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Design And Development of Agriculture sprayer and fertilizer dispenser

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***Abstract* - Combination of Agriculture operations in a single machine can bring about considerable cost reduction, and reduce the time and effort required in the extremely labour - intensive agriculture work and offer solution to the problems of shortage of labour and expensive agriculture operations. The pesticide spraying and fertilizer dispensing are above mentioned agriculture operations prominently done manually. The pesticide spraying is done using a back mounted spray pump whereas the fertilizer dispensing is done using hands.**

Combination of the above two operations is done with the view to reduce considerable man hours and efforts and make them considerable economical. The paper discusses the design and analysis of the critical components of the machine.

1.INTRODUCTION

A sprayer is a device used to spray a liquid. In agriculture, a sprayer is a piece of equipment that spray nozzles to apply herbicides, pesticides, and fertilizers to agricultural crops. Sprayers range in size from man-portable units (typically backpacks with spray guns) to self-propelled units similar to tractors, with boom mounts of 60–151 feet in length.

System design and theoretical derivation of dimensions of the agriculture vehicle for sprayer arrangement. System Design and theoretical derivation of dimensions of the agriculture vehicle for fertilizer dispenser arrangement. Design of frame structure. Design validation of the stress produced in the parts of the sprayer drive system Strength analysis will be done and results be validated using ANSYS software. Design validation of the stress produced in the parts of the fertilizer drive system Strength analysis will be done and results be validated using ANSYS software.

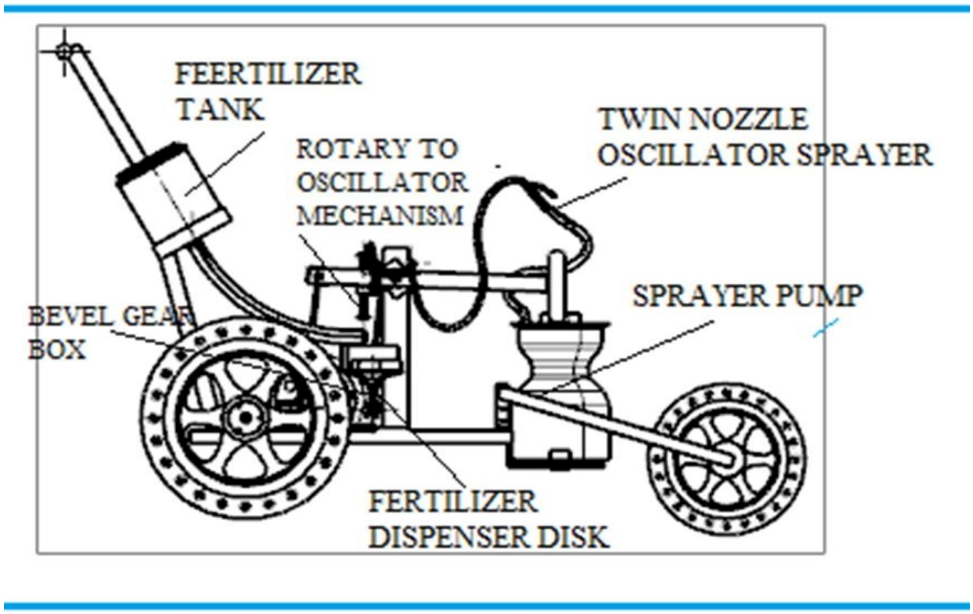
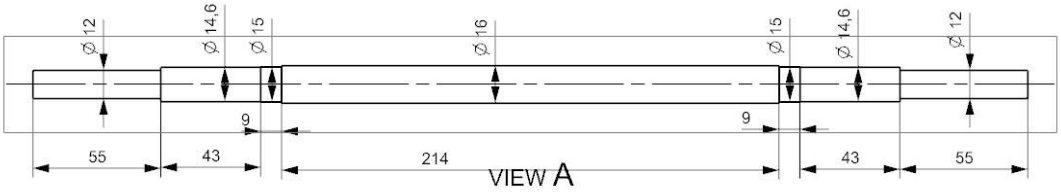


