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WATER PUMP AND WATER FILTER USING SOLAR-HYBRID ENERGY WITH MOBILE VEHICLE

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ABSTRACT

Sunlight in Indonesia is available quite a lot huh this is an opportunity that can be developed to produce electricity. The hybrid solar power system used is a combination of the use of electricity from the generator and a source of electricity from the conversion of solar energy. Water is also a basic need in life. Indonesia 2 climates namely, the dry season and the rainy season. During the rainy season, water is abundant, but in the dry season many areas experience drought, thus requiring water supply from the ground so that water pumps are needed to suck up the water, to be used for daily needs. The system is designed to function with a hybrid system, electrical energy from the generator and solar energy, which can automatically regulate the charging of energy to the battery and supply the load, with an effective working time of approximately 2 hours, the power used ranges from 536 to 537 watt hours, from the supply 12v 100Ah battery energy, installed in series, and has an automatic limit voltage value of 22 volts from the battery voltage. The electric energy generated is used to drive a water pump that is passed by a sediment filter, which consists of silica sand, iron removal, activated carbon and an ultra filter 1200 liters / hour to filter out impurities at the last level, so that water results are in accordance with the feasibility standard.

Keywords: hybrid system, water filter, and electric power.

INTRODUCTION

The availability of non-renewable energy sources needs to be considered for availability, due to limited reserves remaining, so that the utilization efficiency must be done, one of which is done by making a hybrid system (a combination of non-renewable energy sources and renewable energy sources), which will be applied to pumping and filtration of water for daily activities.

Hybrid electric system designed for water pumps. The design developed is to optimize the conversion of energy from solar panels and how to charge batteries, combined with electrical energy from non-renewable energy sources (electricity generators).

The design made aims to make efficient use of electric power that will be used to do pumping water, thus producing electrical energy for water pumps from electric sources that are efficient in the use of energy from non-renewable sources. The aspirated water will flow into the chlorine tube to kill bacteria, followed by sediment filtration (silica material, iron removal), activated carbon, and finally with an ultra filter (filtering water using a membrane), expected results have the feasibility of its use.

LITERATURE REVIEW

The components used for solar energy conversion are as follows:

A. Solar module

The main component of photovoltaic (PV) that can produce DC electrical energy is called solar panels or solar modules. Solar panels made of semiconductor materials (generally silicon), when exposed to sunlight can produce electric current. In this research, 100 solar cell panels of 8 watt peaks (wp) are used, as shown in Figure-1.

B. Battery

A battery is a storage of electrical energy used as a source of electrical energy when the sun does not illuminate solar panels. The battery used is a VRLA (Valve Regulated Lead Acid) battery. Used batteries capacity of 100 Ah, 12 V, as many as 2 pieces, with an efficiency of 80%, with a battery / battery charging time of 12 hours.

Figure-1. Panels or solar cell modules made of semiconductor materials.

C. Hybrid controller and inverter

Used a hybrid controller and a 1400 watt inverter, the input voltage of the solar cell panel is 24 volts and it produces a 24 volt battery charging voltage. The battery regulator is used to regulate the charging of electric current from the solar module to the battery. When the remaining battery charge is 20% to 30%, then the

regulator will decide with a burden. The battery regulator also regulates the excess battery charge and the excess voltage from the solar module. The benefit of this tool is also to avoid full discharge and overloading and monitor battery temperature. The battery regulator is equipped with a diode protection that prevents the DC current from the battery from entering the solar panel again. Inverter (converters DC voltage to AC), produces 220 volt AC phase 1 phase, with a maximum power of 1400 watts.

D. Inverter

Inverter is a device that converts DC into AC in accordance with the needs of the electrical equipment used. This tool converts the DC current from the battery / battery into an AC current for the needs of loads that use AC current.

Electric energy by an electric motor will be converted into kinetic energy which will drive the pump, so that it managed to pump water. The remaining water discharge will be stored in a temporary storage tank. Illustration like in Figure-2.

