

FABRICATION OF AGRICULTURAL MULTIPURPOSE SOLAR POWERED SPRAYER

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Abstract: In this project a Semi- automatic solar powered agricultural sprayer was fabricated which replace the conventional agricultural sprayer. Main aim of this work is to make the conventional agricultural sprayer to a semi- automatic one by equipping an electric motor and a wheel assembly. The motion of the wheels is converted into reciprocating motion of piston in the sprayer. In this work a solar panel and a battery was installed to supply power to motor. This reduces the wage fossil fuels. The spraying of pesticides and insecticides is traditionally done by farm worker carrying backpack type, Engine Driven Sprayers and Hydraulic sprayers. All these mentioned techniques are costlier and somewhat harmful to the worker because the pesticides involves in Toxic condition. Skills of labor required depend upon the complexity of the equipment machinery used. To eliminate these problems, introducing the Solar based pesticides sprayer pump is one of the improved versions of petrol engine pesticide sprayer pump. It is vastly used in the agriculture field & also used for many purposes. This is having more advantages over petrol engine sprayer pump. It uses the solar power to run the motor. So it is a pollution free pump compared to petrol engine sprayer pump.

Keywords- Sprayers, Mechanization, Toxic pesticides, solar powered agricultural sprayer

1. INTRODUCTION:

India is predominantly an agricultural based country with approximately 60% of population of India is very much dependent on farming either directly or indirectly. The farmers have been using the same methods and equipment for ages for example the seed sowing, spraying, weeding etc. operations are carried out by same techniques. There is need for development of an effective spraying machine for increasing productivity levels. Most of the late developing countries of Asia have the problem of higher population and low levels of land productivity as of compared to the developed nations. One the main reasons for lower productivity is insufficient power availability for the farms and very low levels of farm mechanization. This is especially true for India.

2. LITERATURE SURVEY

Siddharth Kshirsagar, Vaibhav, Prashant Umak, Govind Munde,[1] In this research paper author has mentioned importance of mechanization. Conventionally Farm worker carrying backpack type sprayer which requires more human effort and these are more costly and complex. **Kiran CH, Rajesh Sthavarmath, Abhishek, R Gowtham Raj**[2] There are many types of sprayers used by farmers; most commonly used sprayer is backpack sprayer. It has many limitations like low pesticides carrying capacity, inefficient spraying, prolong use of backpack sprayer will lead to back problems of the person using it. **Laukik P. Raut, Smit B. Jaiswal, Nitin Y. Mohite.**[3] In our country farming is done by traditional way, besides that there is large development of industrial and service sector as compared to that of agriculture. The spraying is traditionally done by labor carrying backpack type sprayer which requires more human effort. **Dhiraj N.Kumbhare, Vishal Singh, Prashik Waghmare, Altaf Ansari, Vikas Tiwari, Prof. R.D. Gorle,** [4] This machine will be operated by remote with maintaining some distance therefore no harm effect will occur to human health Also it covers larger area in less time, and also labor cost will reduce and money saved. **M.Venkateswarlu, M.Ashok Kumar, M.Nagakiran, K.SagaKumar.**[5] Conventional sprayers are high in cost and 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 to eliminate this problem we use Solar Power. **Sarvesh kulkarni, Karan Hasurkar , Ramdas kumbhar**[6] There are 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. **Varikuti Vasantha Rao, Sharanakumar, Dr. Basavaraj Amarapur**[7] In this paper, the design and implementation of multiple power supplied fertilizer sprayer has been presented. The proposed system is the modified model of the two stroke petrol engine powered sprayer which minimizes the difficulties of the existing power sprayer such as operating cost, changing of fuel etc. **Nitish Das, Namit Maske, Vinayak Khawas, Dr. S. K. Chaudhary**[8] Day by day the population of India is increasing and to fulfill the need of food, modernization of agricultural sector is important. But till now our farmers are doing farming in same traditional ways. They are doing seed sowing, fertilizers and pesticides spraying, cultivating by conventional methods. **R. Joshua, V. Vasu and P. Vincent**[9] Finding solutions, to meet the "Energy - demand" is the great challenge for Social Scientist, Engineers, Entrepreneurs and Industrialist of our Country. According to them, Applications of Non conventional energy is the only alternate solution for conventional energy demand.

3. SPRAYING METHODS:

Insects are responsible for the destruction of crops and to prevent them we use Pesticides (or) Insecticides are sprayed on crops using devices known as the Pesticides sprayers.

