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Design and Fabrication of Organic Portable Shredder Machine

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Abstract **— The scope of this project was to design and development of a portable shredder machine; focuses on chopping of coconut leaves, Areca leaves and paddy straw, later this chopped powder is a source to prepare the vermin compost. The task started with the accumulation of information and data, through survey in agricultural and literature studies. Existing models are hand wheel operated, vertical and horizontal electric chopping shredder is prone to have problems like large space requirement, uneven cutting, and manpower requirement. Hence traditional methods are not sufficient and satisfactory for chopping the crop residues. Considering the user's needs and buying capacity a prototype was designed and constructed. The proposed prototype is so designed to guide materials in different compartments by power driven transmission through chain, belt, pulley and spur gear attachment to have a chopped and powder materials. The overall operation of the proposed shredder, running at a cutting speed of 700 RPM nearly has a cutting efficiency up to 90%.**

Keywords – Organic matter, Portable Shredder.

I. INTRODUCTION

In India more than 70% of the population is depending on agriculture, it contributes around 17% to the gross domestic product (GDP) of the Indian economy. Basic needs of agriculture are sand, land, seeds, water, machines, fertilizers – organic or inorganic in nature, and so on. In that inorganic fertilizer use in the long term make the land to lose their pH, upset beneficial microbial ecosystems also causes of the greenhouse issue. Hence an attention on organic fertilizers based on agriculture wastes include crop residues such as corn stalks, sugar cane leavings, nut shells, paddy straw, wood chips, sawdust, banana stalk, etc., are concentrated which are biodegradable, releasing nutrient fertilizers, and improve the structure of the soil. But after harvesting them the crop residues are either cut out or shed out as a waste without getting into consideration their nutritive value [1, 4].

It assists in sustaining agricultural production at a higher point and makes it sustainable. It amends the soil physical properties such as granulation, and good tilt, good aeration, easy root penetration and improves water-retaining capability.

Hence an attempt is needed in planning a portable organic shredder, which speeds up the process of composting by increasing the open field of harvest residues for aerobic degradation thereby reducing the time to hold the compost.

Traditional methods are addressed only on the basics of coping techniques [6], I. M. Sanjay Kumar, Dr. T. R. Hemanth Kumar, in their proposed project on methodology for design and development of agricultural waste shredder machine - quality function development (QFD) was prepared where the customers were converted into technical voice detailed product design specification (PDS) was created as per the data's from QFD [2, 3].

Considering the drawbacks of older mechanisms, in account to that problem we are proposed to develop the new mechanism that includes, v-belt drive mechanism, multiple dumping system, multiple blades & multiple shafts in one system and using electric motor & this mechanism is portable in nature, so that this machine is used in all the agriculture fields to convert the agriculture waste into useful Eco friendly manure, so that the produced manure is of low cost when compared to other inorganic fertilizers & also economically cheap for poor farmers.

II. PROBLEM FORMULATION

There is a indigence of a machine that makes the farmers self dependent for their everlasting requirement of organic manure. Then we had surveyed in different sectors and thought of projecting a new prototype model which induces a tendency of producing both chopped as well powder form.

The objectives behind the project are:

a. Conception and development of a machine used for multipurpose in nature as the chopping assembly and powder assembly.

III. METHODOLOGY

Working Principles:

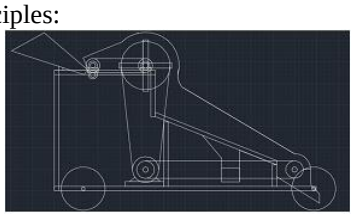

Figure 1: working model of Organic shredder machine

a. Firstly the inputs are fed into the machine chamber through the hopper provided at the top of the machine (inclined feeding).
b. Then it comes in contact with two members, namely one is sucker roller shaft and to the cutter blade shaft.
c. The cutting blades are mounted on the cutter guides. The knife blades provide the shear force to cut the organic matter and the force developed by the rotating of this shaft provides the pushing force to the uncut matter to be shared and also provides a thrown force to throw the

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quoted matter and the machine body guides the organic matter flow in a specific direction.

d. The cut matter or crop residues come from the cutter blade is made to fall in the first dumping stage as per the requirement.

e. A provision is also provided to get the powder matter, powdering blades are provided and the sieve is also provided to get the fine grain size matter on the dumping stage two.

f. When the organic matter or crop residues comes in contact with these rotating members then the shearing action takes place, the clearance between the rotating and stationary guides can be varied according to the size of the crop residues.

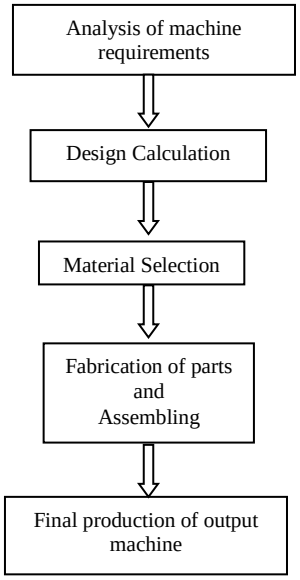

Figure 2: Flow chart for a Portable Organic Shredder

Analysis of the machine requires brief survey in agriculture, improvements in existing machines, possible outcomes, their applications. Later design calculation started by designing on a shaft and motor rated torque to have a power transmission. Based on which materials are selected, to check for their availability and processed for fabrication of parts and assembling them for testing.

