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DESIGN AND DEVELOPMENT OF FERTILIZER FEEDER MACHINE

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ABSTRACT:

Fertilizers are used in the agriculture since long time to improve per hector cultivation. The farmers with small farms are conventionally spreading the urea manually over the area of crop. This method is completely ancient and least effective as there are chances of wastage of urea. This results in economic loss to the farmer and in long term results in less productivity. Requirement of urea is also different in different crops; hence extra amount of urea will affect the crop. Researchers have designed the machines for spreading urea over the farm to be used with tractors. These machines are costly and hence are not affordable for the farmers. We have developed a design for the fertilizer feeding machine of the crop with consideration of amount of urea to be provided to the type of crop. The CAD design of feeder machine and the design calculations are presented in this paper.

KEYWORDS: Fertilizer Feeding Machine, Agriculture Sector, CAD Design, etc.

INTRODUCTION:

Fertilizers are supporting the production of agriculture sector. Agriculture sector is passing through the revolution with lot of technology applications. Indian population is mainly dependent on agriculture sector and other allied fields. The fertilizer can effectively help in production of the crop if it is used in proper amount. We have developed a design the machine for spreading the fertilizer over the farm uniformly. So that, every crop should get sufficient amount of fertilizer. Urea falls in funnel and then it is supplied to crops by dropping mechanism.

By taking into consideration the quantity of urea required for crops and physical structure and crop plantation pattern the calculations are done for quantity of urea taken, the size, layout of vehicle, different parts, their dimensions and material calculations are done. For that different research papers are studied. Material selection is done. Catia drawings are drawn. Parts were collected and assembled and dropper machine is made. Cost of parts is written in table. Testing of dropper machine is done at a field and readings of urea required, time required were taken. With this machine, percentage reduction in time required for Fertilization was observed to be 50% and reduction in labour cost as compared to conventional method was 80%. It has solved the problem of traditional way of Fertilization. Conventionally farmers are spreading urea with hands for crop as shown below.

Fig.1: Conventional fertilizer spreading

The traditional machine to spread the fertilizer is needed to be improved. Indian farmers are really in need of the technological solutions at affordable cost. Utilizing the resources at optimum rate is needed. Urea fertilizer dropper machine is designed for efficient and effective fertilization. As total urea required for one acre is 100kg and for each plant is 10gm.So in this machine we required hopper of capacity 24kg because of that maximum area is covered with less passage of machine.

OBJECTIVES OF WORK:

- Designing walk behind type push operated urea fertilizer dropper machine.
- Providing simple, low cost, self-working, efficient urea spreading technique.
- Reducing efforts of farmers required to spread urea.
- Protecting farmers from hazardous effects of urea.
- Making efficient and effective fertilization.
- Doing uniform urea spreading in farms.

SYSTEM DESIGN:

We had visited a farm for collection of data which is as follows:
Collected Data-
Distance between two lanes- 3 feet= 90cm
Distance between two consecutive crops= 10-20cm
Total urea required for one acre = 100kg
Urea required for each plant = 10gm

Design of hopper

Material: GI-sheet
Density: 7850 kg/m3
Ultimate Tensile Strength: 205 MPa
Yield Strength: 270 MPa
Dimension of hopper
Shape = Square
Area = 305*305 mm^2
Height =250mm

Square Hopper Calculation

Hopper volume of upper square part =$305 * 305 * 120mm^3$
Height of hopper (h) = 250mm

Volume of hopper $= a * b * c + \frac{1}{3}(lh)$ (01)

$= 0.02484 m^3$

Capacity of hopper = 24kg

Calculation of weight of hopper

In this calculation bottom end of hopper is neglect. In this project for calculating the weight of hopper with pipe following equation is used.

$$W = [a * b * c + \frac{1}{3} bh]\rho g \quad (02)$$

Where,

W= total weight of hopper.
a = length of hopper at upper square part.
b = width of hopper.
c = height of upper square part.
l = length of lower pyramidal part.
h = height of lower pyramidal part.
ρ = density of material
g = 9.81 $^{m}/_{S^2}$

Poly-acrylic sheet

Dimensions – $15 * 3cm$
Angle of rotation - 15°

Stepper Motor

Step Angle= 15°
Voltage: 3-6 V
Shaft Diameter: 5mm - Length: 22mm
Torque: 4.2 Kg-cm
Step Angle: 1.8 deg / step
Motor Size: 42x42x40 mm