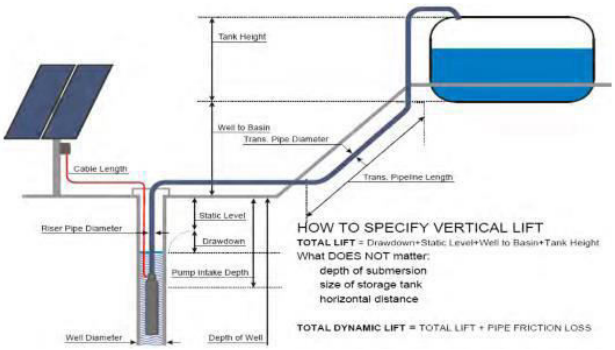

Figure-2. Photovoltaic applications in solar water pumps.

RESEARCH METHODOLOGY

The hybrid Electric Power System for Water Pump is made as in the following block diagram,

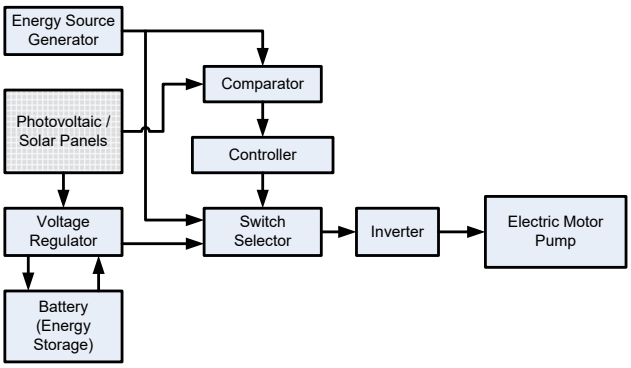

Figure-3. Hybrid Electric System Block Diagram for Groundwater Filtering.

The steps taken include:

a) Designing a hybrid electric power system

The design of a 100wp 12 volt photovoltaic linking circuit with a voltage regulator that has a function to stabilize the voltage generated from photovoltaic, The resulting voltage will be distributed and regulated by a voltage regulator to be used to charge the storage battery and transmits the voltage to the selector switch to be ready to move the electric motor (water pump motor).

b) Comparator system design

The design of a sensor and comparator circuit that functions to compare the energy that is ready to be used in this hybrid electric system, if the energy produced from photovoltaic is ready to drive electric motors, then the selector will direct the connection of energy sources to electric motors, if the energy from photovoltaic is not ready, then the source of the generator will be distributed, so that in this system efficient use of energy sources occurs.

c) The design of the controller system

The design of a controller circuit that will control the system in selecting the power sources to be used.

d) Designing an electric motor drive inverter system

Inverter circuit design function to change the sources of Direct Current (DC) power generated from the system, into an Alternate Current (AC) source, to be ready to move the motors used.

The steps in designing PV technology are as follows (calculation approach):

a. Looking for total usage load per day. The formula used is as follows:

Load Charges (Wh) = power x long time usage (1)

b. Determine the size of the solar module capacity in accordance with the load.

$$\text{Solar module capacity} = \frac{\text{total daily usage load}}{\text{daily solar insulation}} \quad (2)$$

c. Determine the battery / battery capacity.

The formula used is

$$\text{battery capacity} = \frac{\text{total daily energy needs}}{\text{system voltage}} \quad (3)$$

e) Design of water filter

The design of a water filter that will be used continuously, so the water from suctioning, put into a chlorine tube (to suppress bacteria), sediment filters (ingredients, silica, iron removal, activated carbon), and finally the ultra filter (filter by using a membrane), is expected to obtain proper filtration water.

THE RESULTS AND DISCUSSIONS

Equipment installation and equipment connections as shown in Figure-4.

