Scopus
ELSEVIER
doi

Journal of Vibration Engineering

ISSN:1004-4523

Registered

- SCOPUS
- DIGITAL OBJECT IDENTIFIER (DOI)
- GOOGLE SCHOLAR
- IMPACT FACTOR 6.1

Our Website
www.jove.science

DESIGN AND FABRICATION OF A SINGLE-SHAFTSHREDDERMACHINE

[1]Mr.A.RamanjaneyaReddy,[2]KummariGowthamKumar,[3]KommaddiVenkataGangadhar,
[4]IndlaRaviTeja,[5]ShaikSaleemBasha,[6]ShaikAbdulKhalid

[1]AssistantProfessor,DepartmentofMechanicalEngineering, G. PullaiahCollegeofEngineering&Technology,Kurnool,India

[2,3,4,5,6]EngineeringStudentDepartmentofMechanicalEngineering,G.PullaiahCollegeofEngineering&Technology,Kurnool, India

Abstract:

Currently, the largest source of pollution that produces dangerous pollutants that have animmediate impact on both the environmentand human health is the way in which trash isdisposed of. The majority of this trash is made up of plastic, rubber, paper, and soda cans.Nowadays,themajority of wasteproductsare eithernon-biodegradableor takedecadestobreakdown, which increases the volume of rubbish in landfills. The ongoing processes of makingandusingrubber,plastic,andpaperproductsas wellastheintensifiedconstructioncontributetoa significant buildup of waste, an imbalance, and a hazard to the environment. The requirementfor decreasing domestic and technological waste and reintegrating them into the manufacturingprocessisevidentinallindustrialcivilizations.Thisshreddermachineassistswithwaste management and disposal by crushing used bottles and cans. This machine is inexpensive tooperate and repair because it was built with locally accessible raw materials. The machine ismade up of a three-phase electric motor, shaft, bearings, structural frame, cutters, a hopper, ashredding unit, and a discharge chute. The shaft has four cutters placed on it; they are driven by abelt to rotate. With a belt drive, the cutter shaft receives power from the electric motor. Aninternal cut is made due to the effects of tension, friction, and impact during the shreddingprocess; cuts are created inside the shredding device.The twigs are crushed,and the littlefragmentsaregatheredintheshredder'sdischargechute.Thedeviceisuser-friendlyandsuggestedforfarmersandsmallandmedium-sizedbusinessowners.

Keywords: Recycling,Threephasemotor,Plastic,Shreddermachine

1. Introduction:

A shredder is a piece of machinery or gear used to shred things. While most onlinedictionariesdefinetheshredderas"adeviceusedforshreddingdocumentsasasecuritymeasure to avoid identity theft," shredders can be of numerous varieties depending on the material beingprocessed. Shredding systems are used to minimize the size of a given material. Shredders areavailable to facilitate material reduction in a variety of recycling applications, including therecyclingofplastics,electronics,scrapmetal,tyres,agriculturalwaste,andwood.Bothcompleted goods, such as landscape mulch, and raw materials to be reintroduced into productionare produced during the shredding process. Size reduction machinery is referred to by a numberof terms, such as grinders, chippers, granulators, and hammer mills. Overall, their main functionistoreducethesize ofagivenmaterial.

There are significant amounts of agricultural waste produced. Large volumes of it gowasted and frequently present a disposal issue, while some of it is recycled into agriculturalproduce as fertilizer. It has been determined that a significant amount of agricultural waste is stillbeing stored, handled, and managed inefficiently. Its low bulk density and huge area/volume forstorage are the causes. Most of these wastes are burned by farmers in the fields after crops areharvested. As a result, the phenomenon of burning agricultural waste happens every year. Theneedfor such a machine to employ all types of agricultural waste after shredding,which mightbe inexpensive and practical, was feltin order toutilize these wastes for some economicalbenefits.

Product, market, literature, and user studies, among other methods, were used to conductthe survey. Farmers used to manually trim the agricultural remains after harvesting their crops inthe beginning. It was also a tedious task to shred the dried stems the old-fashioned way, byputting them in a cloth bag and driving a bullock cart over them or beating it on the ground. Thismethod worked well to chop the stems (avoiding the painful fingers issue), but we still needed toturn the cloth occasionally to keep it from pulling out because the stems used to come out and dothat. The farmers also beat the stems with bamboos, which was a Herculean task. Thus, these arenot trustworthy methods for shredding crop leftovers to produce high-quality compost in a timelymanner. Hence,itinforms us thatcutting cropleftovers using standardmethodsisneitheradequate nor satisfactory. Due to these human methods, certain significant issues have beendiscovered, and in order to address these issues, the concept of a shredder machine to slice twigsintoeffectivefertilizerwasinvented.

