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EXPERIMENTAL ANALYSIS OF AUTOMATIC MULTIPURPOSE SPRAYING MACHINE USING SOLAR ENERGY

¹ Utkarsh H Parulkar, ²Dr. Narendra N Wadaskar, ³Dr. Satish Ragit

¹Student, ²Professor, ³Professor

Department of Mechanical Engineering and HEAT POWER, GNIT, Nagpur-441501, India.

Abstract-

Pesticide application is the practical way in which pesticides, (including fungicides, insecticides, herbicides or nematode control agents) are sprayed to their biological targets (eg. crop, pest, organism or other plant). Public distress about the use of pesticides has shown the need to make this process as efficient as possible, in order to minimize their release into the ecosystem and human exposure. One of the most common forms of pesticide application, considering conventional agriculture, is the use of mechanical sprayers. Hydraulic sprayers comprise of a tank, a lance (for single nozzles) or boom, a pump and a nozzle (single or multiple). Sprayers changes a pesticide formulation, generally containing a

mixture of water (or another liquid chemical carrier, such as fertilizer) and chemical, into droplets, which can be tiny almost-invisible particles or large rain-type drops. This transformation is carried on by forcing the spray mixture through a spray nozzle with pressure. The size of droplets can be changed, by changing the pressure of nozzle under which it is forced, or by using different size of nozzle or a combination of both. Large droplets have the benefit of being less susceptible to spray drift, but they need more water per unit of land covered. By virtue of static electricity, small droplets are able to increase contact with a target organism, given that very still wind conditions exist.

Keywords – solar panel, sprayers, nozzle, battery, booster pump.

1. Introduction -

Today's world is of new technology and developments. hence rapid working machine and equipment's are going to be manufactured. An Engineer is constantly facing the challenges in bringing ideas and design into reality. New machines and techniques are being developed continuously to manufacture various products at cheaper rate and higher quality. The Automatic Multipurpose Spraying Machine Using Solar Energy and its analysis

is an innovative idea. It is a working project having a guarantee of success. This project can be made in less time hence we have selected this project. This machine is manually operated. A solar panel is a group of solar photovoltaic modules which are electrically connected and placed on a supporting structure. A photovoltaic module is a packed, connected group of solar cells. The solar panel can be used as a part of a larger photovoltaic system which can generate and supply electricity in residential and commercial applications. Each module is graded by its DC output power considering standard test conditions (STC), and generally having range from 100 to 320 watts. The efficiency of a module decides the area of a module considering the same graded output - an 8% efficient and 230 watts module will have double the area of a 16% efficient and 230 watts module. A single solar module will only deliver a limited amount of power; therefore, most installations comprise of multiple modules. A photovoltaic system typically includes a panel or an array of solar modules, an inverter, and sometimes a battery and / or solar tracker and interconnection wiring. Spray heads and Sprinklers are devices that spray in a fixed pattern, Sprays are not usually designed to work at 30psi "Pounds per square inch" pressures or above.

As in agricultures there are no such machines which condition the soil, for that purpose we need a machine this machine can perform the same. While cleaning the roads the problem of dust arises so as to decrease this problem a water spray can be applied first before cleaning. In agriculture the farmer has to work more while operating the manual spraying machine which causes many health issues so as to overcome this problem our machine can be employed. This machine also finds its application in gardening.

2. Material and Method -

In India, farming is done by traditional way, even after large development of industrial and service sector. The spraying is done manually by labor wearing backpack type sprayer which consumes more human energy. The weeding done with the help of Bulls which is costly for small farmers with small farming land, so to overcome these above-mentioned issues, we designed the equipment which will be useful to the farmer for spraying operations.

3. Objectives –

- Reduce the operational cost by using this new mechanism.
- Work reliably under different working conditions.
- Decrease the cost of machine.
- Decrease the labour cost by advancement in spraying method.
- Machine can be used in small farming land such as 5 acres.
- Making a machine which is able to perform both the operations. So, considering these scenarios related to spraying and weeding an attempt is made to design and fabricate an equipment which will able to perform both the operations with more efficiency and also will results in lesser cost.

