

Design and Development of Engine Powered Sprayer Machine

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ABSTRACT: Sprayer is device used to spray liquid. In agriculture, sprayer is a piece of equipment that is used to apply pesticides on agricultural crops. Mainly, the general spraying technique uses hand operated and power sprayers with backpack. By using existing pesticide sprayers very less area is covered while spraying and hence more time is required to spray the entire land and also some existing sprayers are required petrol or diesel as a fuel so that the labour cost of the sprayer is also high. Some series sprayers the pipe line is not rotated in 360 deg and discharge is also very low ($Q < 0.9$ litter/min). To overcome the above problems the present work deals with the design and Fabrication of pesticide series sprayer with the feature of 360 deg. pipe rotation and adjustable pipe length. In this work the model was designed by using CATIA and fabrication was carried out by different techniques. Real time testing was carried out at different agricultural crops.

KEY WORDS: Pesticide Series spraying machine, CATIA.

I. INTRODUCTION

In India 70% people lives in rural areas and main source of their income is farming. In this regard have to make agricultural machine that can help to save their time. Present in agricultural field sprayers are used. These sprayers are hand operated and power operated. According power operated this paper introduced a sprayer is called as series sprayer. This sprayer consists of tank, battery, submerged pump, pipe and nozzles. The battery and submerged pump are incorporated in tank at the bottom. Numbers of nozzles are located on trough out length of the pipe in series way.

Spraying of pesticides is an important task in agriculture for 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 spray pump system.

II. LITERATURE REVIEW

Literature review is nothing but the work done before the present time on the same topic. So, we know that people doing farming from ancient time for food and other purpose. For better grown of crop they spray pesticides on them. There are many types of pesticides spraying technique available now that we can find as we move from east to west and also from north to south. It is difficult to mention all those techniques here. But we tried to mention main techniques used and best known to us. People in India use backpack type sprayer which is carry on back of the person with 15 lit maximum capacities and one nozzle in one hand while other hand is used to pump the machine to create pressure. Another machine which is developed and supplied in England was manufactured and patented by Holme Farm Supplies Ltd. This machine is consisting of water tank on tractor. This water tank contains liquid pesticides. On back side of it a long rod is attached on which nozzles are attached. This is used to spray pesticides. Also, many such machines are manufactured by this company for large scale farming and large size crops.

CONSTRUCTION AND WORKING

PRINCIPLE:

The machine consists of the main body frame, battery, DC Motor, Nozzles, Pipes, Wheels, Tank and DC Pump. This is the three-wheel drive machine. Vertical arm is attached at centre of back side of main frame, carrying horizontal arm. The nozzles are fitted to the pipes which are attached with the vertical and horizontal arm. The horizontal arm is movable on vertical arm. The tank is kept at the centre of the body. The DC Pump is kept at the back side of the tank while the battery is kept at the

front side of same. tank while the battery is kept at the front side of same.



Figure 1 actual model

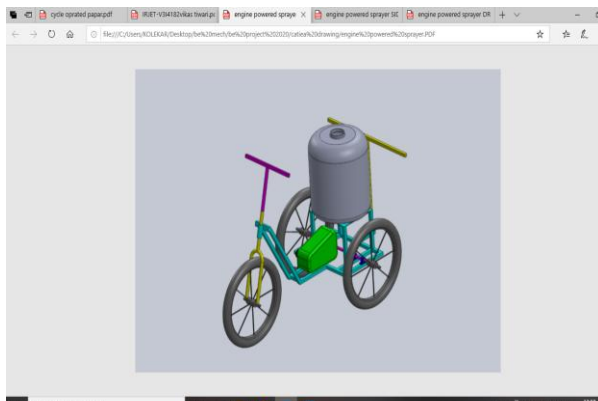


Figure 2 assembly

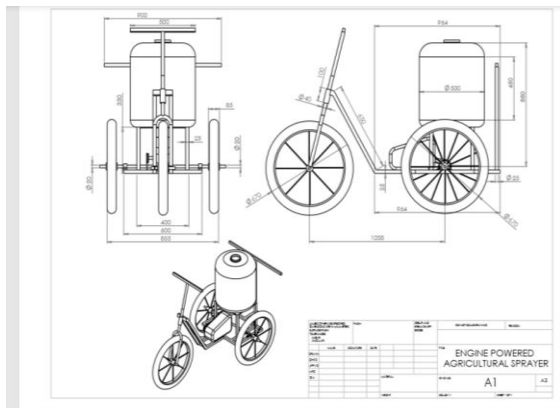
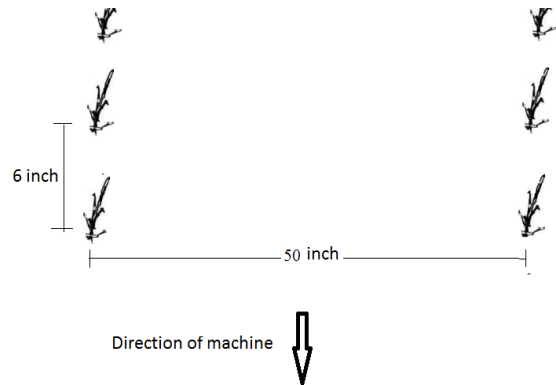


Figure 3 details

Design and calculations:

1-Nozzle:

Selecting the correct type and size of spray nozzle is essential for each application. The



nozzle determines the amount of spray applied to an area, the uniformity of the application, the coverage of the sprayed surface, and the amount of drift. Although nozzles have been developed for practically every kind of spray application, only a few types - extended range flat-fans, single fluid full cone nozzle, etc. are commonly used in the application of crop protection products.

