International Journal of Research in Advent Technology, Vol.3, No.4, April 2015
E-ISSN: 2321-9637

Review of Solar Powered Pesticide Sprayer

Sarvesh Kulkarni[1], Karan Hasurkar[2], Ramdas Kumbhar[3], Amol Gonde[4], Raut A.S. [5]
Student (1234)Department of Mechanical Engineering ,Rajendra Mane College of Engineering and Technology, Ambav ,Devrukh, Ratnagiri, University of Mumbai, India
Faculty (5) Department of Mechanical Engineering ,Rajendra Mane College of Engineering and Technology, Ambav ,Devrukh, Ratnagiri, University of Mumbai, India
Email:.sarvesh.94.kulkarni@gmail.com[1], hasurkarkaran13@gmail.com[2], ramankumbhar94@gmail.com [3], amolgonde50@gmail.com4

Abstract- There is various non conventional energy sources from which the power can be generated. Solar energy, Wind energy, Tidal energy, Biogas energy these are various non conventional energy sources. Solar energy is widely available in nature throughout the year. So it can be utilized in miscellaneous application like spraying, drying and cooking etc. In agricultural areas spraying is one of the essential tasks. This paper gives the information about solar powered pesticide sprayer as in cost effective manner. Solar pesticide sprayer has various advantages over conventional sprayers. It also gives information about various components used in sprayer. As it has various advantages it will become popular in agricultural field.

Index Terms- Solar energy1, Pesticide sprayer 2, Non conventional energy source3.

1. INTRODUCTION

In Agricultural field spraying is one of the essential task as it affects the growth of the crops .In India there are three types of pesticide sprayer are used in agricultural field,

1. Manually operated spray pumps,
2. Fuel operated spray pumps,
3. Electrical spray pumps

1. Manually operated spray pumps
These are manually operated by the person. No any type of energy source is required in this type.

2. Fuel operated spray pumps
This pump uses fossil fuels for operation.

3. Electrical spray pumps
Electrical pump uses the electricity for charging the battery which drives the pump.

Above convention pumps has following disadvantages,

1. Manually operated pumps causes fatigue in operating person and can't be used for longer time.
2. In fuel operated pumps cost of operation is high due to fuels used in it and pumps emitted pollutant gases in environment.
3. Electrical pumps can't be used in some of rural areas due to insufficient supply of electricity.

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.

2. METHODOLOGY

Design and fabrication of solar powered pesticide sprayer has following steps,

2.1. *Selection of components*

The selection of component has done according to the requirement .following are the list of components,

1. Tank
2. Solar panel ab
3. DC Motor
4. DC Battery
5. Nozzle type
6. Connecting pipe
7. Mounting elements

3.1.1. *Tank*

Pesticide tank has capacity of 16 liters. In order to have less weight of the tank, plastic is purposely used for it.

3.1.2. *Solar panel*
Solar panel is the main component of the system.
It has the following specifications,
Capacity of panel - 40 watts

3.1.3. *DC motor*
DC motor is used to lift the pesticide from tank and delivers to the spray gun. DC motor has following specifications,
Current –2.2 A
Voltage –12V
Flow rate -3.1LPM

Figure: DC Motor

3.1.4. *DC battery*
DC battery is power source for this spray pump. This battery is charged by solar panel and removable. It has following specification,
Current – 8Ah
Voltage –12V

3.1.5. *Nozzle*
Nozzle is the basic component of the spray pump which generate spray pattern. The nozzle is selected as per the study. It decides how much area of the plant should cover. So according to detailed study of research paper it can be found that the flat fan nozzle gives the fine spray at 3 bar pressure. It covers the maximum area according to the spray angle [1]
The selection of nozzle can be done by following steps:-

1. Calculation of 'K' factor
Flow rate (lpm) =K*√Pressure (bar)
Flow rate=3.3 lpm
Pressure=3 bar
Therefore K=1.905
According to BETE manufacturer catalogue
Selected standard K=2.23