Fig: Fertilizer Sprayer Vehical

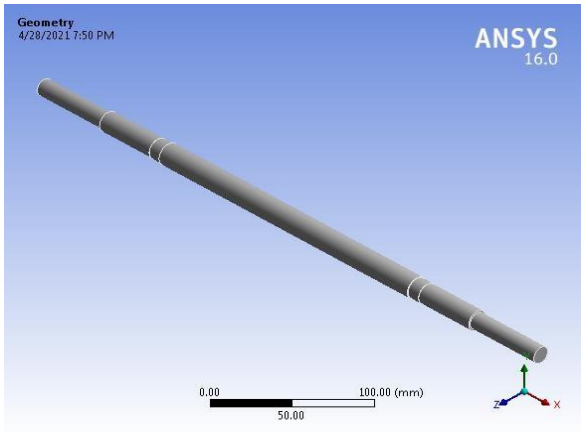
CALCULATION AND ANALYSIS

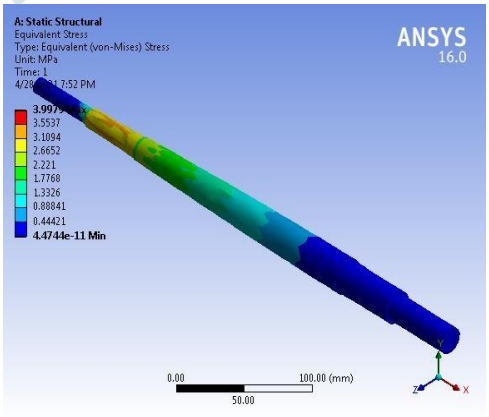
Design Of Rear Wheel Shaft:

Considering that the maximum rear wheel diameter for the vehicle = 14 x 25.4 =356 mm Traction Coefficients for normal Tires Rolling coefficient of friction of Rubber tyre on dry asphalt = 0.013 The tractive force between a wheel and the surface can be expressed as $F = \mu_t W = \mu_t m a_g$ (1) where F = traction effort or force acting on the wheel from the surface (N, lb_f) μ_t = traction - or friction - coefficient between the wheel and the surface W = weight or vertical force between wheel and surface (N, lb_f)) = Not to exceed 30 kg m = mass on the vehicle = 30 (kg, slugs) a_g = acceleration of gravity (9.81 m/s^2, 32.17405 ft/s^2) F = 0.04 x 30 x 9.81 = 11.72 N Torque (2 wheels) =2 x F x Radius of wheel = 2 x 11.72x 0.178 = 2.24 N-m Torque on one wheel = 1.12 N-m

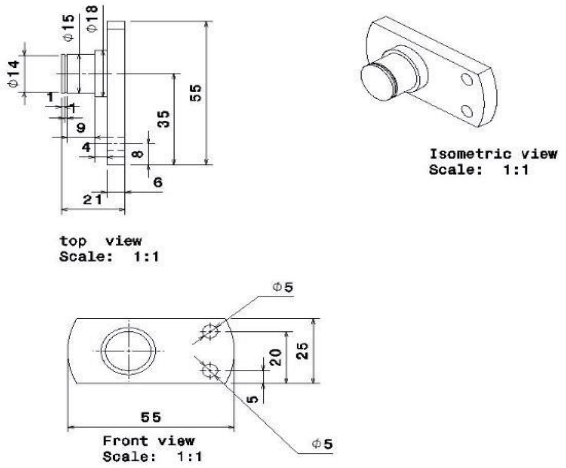


Analysis Of Rear Wheel Shaft:





Design Of Crank Gear Disk Hub:



Crank arm is subjected to direct shear failure owing to the load of the Gear action, Crank arm is having a circular section of 14 mm diameter subjected to direct shear Cam force is give by relation (Cf) = T / r = 1.12 x 1000 / 35