Calculation of nozzle: -

Discharge of pump = mass flow rate (\dot{m}) = 5 lit/min = $8.33 \times 10^{-5} \text{ m}^3/\text{sec}$

$\dot{m} = \text{density} \times \text{area} \times \text{velocity}$

$\dot{m} = \rho \times A \times V$

$\dot{m} = \rho \times \frac{\pi}{4} \times d^2 \times V_1$

$8.33 \times 10^{-5} = 1000 \times 0.785 \times 0.01^2 \times V_1$

$V_1 = 0.00106 \text{ m}^3/\text{sec}$

therefore,

$A_1 V_1 = A_2 V_2$

$0.785 \times 0.01^2 \times 0.00106 = 0.785 \times 0.003^2$

$V_2 = 0.0117 \text{ m}^3/\text{sec}$.

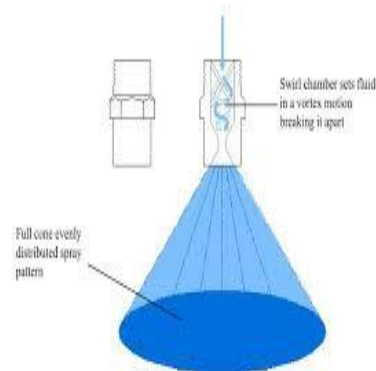


Figure 4 Nozzle

2-Design of drive shaft

As per actual practice and requirement of sprayer Machine travel speed considered = 1 m / sec To maintain proper height of sprayer we can adjust as per farmers requirement.

To move forward 1 m/sec time required considered 5 Sec.

Total travel of machine in 1 acre
 Travel distance = 1ft x 40ft x40ft
 = 1600 ft = 492 meter.
 Total time required = 492 x 5 = 2460 sec
 = 41 min
 = 60 min considered.

So roughly we can say that target of plantation set up for 1 acre is 1 hour
 Wheel shaft rpm

$$V = \frac{\pi DN}{60}$$

N = 31.84 rpm where D = 600mm, V = 1 m/sec

N = 30 rpm considered

Distance covered by in one revolution = πD
 = 1.884 m

Totl plants plantation in one revolution = 1.884 / .15 = 12.56 = 12 plants

The distance between two plantation = 0.15 m

Speed of plantation shaft = 12 x 30 = 360 rpm

Torque required on wheel shaft =

Load of developed mechanism + sprayer system

1. Total estimated approx weight of machine = 80 kg
2. Total weight of sprayer system = 50kg

Total weight: - 80+50 = 130 kg = 1300N

Design load considered = 1.2 x 1300
 = 1560N

Total torque on wheel = 1560 x 0.3 = 468 N-m

we know power

$$P = \frac{2\pi \times N \times T}{60}$$

P = 1469 watt

P = 1.46 kw

By considering agricultural application and extra jerk and safe design prime mover power considered = 2 hp= 1492WATT

So for our project work we have selected engine up to 2hp.

Tank: - Tank is the unit where we can store the mixture of water and pesticides. To protect it from corrosion and for log life and to reduce weight it is made up of plastic. Tank capacity – 15 lit. hight=580, diameter =500

Frame: - Frame is nothing but the chassis for a machine or vehicle. It is the unit where remaining parts of the machine are fitted. To withstand in heavy weight parts, it is made up of Cast Iron.

Pipe: - Pipe is the unit used to carry water from sump or tank to DC Pump and from DC Pump to

nozzles. To reduce cart weight and to eliminate corrosion effect it is made up of plastic.

Metallic T & square: - T is nothing but the 3-way joint in which it accepts the liquid flow from one direction and transfers it to other 2 directions and vice versa. Also, square is same to it but having 4 directions. Both are made up of metal and having internal diameter 8 mm.

III. CONCLUSION

1. It is found that the existing pesticide spraying machine runs on human power. That portable backpack sprayer type machine may cause health problems for person as he directly comes in contact with pesticide. Also, the human who is spraying the pesticides faces the problem of lumber pain.

2. In advent of avoiding such problems enlisted in first point, an automatic pesticides pesticide spraying machine seems an alternative concept.

3. Comparison between the existing machineries and present machine shows that the tricycle operated machine can work very efficiently with respect to covering area, time and cost of spraying process. Also, it seems economical.

4. During testing the speed of vehicle varies continuously; it is because of varying track resistance. Further it is assumed that the spraying would be stopped partially but the pressure generated in spraying pump continues to spray the pesticide because the pressure developed in the pump is sufficient enough to spray for few minutes.

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