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# Solar Fertilizer Spray

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**Abstract:**
In the recent times solar energy finds place several agricultural chores such as drying agriculture products, for irrigation purpose, for pumping the well water in remote villages without electricity. This Technology on solar energy can be extended for spraying pesticides, Fungicides and Fertilizers etc., using Solar Sprayers. This application comes as a boon to farmers as solar energy is cheaply and abundantly available at their disposal and can be used to any extent possible. This system is eco-friendly, economical and eliminates emission of pollutants from combustion of fossil fuels.

## I. INTRODUCTION

A sprayer is a mechanical device used to spray the liquid like herbicides, pesticides, fungicides and fertilizers to the crops in order to avoid any pest. Sprayer provides optimum utilization of pesticides or any liquid with minimum efforts. Dusters and sprayers are generally used for applying chemicals. But these devices are less efficient than sprayers, because of the low retention of the dust. In Indian farms generally two types of spray pumps are used for spraying; hand operated spray pump and fuel operated spray pump, out of which hand operated spray pumps are most popular.

The main drawback of hand operated spray pump is that the user can't use it continuously for more than 5-6 hours since he gets tired after such a long duration. The insecticide reservoir is connected to the blower pipe. By continuously feeding this insecticide to the blower pipe the same is spread or sprinkled where wished. Liquid insecticide is sprayed on the crops using Spray pipe, which receives liquid from a reservoir with the help of a pump.

This pump is driven by another DC motor that receives power from the same battery. Thus insecticide in liquid from Is sprayed where wished. The project can also run emergency lamp using battery power thus this project can be of very much use and can be very beneficial for farmers. The running cost of project is nil protecting the crops from insects. Farmers mainly use hand operated or fuel operated spray pump for this task. This conventional sprayer causes user fatigue due to excessive bulky and heavy construction. This motivated us to design and fabricate a model that is basically trolley based solar sprayer In our design here we can eliminate the back mounting of sprayer ergonomically it is not good for farmers health point of view during spraying in this way here we can reduce the users fatigue level.

There will be elimination of engine of fuel operated spray pump by which there will be reduction in vibrations and noise. The elimination of fuel will make our spraying system eco-friendly. So with this background, we are trying to design and construct a solar powered spray pump system. Now days there are non conventional energy sources are widely used. The energy which is available from the sun is in nature at free of cost. In India solar Energy is available around 8 months in year .so it can be used in spraying operation. Solar pesticide sprayer can give less tariff or price in effective spraying. Solar energy is absorbed by the solar panel which contains photovoltaic cells. The conversion of the solar energy into electrical energy is done by these cells. This converted energy utilizes to store the voltage in the DC battery and that battery further used for driving the spray pump.

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## II. CONSTRUCTION

Main requirement for solar power solid state

### Components

The component has been done according to the Requirements .following are the list of components,

- Tank
- Solar panel
- DC Motor
- DC Battery
- Nozzle type
- Connecting pipe/boom
- Charge controller
- Trolley Assembly
- Mounting element

### Tank

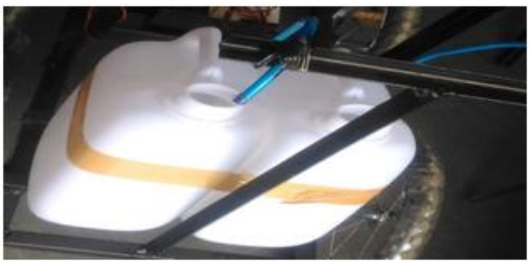

Fig 1: Fertilizer tank

Pesticide tank has capacity of 20 liters.PVC material tank is Use for it

### Solar Panel

Solar panel is the main component of the system.
It has the following specifications,

### Specifications

| | | |
|---|---|---|
| Maximum power (Pmax) | : | 5W |
| Rated power | : | 12V |
| Voltage at Pmax | : | 17.4V |
| Current at Pmax | : | 290mA |
| Open circuit voltage | : | 21.8V |
| Short circuit current | : | 310mA |
| Weight | : | 0.67kg |
| Dimensions (W*H*D) | : | 251*205*18 mm |

### DC Motor

DC motor is used to lift the pesticide from tank and delivers to the spray gun. DC motor has following specifications,
Weight of the motor: 500 gm.
Operating power required: 10 W
Operating voltage: 12 V
Operating current: 0.8 A
Motor speed: 1500 RPM
Liquid Discharge: 1ltr/Min

### DC Battery

Fig 2: 12 v battery

Weight of the battery: 2.5kg
Cost of the battery: 1050
Operating voltage: 12v
Rated current: 8 Ah

### Working

Solar energy obtained by the sun is converted into electrical energy using solar panel by photovoltaic effect. The output of the energy conversion is given to charge a deep cycle lead acid battery through a charge controller. The charge controller limits the rate at which electric current is added to the battery

Fig 3: Working Model

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It has advantages of preventing overcharging and protecting against over voltage. It employs the Pulse Width Modulation (PWM) technique which gradually stops charging the Battery; the main advantage of PWM is that the power loss in the switching device is very low. The output from the charge controller is given to the battery by a 3 pin socket through an electrical network.