Arduino Board (ATMega 328P)

Voltage = 5V
Current = 20 to 50 mA
Pins- 14

Battery

The requirements for running the circuit are:
Arduino: 5 V - 0.05 Amps
Stepper motor: 3-6 V
Pa=0.25 Watts
Wha =W*h
=0.25*3=0.75Wh
mAh= (Wh*1000)/V
mAha=150 mAh

Wheels

Outer Diameter= 500 mm
Weight on each wheel: 91.56 N
Total Working Hours= 5000 hrs.
Static load carrying capacity= 3.655 KN

Fig.2: Picture of the Wheel Used

Chassis and wheel assembly

Brackets are used for wheel assembly in chassis. In this machine we used four brackets.
Length - 900mm
Height – 325mm

Bars are used to keep constant distance between wheels and foe support also. In this machine we used three bars for support.
Length – 610mm

Fig.3: Chassis and wheel assembly

Bent Tubes

Bent tubes are used to drop urea from funnel to crops.
Selection criteria

$$0.7\pi R^2 h = n\frac{4}{3}\pi r^3 \quad (03)$$

R=pipe radius
h=height of pipe
r=radius of granules
n=no of granules

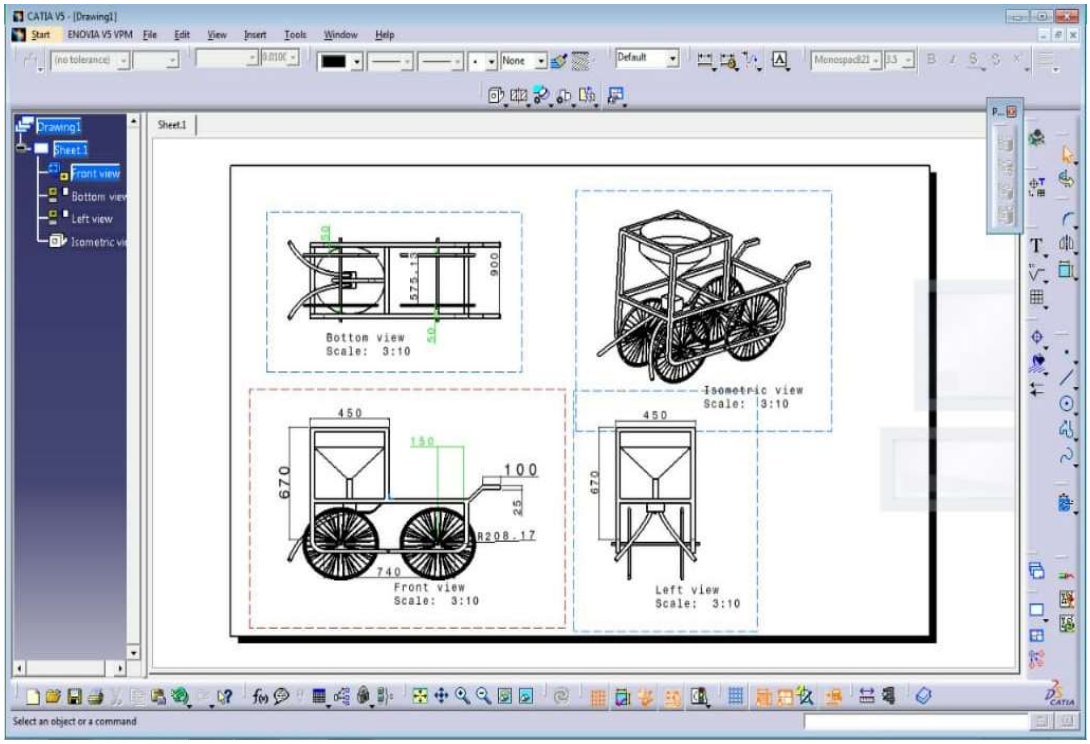

Fig.4: Various Views of the Design in CAD

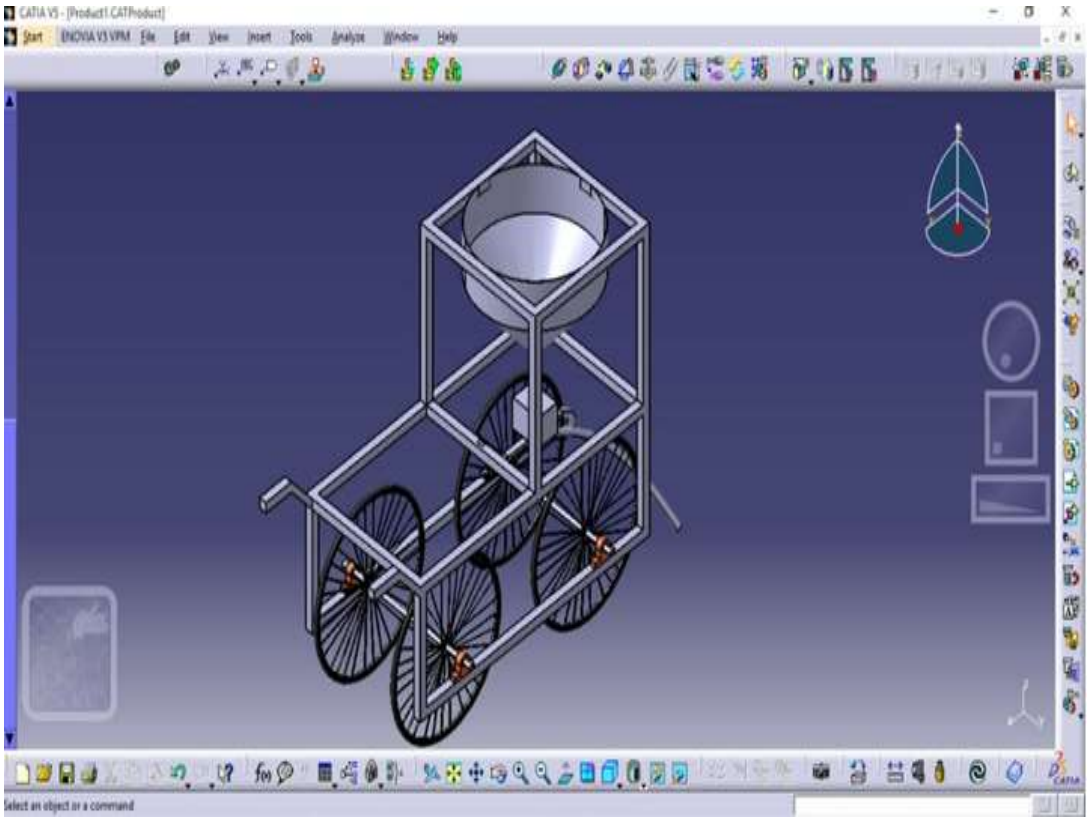

Fig.5: 3D View of the Design in CAD

Fig.6: Developed Hardware Prototype of the Machine

FUTURE SCOPE:

- The urea quantity can be varied for different crops.
- Other fertilizers can also be spread by modifying mechanism.
- This fertilizer dropper is modified for different farms and crops.
- Automation will be implemented in this system by using remote.
- Any type of fertilizer can be spread using same machine.

RESULTS AND DISCUSSION:

For 1 acre = 5000 crops

Time required to travel urea from hopper to crops after pressing switch is 1.32 sec.

Table: 1 Results of the Urea Saving using Dropper Machine Developed

Content	Conventional Method	Urea Dropper Machine
Urea required	200kg	60kg
Time required	3hrs	2hrs
Urea for each crop	Non-uniform and unspecified	10 to 12gm
Wastage	140kg	None

CONCLUSION:

India is agriculture-based country; most of the economy of India is based on agriculture field. All crops required fertilization for their better yield, so in olden days fertilization is done by traditional method. That is by means of throwing urea by hands in farms, due to which more time is required and non-uniform spreading is done by farmers and also its hazardous effects causes disease on farmers. So, the better alternative is required for fertilization. There are very less automatic fertilization techniques are available, like fertilization by using tractor is available but it is costlier.

We find this fertilization machine which is of 24kg capacity. This machine is very effective and efficient; it throws urea uniformly in farms and reduces time required for fertilization. With this machine, percentage reduction in time required for fertilization was observed to be 50% and reduction in labor cost as compared to conventional method was 80%.

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