International Journal of Academic Engineering Research (IJAER)
ISSN: 2643-9085
Vol. 6 Issue 7, July - 2022, Pages: 17-21

DESIGN AND FABRICATION OF A VERTICAL HYDRAULIC JACK DRIVEN PRESS

Kotingo Kelvin[1],Yemi Philip Olisa[2],Angelyna Amos E[3]

DEPARTMENT OF MECHANICAL ENGINEERING,

NIGER DELTA UNIVERSITY, WILBERFORCE ISLAND, BAYELSA STATE, NIGERIA.

ABSTRACT: *The present study has critically designed and manufactured a press which can be operated by a hydraulic jack for not just compression works but also for forming, cutting and production of bales prior to recycling. The vertical press machine is supported by two springs for enforcement of pressure and compression required in metal squeezing operations. The components of the press includes a frame, springs, hydraulic jack, piston, connecting rod, forming box, base, bolts and nuts. The procedure employed an electric arc welding process in cutting, joining of the parts. The force required for the compression plate is 490N whereas the bale density and power of the ram is 1470N and 9.09 kg/m3 respectively. The hydraulic press was built at a cost of fifty thousand naira only (N50000) which is more cheap and economical when compared to the cost of a foreign made hydraulic press machine which cost about $7000 to $10,000. The produced machine met its design objectives and will definitely boast indigenous manufacturing industries in Nigeria.*

Keywords: Hydraulic Press, Press Work, Compression, Recycling

INTRODUCTION

Hydraulic press machine in this paper is designed to squeeze metal by application of mechanical force and pressure. These operations are mainly blanking, squeezing or piercing operations. Consequently, due to the advent of press machines, metals can be formed, bent into any desired shape without removal of chip.This presses are exclusively useful in the production of mass engineering works.

Press machines are no doubt extremely effective in the formation of sheet metal into finalized product. These machines constitute a vital part of manufacturing industry in terms of production of large quantities of engineering components such as domestic electrical appliances, auto body and electric motor parts. Hydraulic presses operate on hydrostatic pressure concept using a pump which generates power for fluid transmission via control valves, connectors, hydraulic pipes and eventually to the hydraulic motor for transformation of hydraulic energy into mechanical and other forms of energy.[i,ii] Furthermore, hydraulic press machine delivers more stimulation against the input pressure and other presses types in a positive manner, especially; during compression of materials in the forming box. In engineering workshop, the hydraulic driven press is very much useful due to its gradual and large magnitude of force and pressure it exerts in the production of bale materials e.g tins, cans, metals that are meant for recycling.

OBJECTIVES

1. To design and fabricate a hydraulic jack driven press machine with less expenses and low cost of maintenance.

2. To design a press machine that actuates and create bales of materials such as cans, tins and metals.

3 To eliminate the crude method of using trucks and other heavy duty vehicles in smashing and squeezing materials set aside for recycling.

METHODOLOGY

The frame has a length of 1370mm, made of an angle bar of 45mm thickness. It supports the structure for carrying of loads such as the forming box, support guides and hydraulic jack and also serves as a pillar mounted on the base. The support structures are made of solid mild steel and acts as housing for the springs which supports the hydraulic jack in providing the force needed during material compression. Also, an electric arc welding process was employed in the cutting and joining of parts used in the fabrication of the hydraulic machine press. The figures in the appendix presents a comprehensive view of the design and fabricated machine press. Furthermore, a detailed description of other basic materials used in the construction of the hydraulic press is given as follows:

Connecting Rod: The connecting rod is linked to the compression head of 435 × 672mm, precisely two rods of 458mm length resting apart and fixed through bored holes along the horizontal axis of the frame which moves back and forth. It aids in stroking of materials during press work operation.

Forming Box: This is known as the production chamber where all the waste cans, tins or metals are placed and compressed to produce bales for recycling. The box has a thickness of 20mm and dimension of 705 × 435mm positioned on rigid support guides which allows for both input and removal of materials after each presswork and this is achievable by simply pushing the bottom plate forward for easy material removal.

Hydraulic Jack: A hydraulic jack is a load lifting device that employs force application through a hydraulic cylinder. The hydraulic jack used for this machine is the same with the hydraulic jacks that are used in lifting of vehicles. Interestingly, a minimum of 3 or10 ton jack is suitable and is placed between the piston and the horizontal axis of the frame.

Springs: The length of the springs are 380mm, fixed on the both sides of the open enclosure bored on both sides of the length of the vertical frame, its purpose is to enforce compression during the operation of the hydraulic jack and returns to its original shape after the removal of the applied load .

RESULTS AND DISCUSSIONS

The work done by the ram is given by the force (P) multiplied the distance travelled by the ram (D), mathematically; $W = PD$ But,

The weight of the hydraulic press is 50kg

Mass of bale = 10kg, therefore F = ma

F = 10×9.8 = 490N

Assuming the ratio length of handle to connecting rod as 3m,

$P = Fx\ l$

P= (490×3), therefore P= 1470N

Power of the ram

The work done by the ram is given by the force (P) multiplied the distance travelled by the ram (D), mathematically; $W = PD$ But, $P = Fx\ /l$

Therefore $W = FxD/\ l$

Let t be the time it takes the ram to travel through D, therefore the power of the ram can be given as $P = Wt$

The hydraulic press machine was tested with tins, cans. The mass of the materials was 10kg. The thickness of the sheet metal was 1.1mm,

(volume = length x width x height). We know that, $\rho = m/v$ where, P = mass density of material

M = mass of cans, tins, V = volume of materials.

Therefore, the density of the material: (10/1.1) kg/m3 = 9.09 kg/m3.

CONCLUSION

The study has designed and fabricated a hydraulic press machine which presents a refined approach of compressing materials. As a result, eliminates the crude method of using hammers, trucks to squeeze metals before recycling of tins, cans, metals etc. The compressed materials after recycling are re-used to produce various desired shapes such as interior decors, auto parts, cups and other house hold materials. Performance evaluation test of the machine did not only show that the design objectives were met but also promises competition with imported press machines of the same capacity. The hydraulic press was designed and manufactured at a cost of fifty thousand naira only (N50000) which is cheaper and economical when compared to the cost of buying and importing a press of same specification which could cost about $7000 to $10,000. The produced machine will no doubt be a boast to indigenous manufacturing industries.

REFERENCES

[i] M. Sumaila and A. O. A. Ibhadode, "Design and Manufacture of a 30-ton Hydraulic Press," AU JT, vol. 14, pp. 196-200, 2011.

[ii] G. K. Adam, "Design and control of a mechatronic hydraulic press system," in Mechatronics, 2004. ICM'04. Proceedings of the IEEE International Conference on, 2004, pp. 311-315.

[iii] A.M. Law & W.D. Kelton, Simulation modeling and analysis (New York: McGraw-Hill, 2000).

[iv] W.J. Palm, Modeling, analysis and control (New York: John Wiley & Sons, 2000).

[v] G.K. Adam, Qualitative models in simulation and control of structural machine processes, International Journal of Modeling and Simulation, 22(1), 2002, 23–29.

[vi] G. Garani & R. Johnson, Joining nested relations and subreations, Elsevier Information Systems, 25(4), 2000, 287–307.

International Journal of Academic Engineering Research (IJAER)
ISSN: 2643-9085
Vol. 6 Issue 7, July - 2022, Pages: 17-21

APPENDICES