The shredding machine can be used in both a commercial and aiding capacity for farmersby establishing small businesses, providing organic compost to differentfarmers who, due totheir poverty, consider making the hasty and senseless decision to commit suicide as they arepoor and are unable to produce their own organic fertilizer and are also unable to afford chemicalfertilizers to increase and meet their minimum crop yield demand, thereby providing farmers willgain from using a shredder machine to effectively employ twigs for compost production andsustainable agricultural production. The objective of this work is to fabricate the multipurposeshredder.

2. MaterialsandMethods:

The availability, cost, durability, and ease of manufacture of materials were taken into account.The machine's effective operation and acceptability by the farmers and households who would utilize itwere important factors that needed to take centre stage. Farmers may readily buy the machine because ofits affordable price.Also, if necessary, it is simple to run, even by uneducated farmers. Reasonabledesign, compact construction, safety and durability, only one motor drive, low noise, ease of operation,compactlayout,stablework,portability,lowenergyconsumption,highproductionefficiency,andaffordable price were acquired from design considerations. The design factors can be summed up asfollows:

i. Accessibility of construction materials: The machine was built with components that weresimple to find. The materials used in the fabrication are easily sourced, such as metal sheet, angle bar,band saw, etc., which are widely available in the nation, for the convenience of future fabrication anddevelopment.

ii. Affordability: The machine is made reasonably reasonable by using inexpensive yet effectivematerialsandcomponentstoachievecosteffectivenessthroughouttheproject.

iii. Ease of use: The machine will be simpler for the operator to use and comprehend if an electricmotorwiththe necessaryhorsepowerisprovidedtorunit.

iv. Strengthanddurability:Materialswithsignificantstrengthanddurabilitywereusedtoimprovethe device'sservice life.

Figure1:SectionalViewsofSingle-ShaftShredderMachine

Figure2:SectionalViewsofSingle-ShaftShredderMachine

3. WorkingPrinciple

The single-shaft shredder is equipped with only one moving shaft, and the blades areinstalled on this shaft to form a mutual shearing form with the fixed blades on the box. The mainshaft is driven by the motor and the reducer, and the material is driven by the spiral blade to enterthe gap between the movableblades and the staticblades. Because the blade is spiral, thematerial will be squeezed, torn, and sheared at the same time, so that the material can enter theequipment well and complete the work smoothly. The multi-shaft shredder has two movingshafts, both of which are inlaid with blades, and the two shafts rotate relative to each other toperformoperations similartoasingle-shaftshredder.

Single shaft shredders are suitable to process waste materials which cannot be cut by using othertypes of size reduction machines. A waste material which is very large in size or resistant to cutting actionof other types of crushers and shredders can be recycled with single shaft shredders. Small sized rotatingblades of single shaft shredders tear a small particle of material in each pass. By this way hard to processmaterial sizes can be reduced easily and effectively. They are constructed very strong to last longer Singleshaft shredders are equipped with sieves. By changing with proper hole sized sieves output materialparticlesizecanbedetermined.

3.1. ShredderBlades

The single-shaft shredder blade, as its name suggests, is mounted on the shaft of a single-shaft shredder, known as a moving blade. The shape is square, the knife edge has an arc on allsides,andthemiddletappinghole, theedgetothemiddlewholepartisinwardlyrecessed,andis used with the fixed knife on the knife holder. Single shaft shredder blade is used for waste plasticfilm, plastic pipe, plastic bags, woven bags, plastic lumps, wood pallets, wood boxes, wastecable, wire, copper, plastic bottle, plastic floor, plastic foam, plastic bucket drum barrel, plasticchair,etc.

3.2. FixedBlades

The document shredding machine has a rotor with circular blades which are equallyspaced along the length of the rotor. These rotating blades cooperate with a row of fixed bladeswhich are mounted along the side of the rotor. The fixed blades are formed from a sheet of metalin which rectangular holes are stamped. The holes are equally spaced and arranged in a row witha bar of metal that forms a fixed blade, separating adjacent holes. A shaft shredder is a machineusedfor reducing the size of any type of material. Thematerials thatare generally shreddedusingashaftshredderincludetires,wood,plastics,metals,carwrecks,andgarbage

4. Design ofComponent:

Speedof thebeltondrivenpulley

DeterminethespeedofbeltondrivenPulley $V_2=(\pi\times d_2\times N_2)/60$

Where d_2=diameterofdrivenpulley, N_2=speedofdrivenpulley. d_2=82mm=8.2cm=0.082m, N_2=1200rpm

$V_2=(\pi\times 0.082\times 1200)/60$, $V_2=5.15$m/s

TensionintightsideofdriverbeltT1=T−Tc−−−(2)T=σa(3), $T_c=mv^2$

WhereT =tension intightsideofthebelt,T=maximumtensionintightsideofbelt, T_c=centrifugaltension,m =massofbeltpermeterlength,V=velocityofbelt,a=crosssectionareaofbelt.