In India there are different types of conventional sprayers can be used, some of them are:

3.1 Hand Operated Sprayer:

Hand operated sprayer is operated by hand so that the discomfort occur while spraying. And also harmful to the worker while using hazardous chemicals.

3.2 Engine Operated Sprayer:

As we know that engine operated sprayer is working on petrol. Petrol is costly fuel so in farmer economical point of view it is not good.

3.2 Battery motor pump sprayer:

Electric motor pump sprayer is used electricity for charging battery. In this way the pump can drive according to battery charging.

PROBLEMS WITH CONVENTIONAL SPRAYERS:

The main problem with this Hand Operated and Fuel Operated sprinklers are Creates impact on Human Spinal cord and results into back pain and also these are somewhat Hazardous to Human Health.

- 1) Hand operated sprayer cannot be use continuously spraying. And moreover it is hazardous to health.
- 2) Engine operated sprayer can be operated on petrol so it is not possible to use every farmer. Because it is high cost.
- 3) It is somewhat costlier here, 70% of people can be live in rural areas. In rural areas there is insufficient electricity. So it is not possible to use electric motor pump for spraying without electricity also timely battery recharge is required

So to overcome all these problems, we are introducing multipurpose sprayer powered by solar energy it is also useful for Agricultural purpose also, it is mostly useful in Hill stations and also for domestic gardening purposes.

4. COMPONENTS USED AND THEIR DESCRIPTION:

The components that are used in the project “FABRICATION OF AGRICULTURAL MULTIPURPOSE SOLAR POWERED SPRAYER” are as follows,

List of Materials

SL. NO.	NAME OF THE PARTS	MATERIAL
1	Dc motor	12v
2	Chain drive	ms
3	Wheel	Plastic
4	Battery	Lead acid
5	Crank plate	ms
6	Spur gear	ms
7	Bearing	Steel
8	Solar panel	Amorphous
9	Sprayer	Plastic
10	Nozzles	Plastic
11	Tank	Plastic

4.1. DC MOTOR:

An electric motor is a machine which converts electrical energy to mechanical energy. Its action is based on the principle that when a current-carrying conductor is placed in a magnetic field, it experiences a magnetic force whose direction is given by Fleming’s left hand rule.

4.2. CHAIN DRIVE:

Chain drive is a way of transmitting mechanical power from one place to another. It is often used to convey power to the wheels of a vehicle, particularly bicycles and motorcycles.

4.3. WHEELS:

Motorcycle wheels are made to cope with radial and axial forces. They also provide a way of mounting other critical components such as the brakes, final drive and suspension.

4.4. BATTERY:

In isolated systems away from the grid, batteries are used for storage of excess solar energy converted into electrical energy.

4.5. SPUR GEAR:

The spur gears, which are designed to transmit motion and power between parallel shafts, are the most economical gears in the power transmission industry. spur gears or straight-cut gears are the simplest type of gear

4.6. BEARING WITH BEARING CAP:-

The bearings are pressed smoothly to fit into the shafts because if hammered the bearing may develop cracks. Bearing is made up of steel material and bearing cap is mild steel

4.7. SOLAR PANEL:

This is the Key part of the product. Solar panel is a connected assembly of photovoltaic cells. Photovoltaic modules constitute photovoltaic system that generates and supplies solar electricity. It grabs sunlight and converts solar energy into electrical energy.

4.8. NOZZLES

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.

