DESIGN AND CONSTRUCTION OF SINGLE SHAFT SHREDDER MACHINE

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ABSTRACT

Today the disposal of waste is the biggest cause of our pollution that creates harmful gasses which directly affects the environment and human body. These waste mostly includes plastic, rubber, papers, coke can etc. Most waste materials, now-a-days are non-biodegradable or it takes decades to degrade; this leads to an increase in the amount of wastes in dump sites. The continuous process of production and use of products from rubber, plastic, papers and the intensified construction lead to a serious accumulation of waste, imbalance, and danger for the environment. In all industrial societies, the need appears for reducing the household and techno genic waste and their reintegration in the production process.

This shredder machine crushes used bottles and cans and helps in west management and disposal. This machine is designed using locally available raw materials which make it cheap and easy to maintain and repair.

KEYWORDS: recycling; waste; plastic; shredder machine.

1. INTRODUCTION

A shredder is a machine or equipment used for shredding. Shredding systems are used to reduce the size of a given material while most online dictionaries define the shredder as "a device used for shredding documents as a security measure to prevent identity theft," shredders can be of many types based on the material being processed.

There are shredders designed to support material reduction across a range of recycling applications, including plastic recycling, e-waste recycling, scrap metal, tire recycling, agriculture waste and wood recycling. The shredding process produces raw material to be re-introduced into manufacturing, as well as finished products such as landscape mulch. Various terminologies are used to describe size reduction equipment, including grinders, chippers, granulators and hammer mills. Overall, their main function is to reduce the size of a given material.

2. DESIGN OF COMPONENT

Speed of the belt on driven pulley

To determine the speed of belt on driven Pulley V

$V_2 = (\Pi \times d_2 \times N_2)/60$ (1)

Where d_2 = diameter of driven pulley, N_2 = speed of driven pulley.

d_2 = 71mm = 7.1 cm = 0.071 m, N_2 = 1100 rpm

$V_2 = (\Pi\times0.071\times1100)/60$, $V_2 = 4.0893$ m/s

Tension in tight side of driver belt T_1, $T_1 = T-T_c$ (2)
$T= \sigma a$ (3), $T_c = mv^2$ (4)
Where T = tension in tight side of the belt, T = maximum tension in tight side of belt, T_c =centrifugal tension, m = mass of belt per meter length, V = velocity of belt, a = cross section area of belt.
a = 8.477×10^{-3} m^2 = 84.77 mm^2, m=103gm/meter = 0.103 kg/m.
if σ = 1 Mpa, than-
$T = 1\times84.77 = 84.77$ N, $Tc = mv^2 = 0.103\times(4.0893)^2 = 1.72$ N, $T_1 = T-T_c = 84.77-1.77 = 83$ N.

Tension in the slack side of drive belt
Using $L_n(T_1/T_2) = \mu\times\theta$ (5), where T_2 = tension in slack side, ɵ = angle of contact in radians, μ = coefficient of friction between the rubber belt and the cast iron pulley,
If μ = 0.3 than-
$L_n(T_1/T_2) = \mu\times\theta$, $L_n(83/T_2) = 0.3\times\Pi$, $T_2 = 32.341$N

Power transmitted by the belt
$P = (T_1-T_2)\times v$ (6), P = (83-32.341)×4.0893 =207.159 W

The twisting moment or torque on the shaft (M).
$M = (T_1-T_2)\times R_2$ (7), M = (83-32.94)×0.0335 = 1.677 Nm = 1.677×10^3 Nmm.

The bending moment on the shaft (M_n).
$M_n = F\times L$ (8), where F = load on shaft, L = perpendicular length,
$F = T_1+T_2$ (9), F = 83+32.341 = 115.341. Mn = F×L = 115.341×0.0335 = 3.864 Nm = 3.864×10^3 Nmm.

The equivalent twisting moment (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 for twisting.
Let $K_m = 1.5$, $K_t = 1.5$.
$M_e=\sqrt{[(1.5\times3.864\times10^3)^2+(1.5\times1.677\times10^3)^2]} = 6345.867$ Nmm

The diameter of the driven shaft
$M_e = d^3\times\tau\times\Pi/16$, where τ = allowable shear stress on the shaft, d = diameter of shaft.
$\tau = \tau_u/fos$, where τ_u = ultimate shear stress on the shaft, fos = factor of seafty.
The material used for shaft is carbon steel of grade 45C8, which has τ_u = 700 Mpa, and fos = 5
τ = 700/5 = 140 Mpa
$M_e = d^3\times\tau\times\Pi/16$, $d^3 = (M_e\times16)/(\Pi\times\tau) = (6345.867\times16)/(140\times\Pi)$, d = 6.1344 = 16 mm

3. CONCLUSION

Shredder machine was successfully run in the Workshop Department of Mechanical Engineering United college of engineering, Naini, Prayagraj, India and the following conclusion can be summed up:

i. It was able to perform the desired cutting.
ii. It was economic in cost.
iii. It provided the desired Material cutting Rate.
iv. Blades can be cleaned easily.
v. Highly skilled operators are not required

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