### Advantages

- Easy in construction
- More economical
- Easy to clean and maintain
- It is a renewable energy source
- It does not create air pollutant & noise
- Easy to handle
- Do not required fuel hence cost reduce for spraying

## III. DESIGN CALCULATIONS

### Specifications

Type: Centrifugal Pump.
Liquid Discharge: 0.5lit/min to 1lit/min.
Speed: 1500 rpm.
Suction Head (hs) = 0.5m.
Discharge Head (hd) = 3m.
Suction pipe Diameter: 12mm =12*10^-3m.
Discharge pipe Diameter: 8mm =8*10^-3m

### Overall Efficiency of The Pump

η= $W*Hm$ 1000 /S.P.
Where, S.P = Power Required To Drive The Pump.
Hm = Monometric Head (in m)
η= Overall Efficiency of the Pump (Assume it is 60%)
η= $\rho*g*Q*Hm$ 1000 /S.P
η= $\rho*g*Q*Hm$ 1000 $*S.P$
η= 1000 $*9.81*8.33*10-6$ $*Hm$ $S$.Where, Q= 1lit/min= 1.66*10^-5 m^3/sec
Assume Overall Efficiency of Pump η=60%

### Hm= Manometric Head.

Hm=( $Po$ $\rho*g$ + $Vo$^2 $2*g$ +Zo) –( $Pi$ $\rho*g$ + $Vi$^2 $2*g$ +Zi)
Where, $Po$ $\rho*g$ = Pressure head at outlet of pump ( hd) = 3m.
$Vo$^2 $2*g$ = Velocity head at outlet of pump = $Vd$^2 $2*g$
$Pi$ $\rho*g$ = Pressure head at inlet of pump (hs) = 0.5m.
$Vi$^2 $2*g$ = Velocity head at inlet of pump = $Vs$^2 $2*g$
Hm = ($Vd$^2 $2*g$ + 3)- (0.5+$Vs$^2 $2*g$)
Vd (Velocity at Discharge) = $1.66*10^{-5}$ $\pi$ 4 $*8*10^{-3}$ = 2.16*10^-3 m/sec.
Vs (Velocity at Suction) = $1.66*10^{-5}$ $\pi$ 4 $*12*10^{-3}$ = 1.76*10^-3 m/sec.
Hm = 3+ (($2.16*10^{-3}$) ^2 2*9.81) - 0.5 + ($1.76*10^{-3}$ 2 2*9.81)
Hm = 14.71-2.45 = 12.26 meter.

### Overall Efficiency of the pump

η= $W*Hm$ 1000 /S.P.
Putting the above value in the equation, we get the power of pump.
Rearrangement of above equation
S.P = $\rho*g*Q*Hm$ $1000*\eta$
= $1000*9.81*1.66*10-5$ $*12.26$ $1000*0.60$ = 3.327*10^-3=3.27 Watt
Power required to the pump is 3.50 Watt.

### According To Pump Operating Power Battery

Type: Lead Acid Battery. Voltage: 12 V
Current: 7 Amps
Power = Voltage*Current = 12*7 = 84 Watt When the circuit is short then,
Voltage: 12v, Current: 1.5 Amps
Power = Voltage*Current = 12*1.5 = 18Watt
According to Battery Output Power Solar Panel Is Selected
Power: 20 watt
Dimension: 397*278*25 mm
Weight: 1.6 kg
Open Circuit Voltage: 21.5 volt
Short Circuit Current: 0.82Amp
Operating Current: 12 Amp.
When the Battery is connected to the Solar Panel through Charge Controller then some amount of load is applied on solar Panel

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Actual power of Solar Panel = voltage* short circuit current = 21.5*0.82 = 17.63 Watt.

Theoretical calculation of current and charging time of the battery

The current produced by the solar panel (I) was calculated by knowing the maximum power (P) of the solar panel and the voltage rating (V) of the battery that is given by $I$ =P/V

Therefore, $I$ =20/12=1.66Amp

Charging time (T) was computed by taking the ratio rating of battery in ampere hour (Ah) to the total current supplied by the solar panel. $T$ =battery rating in ampere hour/ total current consumed by the solar panel

Therefore, $T$ = 7/1.66=4.21 Hrs.min

## IV. CONCLUSION

As we know 70% of population of our country lives in villages & their main occupation is agriculture. The prominent aim of this project is to fulfill the tasks like hand spraying, IC engine spraying, and leg pump spraying etc. using non-conventional energy sources. Thus solar operated spray pump will help the farmers of those remote areas of country where fuel is not available easily. They can perform their regular work as well as saves fuel up to large extent. At the same time they reduce environment p government & also most demanded fuel.

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