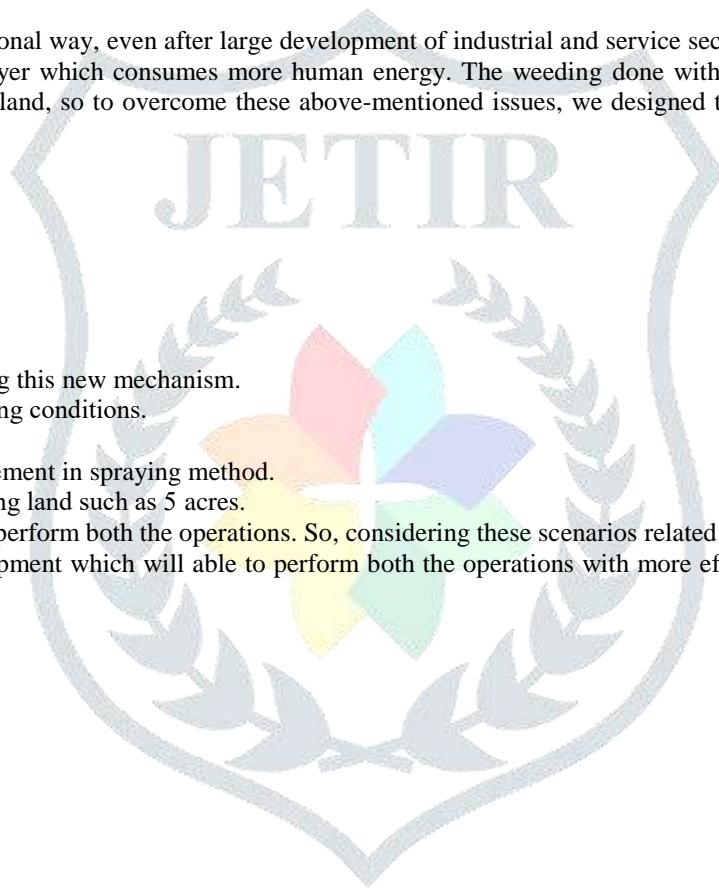




Fig:- block diagram of solar operated spraying machine

4. Construction-

This machine consists of five main parts: -

- i] Charge Control Circuit
- ii] Nozzle
- iii] Battery
- iv] Booster pump
- v] Solar panel

- The components are Booster Pump, Battery, Charge Control Unit are mounted on base of spraying machine.
- The nozzle is placed on vertical adjustable angle and also it is adjustable.
- Battery can be 12 volt and MPPT (maximum power point tracking) charge control circuit is used.
- Tank is use for storing the fluid and the capacity of tank is 30 liters.
- Solar panel device which is used to convert solar energy into electrical energy and which is considered as the future solution for all electrical power shortages.

4.1 Spraying Nozzle-

- A spray nozzle is a device with which we can disperse liquid into a spray. Nozzle is used for three purposes: to create impact force on a solid surface, to increase liquid surface area and to distribute a liquid over an area.
- There are wide variety of spray nozzle which use a number of spray characters to describe the spray.
- Spray nozzles can be classified based on the energy input used to cause atomization which is the breaking up of the fluid into drops.
- Spray nozzles can have one or multiple outlets; if a nozzle has multiple outlets, then that nozzle is called as a compound nozzle.
- Hydraulic spray or single-fluid nozzles uses the kinetic energy of the liquid to break it up into droplets. These are most widely used type of spray nozzles.

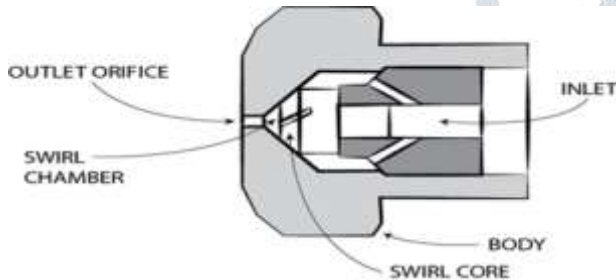


Fig: - 4.1.1 Nozzle

4.2 Charge Control Circuit-

- A solar charge controller is basically a voltage or current controller to charge the battery and prevent electric cells from overcharging.
- It directs the voltage and current coming from the solar panels and passing to the electric cell.
- Generally, 12V boards/panels is used in the ballpark of 16 to 20V, if there is no regulation, the electric cells will get damaged from overcharging. Generally, electric storage devices need 14 to 14.5V to get completely charged.