Table 1: Designed details of a Portable Shredder

Si. No	Design and Specification		
1	V- Belt	Speed of the cutting blade shaft	$N_2 = 360\ rpm$
		Length of the V-Belt	L = 1878.94 mm
		Velocity of the V-belt	V= 5.747 m/Sec
		Cross section of the belt	K_w = 0.89
		Correct center distance	C =758.78 mm
2	$Shaft_1$ [Ref 6]	Reaction Support	R_B =475N, R_A = 475N
		Torque	T = 39523.47 N-mm
		Diameter	d = 24.43mm
3	Chains sprocket	Speed of roller shaft	N2 = 384 RPM
		Pitch of the chain drive	P1 = 9mm, P2 = 10 mm
		Velocity of chain drive	V_1 = 0.81 m/s, V_2 = 0.963 m/s
		Number of strands	J_1 and J_2 = 2
		Chain length in pitches	L_p = 74 Pitches
		Length of chain	L = 740 mm
4	Spur gear [Ref 5] - Pinion weaker $\alpha = 20^0$	Tangential tooth load	F_t = 329.11 N
		Circular pitch	P = 6.57 mm
		Velocity V_m	1.80 m/Sec
		Dynamic Load	F_d = 1416.67N

Table 2: Fabrication of a Portable Shredder

Welded parts	Figure	Type of welding	Thickness
Chassis frame		Arc welding	4mm
Sheet metal body		Arc welding	1.6mm

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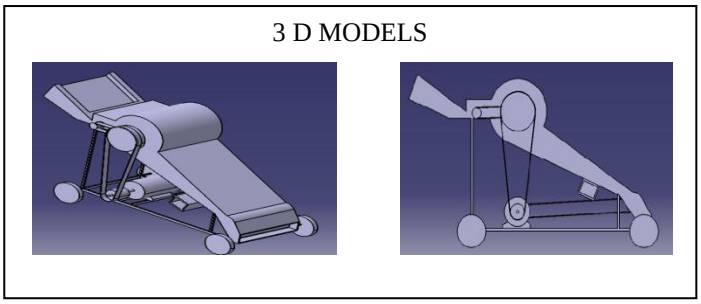

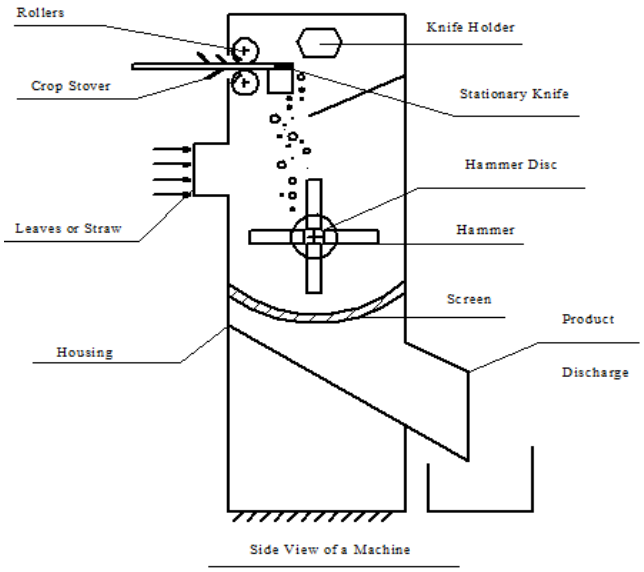

Figure 3: Side view of a Shredder Machine

IV. PRODUCT ANALYSIS

After design and fabrication, the prototype is validated through tests, at constant rpm, on Areca, Coconut Leaves and Grasses at different periods of time to check for chopped and powder content.

Table 3: Areca, Coconut Leaves, Grass Crushed and Powdered form

Products	Original Matter	Chopped Matter	Powder Matter
Areca Fronds			
Coconut Leaves			
Grass			

Si. No	Material input feeding rate in gms		Output chopped rate in gms	Cutting efficiency
1	Areca	1000	950	95%
2	Coconut leaves	1000	900	90%
3	Grass	1000	930	93%

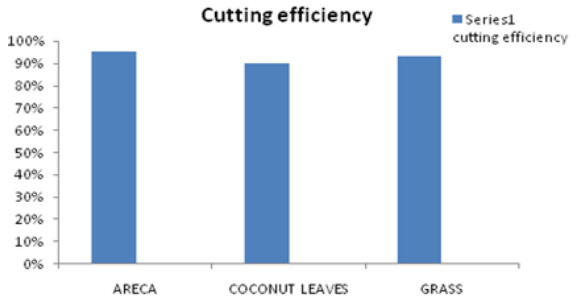

Figure 4: Cutting Efficiency of Organic shredder with quantity, time

From the experiment we observed that cutting efficiency of areca, coconut leaves and grass has a greater improvement approximately up to 90%. Later this can be further used for Manure.

Table 4: Materials Selection and Cost Estimation

Particulars	Quantity	Cost
Motor	1	5000
Shaft	4	1520
Sheet GI and MS	2	2800
Flat blade guides	4	1100
Cutter sharp edge blades	4	2200
Pillow block bearing (205 and 204)	4+2	2100
Bolt, nut and washer	8+8	380
Spur gear	2	540
Chain and Chain sprocket assembly	1	1200
Chassis angles		5400
Pulley	4	2140
V-belt	2	890
Hinges	2	110
Hopper	1	850
Powder blade	18	1230
Welding rods	1 box	750
Powder blade unit	1	1100
Sucking roller unit	2	550
Wheel assembly	4	2000
Paint		500
On and off switch	1	450
Electric copper wire		300
Handle	1	150
Machining and fabrication	-----	2000
Total	76	35260

CONCLUSION

The above proposed organic portable shredder machine capable of operating at rated speed of 700RPM and able to implement in agricultural fields for developing a raw material for compost. The above machine is a prototype and can be enhanced depending on requirement and can be integrated with vermin compost or in generating any other organic fertilizers, since it has good cutting efficiency and chopping them to a powder form.

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