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### Design of Scrap Compressing Machine

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#### ABSTRACT

*Our project aim is to achieve the criteria of proper disposal of scrap considering safety of the labors as a main point with Low Cost Automation, In which involvement of worker for the disposal of precarious scraps are highly minimized for their safety and to achieve different techniques like 5S, kaizen etc. is very difficult to dispose these scraps by human workers even though they work with any protective devices like gloves. For example scraps from sheet metal processes, punching operations are very harmful that they could cut workers hand and other part of the body by their sharp edges. Manual operations of these presses give fatigue to operator, since he has to exert physical energy. So there is no manual involvement for the scrap disposal. The press setup mainly uses the hydraulic power system because hydraulic systems can provide large amount of power and very precise movement and the setup also uses the pneumatic system. Any type of scrap can be made into cubes by bailing them using this press setup some limitation like cast iron scrap can't be able to bill irrespective of any amount large load applied to bail it.*

#### 1. INTRODUCTION

Day by day modern engineering industries are developing fast. In this development automation of machineries is an important aspect. Every machine is built up with consideration of some design aspects in which the power transmission system used in it has unique importance. Successful power transmission enables the machine to work easy, more accurate and faster to minimize the down time. Most of the mechanical drives are bulky, complicated and has poor effectiveness due to rapid wear of mating surfaces. Therefore fluid power systems are used in most of the modern machineries to achieve the successful result in power transmission. Fluid power can be divided into two basic disciplines. The media used for the systems are organized as

1. Hydraulics- Employing a pressurized liquid
2. Pneumatics-Employing compressed air

power energy in industry is used for transmission of power, through pressurized flow, which is controlled by using different control element is linked with the element parts for desired movement.

1. Power unit
2. Working element or actuators
3. Control unit
4. Pipes, hoses and connectives.

#### 2. PARTS OF SCRAP COMPRESSING MACHINE

1. Hydraulic press cylinder
2. Base plate
3. Die cavity cylinders
4. Scrap feeding conveyor
5. Ejector
6. Scrap cube loading conveyor
7. Hydraulic control system
8. Pressure gauges
9. Electrical control panel

#### 3.CIRCUIT DIAGRAM

a)	Charging Chamber	300X300X700
b)	Pressed bale	300X300X300
c)	No of Hydraulic Cylinders	02 Nos
d)	No of Pneumatic Cylinders	01 Nos
e)	Working Pressure	35KN
f)	Oil Drive	Plunger Pump
g)	Power obtained while pressing	4 to 10 tones
h)	Idle Cycle Time Without feeding(Pressing)	60 to 80 Sec
i)	Weight bale	5 to 12
j)	Hard plate lining	If needed
k)	Type of control	02 Nos of hand lever
l)	Type of loading	Manually from top or by cylinders
m)	Type of unloading	Using pneumatic cylinders