As the eccentricity radius of 35 mm is considered for the pump rocking action (Cf) = 32 N

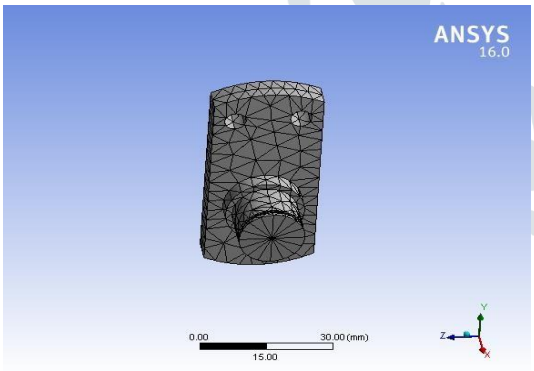
Material selection

Table.4 Material selection Of Crank Gear Disk Hub.

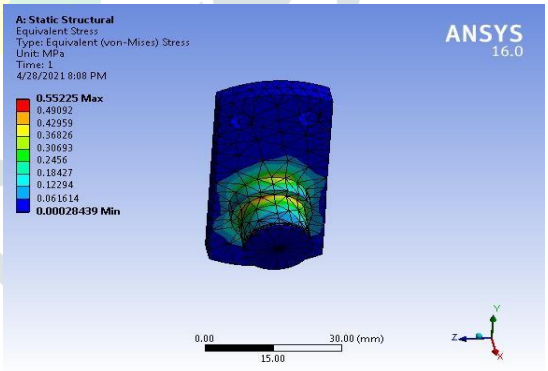
Designation	Ultimate Tensile strength N/mm^2	Yield strength N/mm^2
EN 9	600	480

Shear stress = shear force / area fs_{act} = (32 / π X 14 ^{2} /4) N/mm^2 =0.207 N/mm^2 As; **$fs_{act} < fs_{all}$ Crank is safe**

Analysis of Crank:

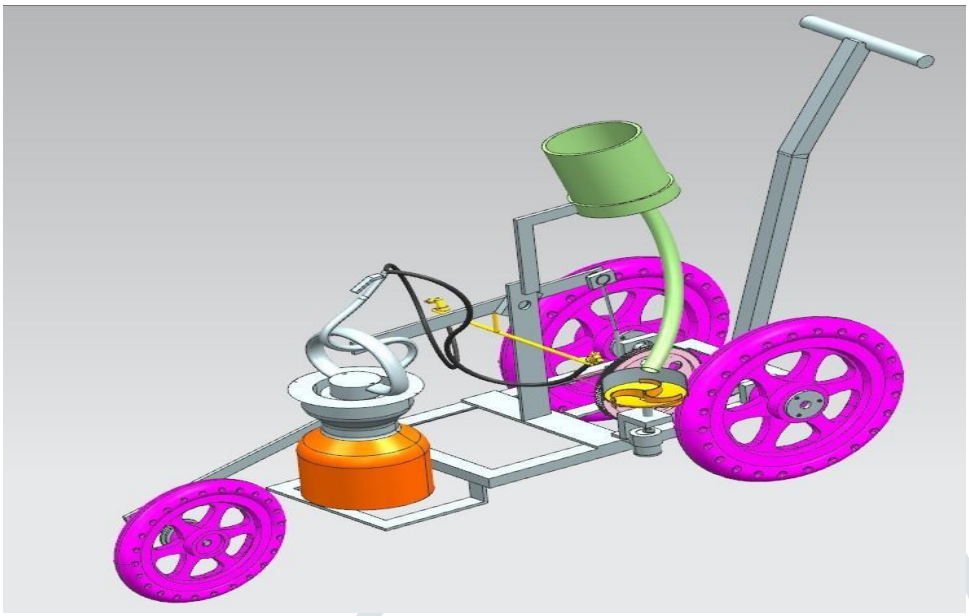


Meshing of Crank



Maximum Stress In Crank

Construction:



Base frame or chasis : The base frame of chasis is an mild steel fabricated structure that holds the entire assembly of the sprayer. The rear side carries the rear wheel shaft that carries the rear wheels, the front wheel steering carries the front wheel bracket which provides the necessary turning effect.

