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Design and Development of Pulverizer for Non-Ferric Alum

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***Abstract*— A Pulverizer is a mechanical device for the grinding of different types of materials. Under pulverizer concept we have to select one of types of crusher. Crushers are one of the major size reduction equipment that is used in mechanical, and other different aspect of that type of industries. A crusher is a device that is designed to reduce large solid raw material into smaller chunks. They exist in various sizes and capacities which range from 0.1 ton/hour to 50 ton/hour. Our objective is to design and develop of various components of an Impact crusher like shaft, rotor, bar, casing, and discharge mechanism which will be useful in minimizing weight, cost and maximizing the capacity, do not spread in the atmosphere of their output (Power form) and also do their analysis. The Impact Crusher Machine rotor revolves in fixed direction by means of driving action that connects with motor. Impact crushers involve the use of impact rather than pressure to crush materials. Here the material is held within a cage, with openings of the desired size at the bottom, end or at sides to allow crushed material to escape through them. The mechanism applied here is of Impact loading where the time of application of force is less than the natural frequency of vibration of the body. Since bars are rotating at a very high speed, the time for which the particles come in contact with the hammers is very small, hence here impact loading is applied. The shaft is considered to be subjected to torsion and bending. The grinding screen is also designed for optimal output from the horizontal impact crusher. A performance model is also considered for the horizontal shaft impact crusher so as to find out the relation between the feed, the crusher parameters and the output parameter.**

Keywords- Non- ferric alum, Pulverizer, Horizontal Impact crusher,

I. INTRODUCTION

The crusher defends as the machine or the tool which designed and manufacture to reduced the large materials into smaller chunks. It could be considered as primary, secondary or fine crushers depending on the size reducing ratio. Crushers classified depending on the theory of the crushing acting as, jaw crusher, conical crusher and impact crusher. And these crushers use the impact rather than the pressure to chunk and break the material. The impact crusher classified to horizontal impact crusher and vertical impact crusher based on the type of arrangement of the impact rotor and shaft.

OVERVIEW – Horizontal shaft impact crushers break rock by impacting the rock with hammer or blow bar that are fixed upon the outer edge of the spinning rotor. Here the rotor shaft is aligned along the horizontal axis. The input feed material hits the rotating hammers of the rotor and due to this sudden impact it breaks the material and further breaks the material by throwing it on to the breaking bar/anvil. These have a reduction ratio of around 10:1 to 25:1and are hence use for the extracted materials, sand gravel etc.

II. LITERATURE SURVEY

It was also found out that the particle entering into the breakage process procures continuous breakage until it fails the classification function for breakage. Hence larger the parent particle the larger is the number of breakage process. Due to the dynamic nature impact breaking it was found that the classification function depends on the crusher design parameters (shape parameter and impact energy) and feed rate and also on the material strength parameters. The performance model is able to predict the product size distribution with reasonable accuracy even when important variations in both the rotor velocity and feed are imposed. The specific impact energy for a Horizontal shaft crusher is very less than that for a vertical shaft crusher. It was also found out that no other force acts on the particle during its free fly from the rotor hammer impact to the wall impact. The depth of penetration can be increased by decreasing rotor speed or increasing the height of fall. For effective crushing the velocity of free fall of the lump should be sufficient to reach the middle of head of hammer or the impact zone. The particles with a smaller grain size have higher strength. From the kinetics of the hammer/ blow bar rotation it was found out that reducing the number of blow bars on the rotor not only reduces the total weight and cost by also provides enough spaces between the two hammers so that the portion of material admitted to each row of blow bars encounters a crushing surface equal in size to a continuous bed over the entire width of the rotor and consequently a larger surface than that of the original arrangement by the magnitude of the gaps between the hammer/blow bar heads will be available. Also for the size of the material required we can find out the optimum speed of rotation of the rotor.

III. MATERIAL AND METHOD OF PROCESSING

Formula of non-ferric alum is Al2(SO4)314H2O.
Chemical Appearance of non-ferric alum is White Crystalline Solid. It is slightly soluble in alcohol, dilute mineral acids. Its taste is sweet.
Non- Ferric alum is used as a chemical in water treatment plants. It takes the role of coagulating agent to clear away the impurities found in various water sources. It can also control the level of pH in the treatment of waste water.

- **METHODS**

1. We have designed the different parts of horizontal impact crusher in AUTOCAD.
2. We have designed the horizontal impact crusher assemble part on CREO.
3. Design of horizontal impact crusher analysis is done under ANSYS WORKBENCH.
4. With the help of dynamic analysis under displacement process we found out their impact load occurs.