4.9. TANK:

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

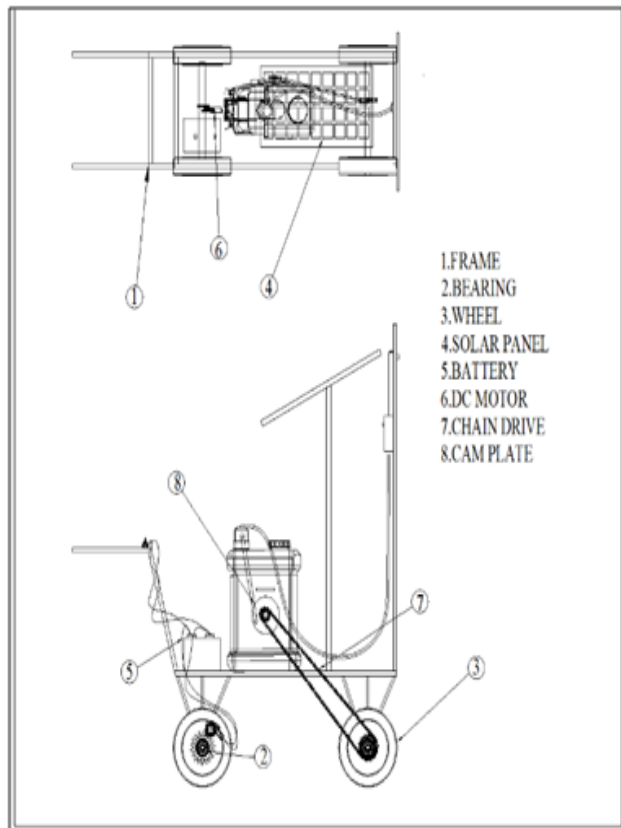


Fig 1: Front and top views

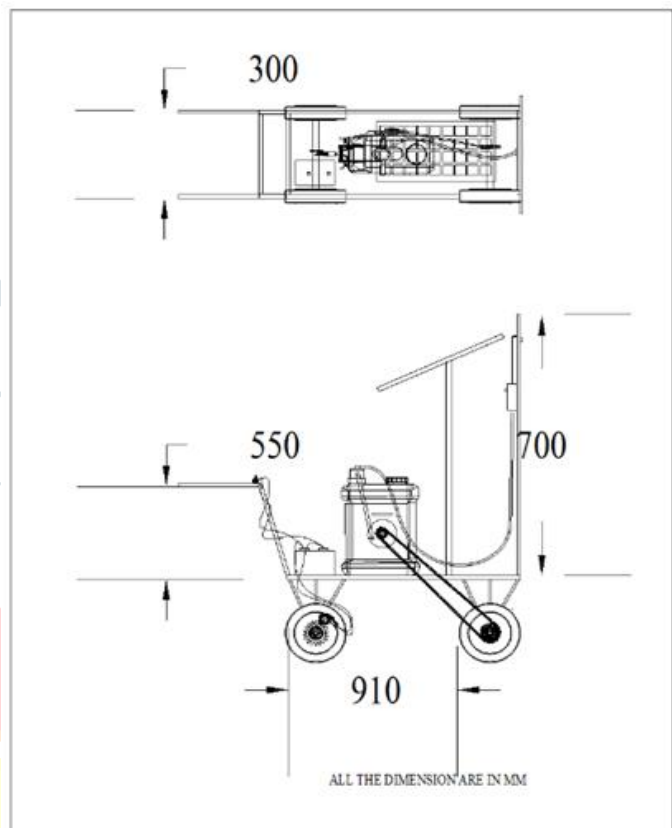


Fig 2: Views with dimensions

5. FABRICATION PROCESS & WORKING MECHANISM

These are steps to fabricate this solar powered agricultural sprayer vehicle.

Cutting operations

Welding

Drilling

Grinding

Fitting or Assembling

5.1. CUTTING OPERATIONS:

To cut the pipe we are using hand cut saw machine by this easily and accurately we can separate the lengthy bar or pipe in equal dimensions.

5.2. WELDING:

Welding joints different metals with the help of a number of processes in which heat is supplied either electrically or by mean of a gas torch. Here we are using Arc welding.

5.3. DRILLING:

Drilling is used to drill frame bars to install the tank in the middle part of the frame or chassis. After the drilling we can install the tank with bolt and nut arrangement. And also drill the solar panel holder rod.

5.4. GRINDING PROCESS:

The nozzles edge parts which are given in threaded shape but those are never fitted in the pipe which is used to hold the nozzles in the top front of the spray vehicle. Not only for this but also to remove the sharp edges of the cut pipes.



Fig 3: Fitting the tires



Fig 4: Installing the tank



Fig 5: Spraying pipe



Fig 6: Arrangement of Solar panel

5.5.ASEMBLING (OR) FITTING PROCESS:

The last step is assembling or fitting step. In this step all the parts are combined or joined to make it as a full-fledged working vehicle.



Fig 7: Fabricated spraying vehicle

5.6.WORKING:

