you need more water and so the solar power is there for the pump (4).

The main driving factors for selecting the appropriate technology are regional feasibility, water demand, systems efficiencies, and initial and long term costs. Solar powered pumping systems are used principally for three applications: town and city water supply, livestock watering and irrigation (1). Solar powered water pumping systems can provide drinking water without the extensive maintenance required by diesel pumps. Solar power is one of the alternatives but is costly and unaffordable.

2. LITERATURE REVIEW

Continuous consumption of fossil fuel has encouraged to switch over the renewable sources such as solar, wind, biogas to power the water pumping system (5). Shifting to renewable energy sources such as solar, wind, bio-gas, and hybrid system is the optimum solution for energy crises related problem in India (6). The majority of the commercially available water pumps run on electricity or Diesel oil. Conventionally, electricity mostly generated by burning fossil fuels has been supplied from the national grids. This presented a problem for supplying water to remote areas which cannot be connected directly to a national grid station (7). Solar photovoltaic turned out to be the suitable one out of several available renewable sources of energy for water pumping. While being clean and naturally available, solar energy has been proved to have a direct relationship between its availability and water demand (8). In economic terms, the problem associated with the use of fossil fuel such as availability, transportation cost, price, effect on the environment while the reduction in PV panel prices due to advancement in the PV technology; adds on increasing the feasibility of using solar-powered water pumping systems(9). S.A.Shufat et al (10) designed the solar tracking system with dual planes. Solar radiations are transformed into electrical power offers statistics about development methodology of electricity by means of photo voltaic panels and to provide water in faraway areas. M.M.Haque (11) designed the solar running water pump using PV module for irrigation purpose. Compared the cost of diesel with photovoltaic pumping system, proved PV system is more economical. As solar and wind are present in abundant everywhere and it can be directly consumed without anyone permissions, eco-friendly as don't left out any wastage, due to these all reasons they are providing as the most promising power generating resources in local power generation due to its topological advantages(12). The evolution of new materials meant smaller, cheaper materials and crystals like copper-indium-gallium-selenide which are shaped into usable, flexible films. However, while solar energy comes from a free source, the

materials needed to produce a decent solar energy panel is expensive (3). The reduction in PV panel prices due to advancement in the PV technology adds on increasing the feasibility of using solar-powered water pumping systems(13).

Solar technologies are broadly characterized as either passive solar or active solar depending on the way they capture, convert and distribute solar energy. Active solar techniques include the use of photovoltaic panels and solar thermal collectors to harness the energy. Passive solar techniques include orienting a building to the Sun, selecting materials with favorable thermal mass or light dispersing properties, and designing spaces that naturally circulate air(4). Sun is primary source of energy, and all form of energy on the earth is derived from it. The sun gives us 1000 times more power than we need. If we can use 5% of this energy, it will be 50 times what the world requires (1). The development of affordable, inexhaustible and clean solar energy technologies will increase countries' energy security through reliance on an indigenous, inexhaustible and mostly important as an independent resource, enhance sustainability, reduce pollution, lower the costs of mitigating climate change, and keep fossil fuel prices lower than otherwise(14).

2.1 Solar Powered Water Pumping System

With increasing awareness about the emerging energy crisis in the world, solar-powered water pumping systems have been a real focus of interest of researchers for decades. There are various possible designs for developing solar-powered water pumping systems. However, the most common is the one that involves PV panels(15). There is a need to condition the generated power from the power collection system so that it can power up the water pump. A water pump is installed in the water source. It pumps the water from the source to a water reservoir located at a higher elevation from the ground level. The elevation difference from the water pump to the inlet of the water reservoir is known as the pump head. This pump head is an important parameter in designing the pumping system (13).

2.2 Global scenario of solar powered water pumping system

Solar powered water pumping has been recognized as suitable solution for grid isolated rural locations in poor countries where there are high levels of solar radiation. Solar powered systems are often considered for use in developing countries instead of other forms of alternative energy because they are durable and exhibit long term economic benefits. Small farms, villages and animal herds in developing countries require hydraulic output power of less than a kilowatt. Many of these potential users are too far from an electrical grid to economically tap that source of power, and engine-driven pumping tends to be prohibitively expensive as well as unreliable due to the high cost of purchased fuel and insufficient maintenance and repair capabilities (14).

Solar power may be a particularly viable alternative to fossil fuels due to the high level of the sunshine in the Middle East

and North Africa (MENA) regions. Remoteness from the electrical transmission national grid and poor road connections are among the driving reasons for rural energy development (16). Fluctuating oil prices motivated the countries in the west to develop PV pumping systems so as to ascertain the utilization of PV pumping systems to satisfy both potable water and irrigation requirements in remote areas (17). In Sonora, Northwest Mexico, the prices of PV module reduced by 80% while the diesel price increased dramatically to 250% over the last decade (18).

The general trend of solar water pumping system development in Eastern Asia was to provide small sectors with fresh water and to predict the future dissemination levels (19). Setiawan et al. (20) reported on a solar water pumping system as water supply source for a small village in Indonesia. Business models were developed for both farmland and grassland conservation. Zhanga and Yan (21) studied the present and enhanced business models that focus on the applications of PV in China, their availability, limitations, and accessibility. Their economical values were addressed and four different scenarios on PV systems were compared.

2.3 Indian scenario of solar powered water pumping system

Solar PV water pumping systems are used for irrigation and drinking water India. In India, there are many areas where drinking water is problem. In most of the case hand pumps are used at villages and remote places to solve the problem. There are operated with hands .It is difficult to operate it for children and women as it consumes human power. In India, it was reported that solar powered water pumping systems were suitable to irrigate small application and minor drinking water demand where conventional energy sources are unavailable or expensive (22). Akker and Lamba (23) discussed the installation of 1000 small solar powered water pumping systems at different regions in Punjab, funded by the Indian Renewable Energy Development Agency. In India, diesel and grid electricity are the two major sources for the driving of water pumps for irrigation and household applications. The use of solar pumps can save the consumption of electricity and subsidy provided to the farmers in diesel prices. The Indian government has recently launched a new scheme named Pradhan Mantri Kisan Urja Suraksha evam Utthan Mahabhiyan (PM KUSUM), which aims to install an off-grid solar pump and to replace the existing grid-connected agriculture pumps (24).

2.4 Applications of solar powered water pumping system

A solar reciprocating pumping system is believed to be applicable to many remote and domestic irrigations applications without access to electricity relaying diesel power and having insufficient wind for pumping. Implementation of solar water pumping is seen in various types of application, have proved that it not only contributing to ecological balance as well as upgrade the socio-economic growth. Alajlan and Smiai (25) designed and constructed two main PV systems, one for the pumping of water and another

for desalination of raw water by reverse osmosis method and system is integrated with a battery backup of five days.

3. CONCLUSION

Solar PV water pumping system is reliable and eco-friendly solution to utilize the naturally available resources around. It can be easily installed with minimal maintenance and can survive up to decades. It can be used to supply heat to homes and public buildings quietly. It is self-priming and is powered by an intelligent solar system in which solar panel targets the radiation from the Sun. It conserves electricity by reducing the usage of grid power and conserves water by reducing water losses. The method used to build solar powered water pumping system is cost effective comparatively to an electrically operated hydraulic pump. With decreasing PV module costs and increasing efficiency, PV is getting more pervasive than ever.

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