- The solar charge controllers are available in all sizes, features and costs. The range of charge controllers is from 4.5A to 60 or 80A.

Features of Solar Charge Controller -

1. Protects the battery (12V) from over charging
2. Reduces system maintenance and increases battery lifetime
3. Auto charged indication
4. Reliability is high
5. 10amp to 40amp of charging current
6. Monitors the reverse current flow

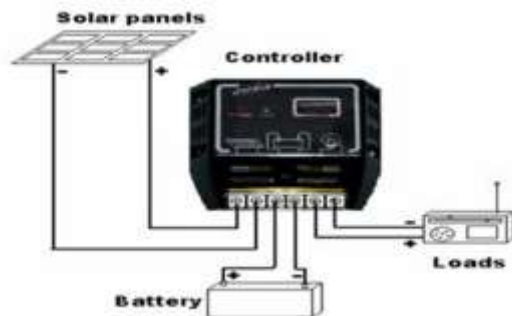


Fig: -4.2.1 charge control circuit

4.3 Solar Panel -

Solar panels concentrate and absorb the sunlight to generate electricity or heat. A photovoltaic (PV) module is a packed, connected arrangement of 6x10 photovoltaic solar cells. Photovoltaic modules comprise the photovoltaic assembly of a photovoltaic system that generates and supplies solar electricity in residential and commercial applications. Each module is graded by its DC output power considering standard test conditions (STC) which ranges from 100 to 365 Watts (W). The efficiency of a module decides the area of a module for the same graded output.



Fig: - 4.3.1 Solar Panel

4.4 Booster Pump -

- A booster pump is a machine which soars the pressure of a fluid. They may be used with gases or liquids, but the details of construction will vary depending on the fluid.
- A gas booster is similar to compressor, but it has simpler mechanism with only a single stage of compression, and is used to escalate pressure of a gas already above ambient pressure.
- Two-stage boosters are also used. Boosters may be used for increasing pressure of gas, charging gas cylinders transferring high pressure gas, and scavenging.
- The primary specifications to consider when selecting booster pumps are boost, horsepower, flowrate, pressure and power rating.

- Maximum flowrate describes the highest achievable rate of volume discharge through the pump.



Fig: - 4.4.1 Booster Pump

5. Solar panels algorithms -

Hardware implementation of various control algorithms for such systems is one of the 4.4. means to improve the efficiency of solar plants. There is numerous algorithm which allow hardware construction for solar systems^{2,4}. The most effective ones are those which uses the Maximum Power Point (MPP). It calculates constantly the instantaneous power by continuous voltage and current measuring and uses this data to modify the parameters of the converter. Thus, the value of charging current of damping system is controlled and the maximum output power is achieved, independent of the operation conditions of the inverter (temperature, load power, illumination level)^{5,6}. Depending on various parameters such as temperature, the position of the panel, the values of voltage and current vary within wide limits (Fig).

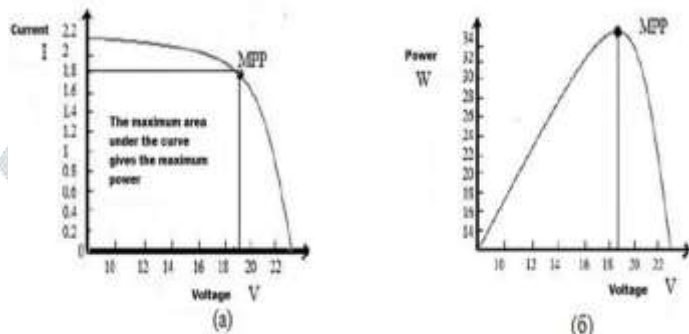


Fig. 5.1 Power versus voltage and current versus voltage functions.