2. Calculation of nozzle dimension
So the selected nozzle is NFS 098.
The pipe dimensions are 1/4 inch = 6.35mm
So selected pipe diameter = 7mm

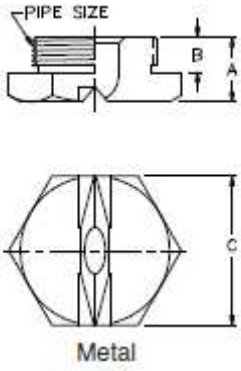

Figure: flat fan nozzle drawing

Dimensions of nozzle has been selected according to BETE manufacturer catalogue as
A = 11.9 mm
B = 7.11 mm
C = 17.5 mm

Figure: Metal flat fan nozzle

4. Selection of nozzle material
Generally brass, stainless steel, tungsten carbide, ceramic are used to manufacturing the nozzles. In this the brass is cheapest one but the main problem is that its corrosion resistance is less than that of the steel. Also it has got more corroded to the liquid fertilizers. As it is having such kind of drawbacks the material which is good enough is Stainless steel. It gives longer performance and produces the uniform pattern of spray .so that we had selected stainless steel material for nozzle.

3.1.6. *Connecting pipe*
It supplies pesticide from tank to the nozzle.
As discussed above the pesticide will always floe through the pipe. So it should not wear fast. So material used for the pipe is stainless steel.

3.1.7. *Mounting elements*
Mounting element used for making assembly

***2.2 General Calculation* [4]**
Following are the general calculation,

Power generated by solar panel= 40 watts
Power = energy/sec
Battery 12V, 8Ah current
Power =V*I
= 12*8
= 96WH

Time required charging the battery
= (96/40)*2.5
=6 hrs*

*Note-Time varies because of intensity of sun radiations at different days.

Backup time of sprayer
= (power stored in battery/power consumed by motor)
= 96/(2.2*12)
=3.63 hrs

3. ASSEMBLY

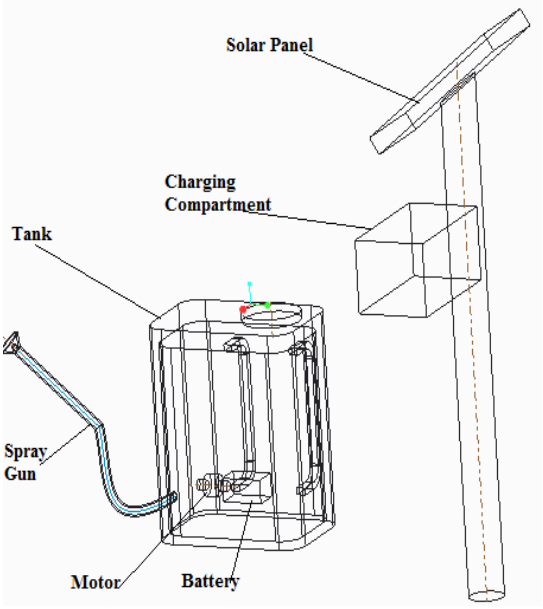

Figure: CAD model of the assembly

Assembly is done as shown in figure.

4. PRINCIPLE OF OPERATION

Sun radiations are incident on the solar panel. Solar panel consist of photovoltaic cells convert this solar energy in to the electric energy. Further this current generated by the solar cells is supplied to the battery via electric wires. One controller is placed between the solar panel and the battery which control the current which is supplied to battery. This battery is removable so after fully charged it can be removed and placed in the sprayer. In this way charging is done.

When battery is connected in the sprayer, it supplies the current to the DC motor and it runs at required speed. Motor has two opening one inlet and one outlet. Motor develops the suction and lift the pesticide from the tank and via connecting pipe supplies to the nozzle. Nozzle generates the spray pattern .After the in this way the pesticide is spray on the crops.