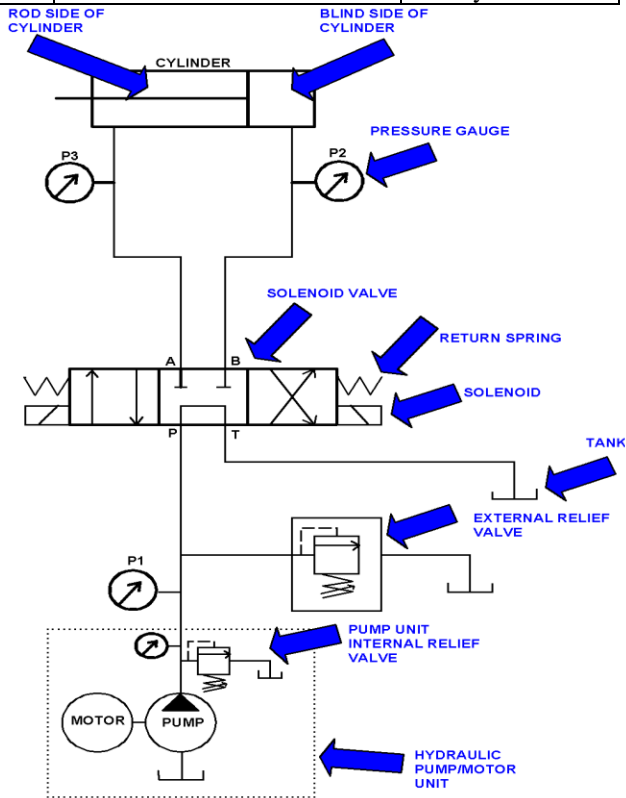


Fig. 1 Circuit Diagram

**4. SCOPE OF THE PROJECT**

Scraps can be compressed to create small blocks. Space can be saved in the industry. Cost of scrap transportation can be saved. More scrap material can be transported. Scrap recycling will become easier. The efficiency of the company can be measured. Wastage of scrap by rusting and going into mud is avoided.

**5. SPECIFICATIONS**

TABLE I Specifications

**6. MATERIAL OF PARTS**

A prefer design should also consider ease in manufacturing. The material chosen for this purpose is mild steel, in scientific term C15. The reason for choosing C15 is that it is easily available in the market, easy for manufacturing and it has good strength.

TABLE II PROPERTIES

Material	Met ing point °C	Mod ulus of Elasti city N/m m <sup>2</sup>	Mod ulus of Rigid ity N/m m <sup>2</sup>	Poiss on's ratio	Tens ile Stren gth N/m m <sup>2</sup>	Yiel d stren gth N/m m <sup>2</sup>
Steel C 15	1510	2.08* 10 <sup>5</sup>	0.79 *10 <sup>5</sup>	0.3	370	240

**7. CALCULATIONS**

**7.1 THICKNESS OF BOTTOM PLATE**

Direct load of 35KN is acting on the plate. The length and breadth of this plate is used to determine the thickness of the bottom plate. So the thickness is the main parameter to be decided and finalized.

Taking 2D figure of the plate in X-Y plane,

Maximum bending moment at AA<sub>yy</sub>

$$P = 10000 * 130$$

$$= 3 * 10^5 \text{ N-mm}$$

Where,  $\sigma = M/Z$

$$\sigma = 0.66\sigma_y$$

$\sigma =$  Actual yield stress/Factor of safety

$$\sigma = 240/2.5$$

[Assume FS=2.5]

$$= 96 \text{ N/mm}^2$$

Thus,  $\sigma = 0.66 * 96$

$$= 63.36 \text{ N/mm}^2$$

Also,  $Z = I/Y$

$$= [bt^3/12]/[t/2]$$

$$= [bt^2/6]$$

$$\begin{aligned} \text{As, } \sigma &= M/Z \\ &= [13 \times 10^5] / [bt^2/6] \\ &= 63.36 = 53594/t^2 \\ t^2 &= 784 \\ t &= 28.10 \text{ mm} \end{aligned}$$

So we take bottom diameter as 30mm which is greater than 28mm. so our design is satisfied.

Verification

$$\begin{aligned} \sigma_{\text{Actual}} &= \text{Load/Area} \\ &= 50000 / [1000 \times 1000] \\ &= 0.05 \text{ N/mm}^2 \ll \sigma_t \end{aligned}$$

Where, allowable tensile stress  
= 370 N/mm<sup>2</sup>

### 7.2 THICKNESS OF TOP PLATE

Direct load of 35KN is acting on the top plate. But since this is a coplanar system, we assume the total force of 'P' to be acting at the center. The length and breadth of this plate is used to determine the thickness of top plate. The thickness is to be decided.