6. Methodology -

Solar energy is clean and free source of energy. Proper utilization of solar energy for household and industrial requirements are now need of time. The method of solar based water pumping is essential technology to save valuable resources i.e., water and energy. One of the important application of solar based pumping is to irrigate farm crops. Solar water pump technologies used nowadays comprises of both AC and DC pumps. Major problem in commercialization of any solar project is the cost per watt of installed system. Farmers with higher income can afford new integrated system i.e. DC motor pump set with solar PV panel. Farmers having low- and middle-income levels are unable to afford high cost of integrated system. So, they rely on conventional electrical power source from SPANCO or other private electricity supplier companies. Ultimately, integrated solar water pumping method and concerned policies become useless to recover invested revenue. Here an attempt has been made to substitute existing AC water pumps of farmers. The experimentation was done on bore well submersible pump at Institute of Chemical Technology.

7. Model –



8. Working -

Solar Panel operates on the Photoelectric Effect principle. When the light in the form of photon falls on the Solar Panel, electricity is generated, this is then used to drive the appliances. This can also be saved in a battery. The battery will get charged with the help of Solar Panel. The battery can be further used to drive the motor. The charge controller used in the model is to protect the battery. When the battery gets fully charged the Charge controller circuit will cut off the Solar panel with the battery to avoid the overcharging of the battery. This will save the battery from getting impaired. The battery is used to drive the DC Pump. The control switch is being used to operate the activation and deactivation of the DC Pump. When the switch is activated, the DC Pump would create suction because of which the liquid from the storage tank will be given to the sprinkler.

Solar radiation can be used to charge the battery which can be used anytime to operate the sprayer. A Solar Panel converts solar energy directly into electricity using semiconductor layer or the PV cells. When Sunlight falls upon the Solar cell, light is absorbed and it is converted into Electrical Energy by means of Electron Movements. This Solar Panel is attached to 12V lead acid battery for depositing the electrical energy. A 12V DC motor is connected to these lead acid-battery to convert the electrical energy into mechanical energy.

9. Effect of nozzle on various parameters -

- **Effect of nozzle type, angle and pressure on coefficient of variation (C.V %)**

According to outcomes of coefficient of variation in the Table 1 and analysis of variance Table 2 indicates that pressure, angle and nozzle type effect significantly on the spray uniformity distribution. The decrease in nozzle angle causes increase in coefficient of variation of spray. Also, increase in nozzle pressure causes good uniformity of dose. It can be observed from Table 1 that the best value of coefficient of variation is 42.73% which was achieved by using nozzle TPE at pressure 300 kPa with angle 80°. In general, even nozzle with flat fan has provided uniform distribution as compared to standard flat fan.

- **Effect of angle, pressure and nozzle type on spray volume distribution**

The effect of interaction of angle, pressure and nozzle type, were also investigated. The interactivity among these factors changes the results of the spray.

10. Conclusions of the algorithms –

Algorithms which are obtained and are used for analysing information from the external installed sensors are cornerstone of solar panels control systems. It has the cons which cannot be revealed within modelling of system via software package of Mat lab. System will not be beneficial to the non-tropical countries. The control system using sun tracking system has to be able to observe the sun under the correct corner, and even during the overcast periods. During such times, sun tracking sensors work extremely inefficiently, actually preventing the computing block of system of the managing director of data which are responsible for developing operating signals for step motor. In case of the simulated system, the following situation of system is predicted. Various kinds and designs of systems of tracking together with various equipment are used to increase power efficiency of solar collectors. Coming to the distinguish systems of the closed and opened cycle, The closed systems with Sun tracking show the best accuracy of tracking. Open solar systems are characterized by searching vector of the star calculated by means of algorithms of astronomy. The closed cycle system loses a signal of feedback and, as a result, position of the sun when the sensor is shaded or the sun is covered by clouds. Open architecture systems use sensors with comprising open cycle or the algorithms where image of the Sun is not the main form of feedback. Received results can be beneficial in case of intelligent control systems operated on solar batteries in the modern-day basis.

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- D.H.Kokate^a, V.S.Korpale^a, S.P.Deshmukh^{a*} *Department of General Engineering, Institute of Chemical Technology, Matunga, Mumbai-400019, India*

- M. Donatelli a, * S. Bregaglio a, R.D. Magarey b, J.P.M. Whish d, L. Willocquet c, S. Savary
- Nor Azwadi , Nasir .S. Hassen*, Jamaludin and C. Sidik .M. Sheriff Thermo fluid Department , Faculty of Mechanical Engineering, Technological University of Malaysia, UTM Johor Bahru.
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