Drive Assembly: The drive assembly comprises of the driver pinion on rear shaft, and the spur gear on crank. Thus when the vehicle moves in forward direction the wheels will rotate the rear wheel shaft and thus the driver gear drives the driven gear and there by the intermediate shaft.and the pitman arm which reciprocate the piston of sprayer.

Pump System: The pump system comprises of sprayer mechansism of 5 litre capacity integrated with inbuilt and sprayer.

Air storage and pesticide storage :The compressed air is stored in the air chamber of storage tank and the pesticide is stored in the liquid chamber, the sprayer connected to the tank sprays this liquid pesticide using the compressed air.

Solid fertilizer storage container : This arrangement is used to store the solid fertilizer and is provided with a tee element to equally distribute the fertilizer to the both sprayer elements.

Results for Sprayer mechanism:

Sr. No	Walking Speed	Area covered / tank	Time
01	3kmph	0.48 acres	21 min
02	3.5 kmph	0.56 acres	18 min
03	4 kmph	0.68 acres	16min
04	4.5 kmph	0.76 acres	14 min

The area covered by the sprayer is seen to increase with the increase in walking speed and coverage of more area is also accounted to increase in pumping pressure that increases very small droplets and thus lesser pesticide usage as compared to low walking speed of the vehicle

Advantages :

- Pump mounted on vehicle
- Automated Pumping
- Compact size
- Low Cost
- Low maintenance
- More area coverage

Disadvantages

- Presently only 5 –litre capacity .
- Not Suitable for very close gap crop

Conclusion:

Combination of both operations in one vehicle will reduce the cost of operation and will be beneficial to the farmer . The critical components of the system namely the wheel shaft , crank, dispenser shaft were checked by theoretical as well as analytical method and the parts were found to be safe. The manufacturing of the combination system has be done by suitable methods. The assembly of the components has be done and the testing has been done to determine the performance of the sprayer and fertilizer dispenser mechanism The area covered by the sprayer is seen to increase with the increase in walking speed and coverage of more area is also accounted to increase in pumping pressure that increases very small droplets and thus lesser pesticide usage as compared to low walking speed of the vehicle. The time of spraying by the sprayer decreases with the increase in walking speed , this is as an effect of more spraying pressure and larger area covered as a result of fast walking speed

REFERENCES :

- Prof. Swati D.Kale, Swati V. Khandagale, Shweta S. Gaikwad, “Agriculture Drone for Spraying fertilizer and pesticides”, “International journal of advance research in computer science and software Engineering”, volume 5,Issue 12,(Dec-2015)
- S.R.Kulkarni, Harish Nayak, Mohan Futane, “Fabrication of portable foot operated Agricultural Fertilizer and pesticides spraying pump”, “International journal of
Engineering Research and technology”, ISSN:2278-0181,volume 4 ,Issue 07(July2015)

- Saharawat, Y.S., Singh, B., Malik, R.K., Ladha, J.K., Gathala, M., Jat, M.L. and Kumar, V. 2010. Evaluation of alternative tillage and crop establishment methods in a ricewheat rotation in north-western IGP. Field Crops Res. 116: 260–267.
- IV. Kalay khan, S.C. Moses, Ashok kumar "A Survey on the Design, Fabrication and Utilization of Different Crops Planter" European Academic Research - vol. iii, July 2015
- v)D.N.Sharma and S. Mukesh (2010) "Farm Machinery Design Principles and Problems" Seciond revised edition Jain brothers,New Delhi VI. Vern Hofman, Elton Solseng, "Spray Equipment and Calibration", Agricultural and Biosystem Engineering, North Dakota State University, Sept 2004.