Thickness of the top plate

Taking 2D figure of the plate in X-Y plane,

Maximum bending moment at AA<sub>y</sub>

$$\begin{aligned} M_x &= 10000 \times 130 \\ &= 13 \times 10^5 \text{ N-mm} \end{aligned}$$

Where,  $\sigma = M/Z$

$$\sigma = 0.66 \sigma_y$$

$\sigma =$  Actual yield stress/Factor of safety

$$\sigma = 240/2.5$$

[Assume FS=2.5]

$$= 96 \text{ N/mm}^2$$

Thus,

$$\sigma = 0.66 \times 96$$

$$= 63.36 \text{ N/mm}^2$$

Also,  $Z = I/Y$

$$= [bt^3/12] / [t/2]$$

$$= [bt^2/6]$$

As,  $\sigma = M/Z$

$$= [13 \times 10^5] / [176t^2/6]$$

$$= 63.36 = 44318.18/t^2$$

$$t^2 = 699.49$$

$$t = 26.44 \text{ mm}$$

So we take bottom diameter as 30mm which is greater than 26.44mm. So our design is satisfied.

**Verification:**

$$\begin{aligned} \sigma_{\text{Actual}} &= \text{Load/Area} \\ &= 50000 / [560 \times 560] \\ &= 0.15 \text{ N/mm}^2 \ll \sigma_t \end{aligned}$$

Where allowable tensile stress ( $\sigma_t$ )

$$= 370 \text{ N/mm}^2$$

### 7.3 DIAMETER OF SUPPORT PILLAR

The load in one support pillar is half of the total and in our case it is 25000 N (For maximum load). The pillar is considered as the column that is

fixed at the both ends. Applying Euler's column theory,

$$P = 4\pi^2 EI/L^2$$

Where,

Critical load on the pillar (P) = 35000N

Modulus of elasticity (E) =  $2.08 \times 10^5 \text{ N/mm}^2$

Moment of inertia (I) =  $\pi d^4/64$

Length of pillar (L) = 1000mm

So,

$$35000 = [4 \times 3.14^2 \times 2.08 \times 10^5 \times (3.14 \times d^4/64)] / 1000^2$$

$$d^4 = 202006.24 \text{ mm}^4$$

$$d = 37.7 \text{ mm}$$

So, we use a pillar of diameter 40 mm, which is the nearest to 37.7mm

**Verification :**

$$\sigma_{\text{Actual}} = \text{Load/Area}$$

$$= 35000 / [(3.14/4) \times 40^2]$$

$$= 27.86 \text{ N/mm}^2 \ll \sigma_t$$

**Verification :**

$$\sigma_{\text{Actual}} = \text{Load/Area}$$

$$= 50000 / [(3.14/4) \times 40^2]$$

$$= 27.86 \text{ N/mm}^2 \ll \sigma_t$$

### 7.4 POWER OF THE DIE CYLINDERS

Inlet pressure of the oil from the pump P<sub>1</sub>

$$= 20 \text{ kgf/cm}^2$$

Outlet diameter of the cube die piston D<sub>1</sub>

$$= 36 \text{ mm}$$

Area of the blank end of the cube die piston A<sub>1</sub>

$$= [3.14 \times 36^2] / 4 \text{ mm}^2$$

Force given by the coil to the cube die piston F<sub>1</sub>

$$= P_1 \times A_1$$

$$= 203.5 \text{ kgf}$$

$$= 203 \text{ T}$$

Inlet pressure of the oil from

The oil in the blank end of the die cylinders attains 100 kgf/mm<sup>2</sup> which opens sequence valve and the oil enters the blank end of the press cylinders from the sequence valve. According to the Pascal's law, pressure at any point in a liquid is same. So the pressure of the oil which enters the blank end of the press cylinders is 100 kgf/mm<sup>2</sup>.

### 7.5 POWER OF THE PRESS

sequence valve to the press cylinder P<sub>2</sub>

$$= 100 \text{ kgf/cm}^2$$

Outlet diameter of the cube die piston D<sub>2</sub> = 67mm

Area of the blank end of the cube die piston A<sub>2</sub>

$$= [3.14 \times 67^2] / 4 \text{ mm}^2$$

Force given by the coil to the cube die piston F<sub>3</sub>

$$= P_3 \times A_3 = 63.07 \text{ kgf}$$

$$= 3.5 \text{ T}$$

### 7.6 POWER OF THE EJECTOR

Inlet pressure of the air P<sub>3</sub> = 6.2 kgf

Outlet diameter of the cube die piston D<sub>3</sub> = 36mm

Area of the blank end of the cube die piston  $A_3$   
 $= [3.14 * 36^2] / 4 \text{ mm}^2$   
 Force given by the coil to the cube die piston  $F_2$   
 $= P_2 * A_2$   
 $= 3523.86 \text{ kgf}$