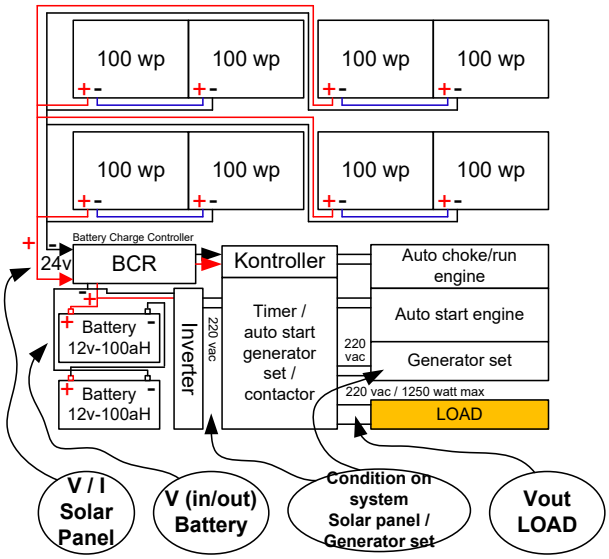

Figure-4. Connection of equipment testing and measurement.

To find out the power that can be used from the system and the power needed by the pump, voltage and current measurements are made when pumping water with the results shown in Table-1.

Table-1. Voltage measurement and conditions on the system.

No	Time Measurement	Condition Solar Panel		Condition Battery		Mode System		Vout Inverter (V)	Load (watt)
		V (V)	I (A)	V (V)	I (In/out) (A)	Solar Panel	Generator-set		
1	12.00pm	39,13	3,43	27.23	3,39 in	off	on	223,4	604,5
2	13.00pm	39,27	3,01	27,28	2,89 in	off	on	221	660,5
3	14.00pm	39,05	2,16	27,21	2,05 in	off	on	221,5	660
4	15.00pm	39,23	0,22	26,35	0,21 in	off	on	221,7	586
5	16.00pm	0	0	24,67	27,5 out	on	off	209,8	536
6	17.00pm	0	0	24,10	28,5 out	on	off	210	534
7	18.00pm	0	0	23	28 out	on	off	210,4	537
8	19.00pm	0	0	22	0	on	off	0	0

Measurements are made in an open field to get full sunlight, by turning on the system according to the mode, automatic mode, when there is sunlight that is converted to electrical energy (voltage and current), then the system mode will run the generator automatically and the electrical energy from the generator will be flowed directly to the load, Electrical energy from the conversion of solar panels stored in batteries.

From the measurements above, it can be seen, the system can function in accordance with the planned mode, automatic mode (generator set is on, when there is sunlight, and generator is off when solar energy (solar panel voltage is smaller than 24 volt battery voltage)), and the system uses energy from the battery. The battery will supply energy to a load of approximately 2 hours, with variations in the load of 536 to 537 watt hours The filter design to be used, has a maximum capability of 1200 liters / hour for the ultra filter, the results of water filtration in accordance with the maximum capacity of the suction pump 3m3 / hour, with a design as shown in Figure-5.

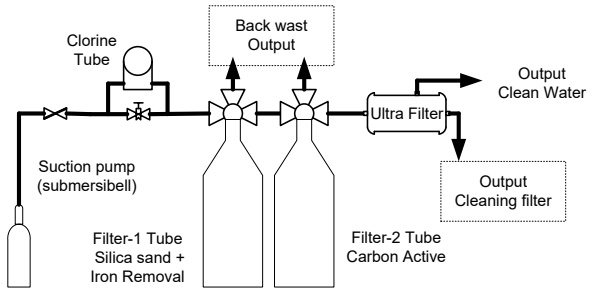

Figure-5. Construction Filters.

CONCLUSIONS

It was concluded, the system could function hybrid, electricity from the generator and solar energy, can function automatically charging energy to the battery and supply the load, with a work time of approximately 2 hours, and the power that can be used ranges from 536 to 537 watt hours, The system will completely stop when, the battery voltage is less than 22 volts (the deepest battery voltage), and no solar energy is obtained, The water pump can drain water through a filter designed with a capacity of 3m3 / hour.

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