5. RESULT, MERITS AND ADVANTAGES:

5.1*Result*
According to the test conducted it is found that 12V, 8Ah battery can be charged fully in hours during the day.

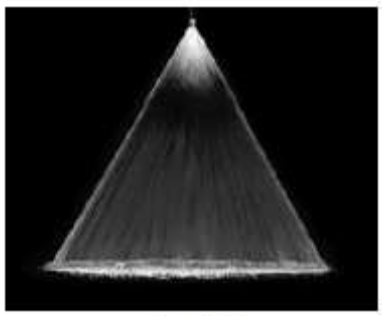

Figure: spray pattern obtained at 45° angle

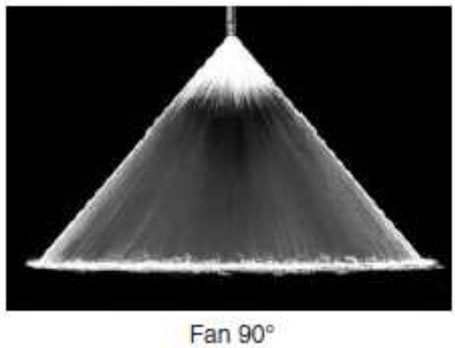

Figure: spray pattern obtained at 90° angle

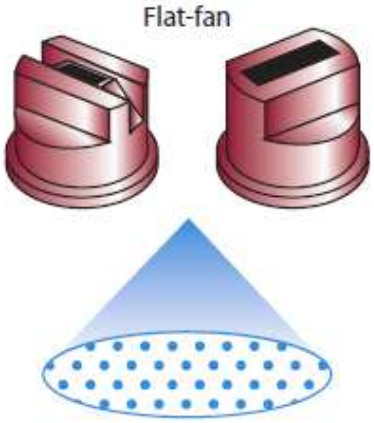

Figure: flat fan nozzles with spray pattern

5.2 *Merits*

- Less power consumption.
- Less operation cost
- Effective spraying

5.3 Advantages

- No any type of pollution.
- Less maintenance cost as compare to other.
- Easy in operating.
- Eco friendly

6. CONCLUSION

It is observed that, this model of solar powered pesticide sprayer is more cost effective and gives the effective results in spraying operation. As it runs on the non conventional energy source i.e. solar energy, it is widely available at free of cost. In now days where world is moving towards the finding the new ways for the energy requirement, it can be a better option for the convention sprayer. As India is a developing country, this product can be become more popular in rural areas.

Future scope:
1. The overall weight of the tank can be minimized by molding techniques.
2. The battery backup can be increased by adopting some new technology in electronic fields.

Acknowledgments

- This entire project was successfully completed with the valuable support and guidance of Prof. A.S. Raut .We truly grateful to have their support and guidance for completion of this work.
- We are thankful to Gunvant Udyog, Kolhapur for their support during the manufacturing and testing of the nozzle spray pattern in their firm.
- We acknowledge Sanmeed Solar Shoppe, Kolhapur for their help.

REFERENCES

[1] D.Nuyttens, K. Baetens, M .De schampheleire, B.sonck.(2007): Effects of nozzle type, size and pressure on spray droplet characteristic. Biosystem Engineering 97,pp 333-345.
[2] Pedro Teixeira Lacava, Demétrio Bastos-Netto, Amílcar Porto Pimenta (2004): Design procedure and experimental evaluation of pressure-swirl atomizers.24th International Congress of Aeronautical Science.
[3] MD .Atiar Ali: Solar system calculation and design.
[4] Brent A. Pringnitz.: Sprayer nozzle selection for pesticide performance and drift reduction. Extension program specialist, Department of Agronomy Iowa State University.
[5] John W. Slocombe: Agricultural spray nozzle : selection and sizing, extension agricultural engineer ,Kansas State university
[6] BETE Flat fan nozzle catalogue,WWW.BETE.COM.