**8. DESIGNS AND TESTS**

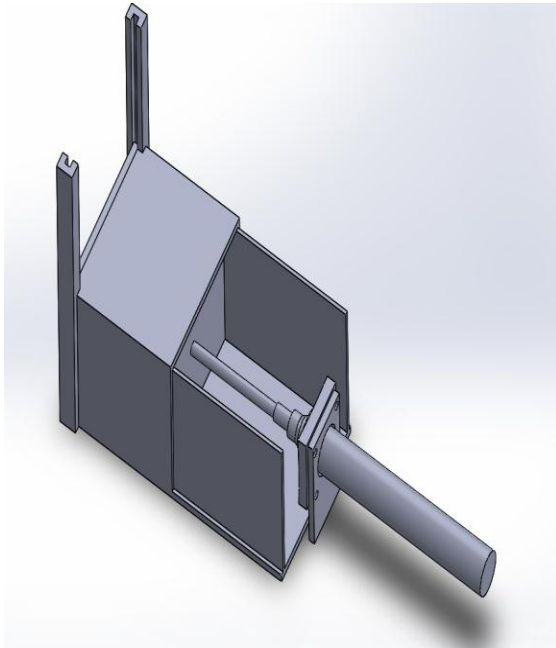


Fig. 2, A Design from solid works

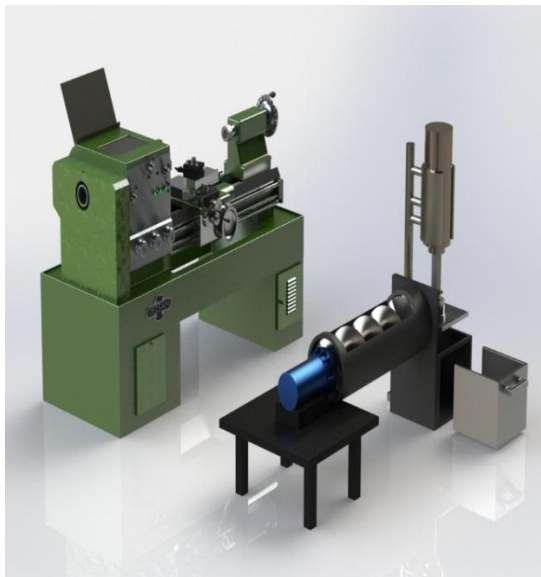


Fig.3, Design of scrap bailing press with a conveyor is attached to a lathe as seen above-mentioned

TABLE III Difference Of Methods

S. No	Ordinary Method	Scrap Bailing Press
1.	The scrap and collected and dumped in separate place.	The scraps are converted into cubes.
2.	The scraps are collected with the use of brooms into a trolley.	The scraps are collected using conveyors
3.	This method is less safe.	This method is highly secure.
4.	Two or more people are involved.	Only one person is enough.
5.	Gloves are needed while working.	Gloves are not at all necessary.
6.	It is very less efficient and it creates more loss of physical energy.	Highly efficient and only less amount of physical energy is used.
7.	Time consumption is high.	Less time consumption.
8.	Human power is used.	Hydraulic and pneumatic power is used.
9.	High hazardous.	It is hazardless.

**9. CONCLUSION**

The design for the manufacturing of a scrap bailing press has been successfully done. We analyzed that the scrap bailing press is very much useful. These can actually be used even in the management of the general plastic & other waste, but is proved more helpful in manufacturing industries. By using this device waste material management can be done successfully. This press design uses every raw material that sector buys, thus obtaining easy management and good cycle flow of materials over the industry, thereby helping to achieve the concepts of TPM, TQM, KAIZEN technology and 5S concepts. And we can also achieve the different safety management acts.

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