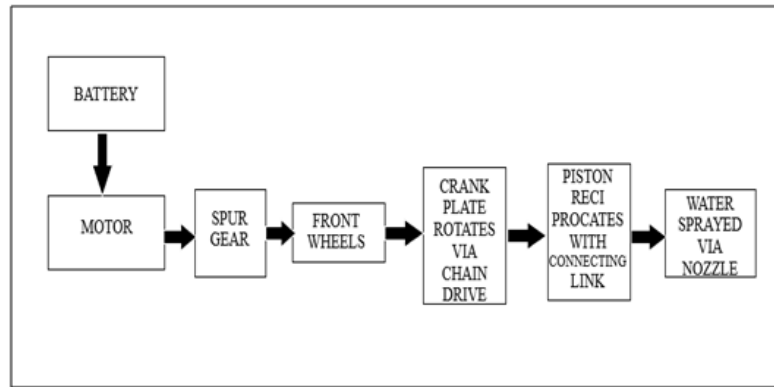


Fig 8: This is the working flow chart of multipurpose agricultural sprayer

6. GENERAL CALCULATIONS:

Solar panel: Power = 24w, Voltage =12v

Then current produced by the panel is given as $I = P/V$ $I = 24/12 = 2$ Ah

Battery: Voltage = (V) =12v, Current=(I) =7Ah=0.116Amp, Power= $V*I=12*7=84$ WH =1.4 watts

DC Motor: Volt=12v D.C Power=26 watt Rpm= 60 Rpm

Then current required for the pump is given as $I = P/V$ $I = 26/12 = 2.16$ Ah

FLOW RATE OF NOZZLE:

Nozzle Type – Solid Nozzle

Nozzle Angle – 90 degree

Nozzle radius – 1 mm = 0.039 inch

$Q_n = 28.9 * D^2 * (86.73)^{1/2}$

Where, Q_n = Flow rate of water from nozzle (gpm), D = Nozzle diameter (inch), P = Pressure at nozzle (psi)

$Q_n = 28.9 * (0.039)^2 * (86.73)^{1/2} = 0.4093$ gpm , $Q_n = 1.86$ lpm

Following are the general calculation,

Power generated by solar panel= 24 watts

Power = energy/sec

Battery 12V, 7Ah current

Power = $V*I = 12*7 = 84$ WH

Time required charging the battery = $(84/24)*2 = 7$ 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)
= $84 / (2.2*12) = 3$ hrs

7. CONCLUSION

1. Solar based pesticide sprayer is one of the improved models of pesticide sprayer pumps. The fabricated model satisfies all the requirements of the user and it is designed according to the parameters.
2. It involves minimum intervention of manpower. It completely eliminates use of fossil fuels and uses renewable resource i.e. solar energy.
3. This is having more advantages over petrol engine sprayer pump. It uses the solar power to run the motor. So it is a pollution free pump compared to petrol engine sprayer pump.
4. The solar water-pumping technology is commercially available, has-proven record of reliability, require, minimal skilled manpower once in operation, and maintenance cost is also very minimal and affordable.
5. The photovoltaic pumps have many advantages including they operate on freely available sunlight and therefore incur no fuel or electrical costs. The designed model is compact, affordable, user friendly and produces no bad impact on environment.

Hence the designed model is less cost and eco friendly and easy to operate.

Future scope:

We can add Wireless Technology to Control Machine i.e. fully automatic.

We can interface sensors to this Machine so that it can monitor some parameters.

8. REFERENCE

- [1]: Siddharth Kshirsagar, Vaibhav, Prashant Umak, Govind Munde, 02 March 2015. "Design and Development of Agriculture Sprayer Vehicle"
- [2]: Kiran CH, Rajesh Sthavarmath, Abhishek, R Gowtham Raj, May 2018, "Fabrication of Multipurpose Pest Sprayer".
- [3]: Laukik P. Raut, Smit B. Jaiswal, Nitin Y. Mohite. "Design, Development and Fabrication of agricultural pesticides sprayer with Weeder".
- [4]: Dhiraj N. Kumbhare, Vishal Singh, Prashik Waghmare, Altaf Ansari, Vikas Tiwari, Prof. R.D. Gorle, Apr-2016, "Fabrication of Automatic Pesticides Spraying Machine".
- [5]: M. Venkateswarlu, M. Ashok Kumar, M. Nagakiran, K. Saga Kumar. "Agricultural Solar Sprayer with Multi Applications".
- [6]: Sarvesh kulkarni, Karan Hasurkar, Ramdas kumbhar, April 2015. "Solar Powered Pesticide Sprayer".
- [7]: Varikuti Vasantha Rao, Sharanakumar, Dr. Basavaraj Amarapur, August 2013, "Multiple Power Supplied Fertilizer Sprayer".
- [8]: Nitish Das, Namit Maske, Vinayak Khawas, Dr. S. K. Chaudhary, April 2015, "Agricultural Fertilizers and Pesticides Sprayers".
- [9]: R. Joshua, V. Vasu and P. Vincent, 05 May – 2010. "Solar Sprayer - An Agriculture Implement".