$a=8.477\times 10^{-3}m^2=84.77mm^2$, $m=103$gm/meter=0.103kg/mIfσ=1Mpa ,than-

$T=1\times 84.77=84.77N$, $Tc=mv^2=0.103\times(5.15)^2=2.73N$, $T_1=T-T_c=84.77-2.73=82.04N$

Tensionintheslackside ofdrive belt

Using $L_n(T_1/T_2)=\mu\times\theta$−−−(5),

Where

T_2=tensioninslackside,ɵ=angleofcontactinradians,μ=coefficientoffrictionbetweentherubberbeltandthe castironpulley,

If μ=0.4than

$L_n\left(\frac{T_1}{T_2}\right)=\mu\times\theta$, $(L_n\left(\frac{82.04}{T_2}\right)=0.4\times\pi$, $T_2=23.37N$

Powertransmittedbythebelt

$$P=(T_1-T_2)\times V---(6)$$

$$P=(82.04-23.37)\times 5.15=304.00W$$

Thetwisting moment ortorqueon theshaft (M)

$M=(T_1-T_2)\times R_2---(7)$

$M=(82.04-23.37)\times 0.041=2.405N-m=2.405\times 10^3N-mm.$

Thebending momentontheshaft.(M_n)
$M_n = F \times L$−−−(8),

Where$F$=loadonshaft,L=perpendicularlength,
$F = T_1 + T_2$−−−(9)

$F = 82.04 + 23.37 = 105.41$

$Mn = F \times L = 105.41 \times 0.0385 = 4.058 N-m$

$= 4.058 \times 10^3 N-mm$

Theequivalenttwistingmoment(M_e)
$M_e = \sqrt{[(K_m \times M_n)^2 + (K_t \times M)^2]}$−−−(10),

Where Km = combined shock and fatigue factor of bending, Kt = combined shock and fatigue factor fortwisting.
Let$K_m = 1.5, K_t = 1.5$

$$M_e = \sqrt{[(1.5 \times 4.085 \times 10^3)^2 + (1.5 \times 2.405 \times 10^3)^2]} = 7110.57 N-mm$$

Thediameterofthedrivenshaft
$M_e = d^3 \times \tau \times \pi / 16$,

Whereτ= allowableshearstressontheshaft,d=diameterofshaft.
$\tau = \tau_u / fos$,where τ_u=ultimateshearstressontheshaft,FOS=FactorofSafety.
The materialusedforshaftiscarbonsteelofgrade45C8,whichhasτ_u=750Mpa,andFOS=4

$\tau = 750/4 = 187$Mpa
$M_e = d^3 \times \tau \times \pi / 16, d^3 = (M_e \times 16)/(\pi \times \tau) = (7110.57 \times 16)/(187 \times \pi), d = 5.785mm$

5. Conclusion:

Insteadof justusingmanually operatedprocedures,a properexamination of thedesignisperformed and something even better is generated. Eventually, we draw the conclusion that thefarmer would be better off using the machine than chopping twigs manually. The equipment wascreated with the diverse needs of farmers and other clients in mind. The job that this machineperforms is minimal because it was designed for small business owners or farmers. The capitalinvestment needed to buy larger crop residue shredding or chopping equipment is very high, andthe alternative useofchemicalfertilizersisalsohighlyexpensive.

i. Itwaspossibletocutthewaythatwaswanted.

ii. Ithadalowprice.

ItgavethenecessaryMaterialcutting Rate,oriii.

iv. Bladesaresimpletoclean.

Theuseofhighlyskilled operatorsisnot necessary

6. References

[1] Sanjay KumarI M andKumarH T R, 2015 Design andfabrication of coconut leavesshredder *InternationalJournalof EngineeringResearch and GeneralScience* **3** 42,273-81.
[2] Screenivas H, Sundeep Y, Ajayi, Naveen K and Krishnamurthy N 2017 Conceptual designanddevelopmentofshreddingmachineforagriculturalwaste*InternationalJournalofInnovativ eResearchinScience,EngineeringandTechnology* **65**2347-510
[3] PothiNalfachai2016Anestimationofaratedmotorforamulti-purposeshreddermachine *Sakon Nakhon RajabhabhatUniversityJournal of Science and Technology*163-169
[4] Khurmi R S and Gupta J K 2013 Design of machine elements" (Eurasia Publishing House(pvt.)Ltd)
[5] PSG 1982 Design data compiled by Faculty of Mechanical Engineering P S G College ofTechnology.Coimbatore641004India.
[6] Adepo, S.O. Obanoyen, N.O. "Design and construction of a plastic shredding machine".Journal of multidisciplinary engineering science and technology (JMEST) ISSN: 2458-9403,Vol.4Issue9,September-2017.