A. Line Diagram

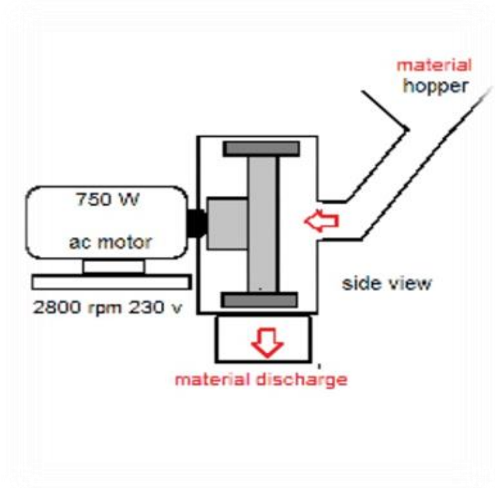

Figure 1:- Line diagram of impact Crusher

B. Design on CREO

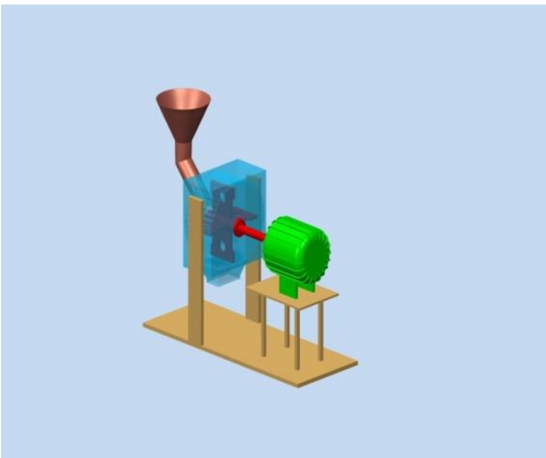

Figure 2 :- Design on Creo of Impact Crusher

IV. CALCULATION & ANALYSIS

Theoretical calculations of Horizontal Impact Crusher are done as follows:

➢ ***Non-Ferric Alum (Raw Material)***

Density:- 1600kg/m^3
Feed size:- 12.5mm
5 Metric per shift:- .625 TPH
Let us consider a hammer made of Stainless steel and having Rectangular section.

➢ ***Hammer/ Bar***

- Material:- Stainless Steel
- L:- 70mm, W:- 70mm, H:- 8mm
- E:- 190 GPA, Yield stress:- 300MPA
- Height of fall of material:- 90mm, density:- 7.8gm/cm^3
- Wt. of blow bar:- Volume*Density
  = (Area*length)*Density
  = 53.125*7.8
  = 415gm
  = 0.415kg

➢ ***Rotor Shaft***

Material:- Stainless steel
Density :- 7850 kg/m^3
Shaft dia:- 30mm
Wt. of rotor plate:- .415kg
Volume of Shaft :-∏ /4*d^{2}l
= ∏ /4*30^2 *100
= 77754.41 mm^3
Mass of Shaft :- 0.55kg

➢ ***Casing Teeth Specification***

- Standard size of teeth of anvil for 1.5cm size of inlet material.
- ✓ Pitch is 6mm
- ✓ Height of teeth is 5mm
- ❖ Length of the anvil will be 100mm which will compensate the size of Hammer bar

➢ ***Integrated Single Phase Induction Motor***

- 1 HP Motor
- Power :- 750 watt
- Voltage :- 220v
- N :- 2880rpm
- I :- 8 amp
- P = Ш*T

750= 2 ∏N/60*T
T = 750*60/2*3.14*2880
T = 2.486 N-m (J)

V. ANALYSIS

❖ ***When the blow bar is subjected to a concentrated load at the mid of its span.***

- Max moment:- 43.26N-mm
- Max allowance moment:- 2250N-mm
- Since M all > M max

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The design is safe.

- ***When the blow bar is subjected to a concentrated load at the tip of the cantilever.***

  - Max moment:- 86.52N-mm
  - Max allowance moment:- 2250N-mm
  - Since M all > M max

The design is safe.

- ***Impact bending stress due to cantilever beam subjected to uniformly distributed load.***

Maximum stress induced:-
= 389.58 N/mm^3
Maximum allowable stress :- 500 N/mm^3

- ***Static load shearing i.e. bending of tip of bar***

y_s :- 7.9*10^{-10} mm

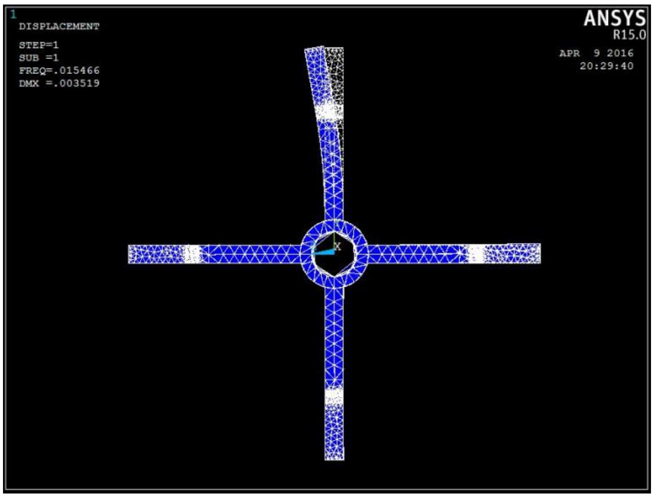

Figure 3:- Load Impact of Hammer of Impact Crusher

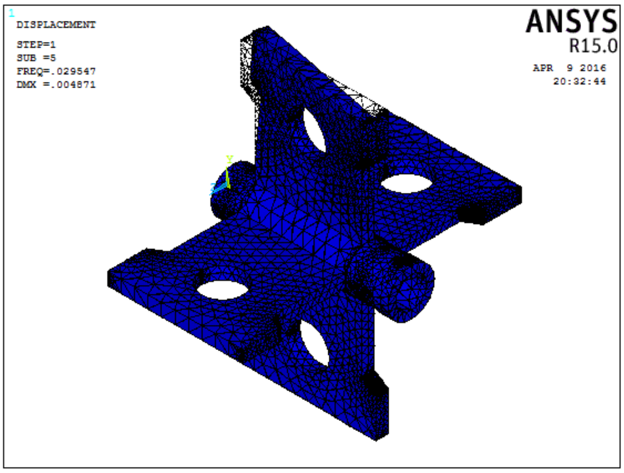

Figure 4:- Displacement of Hammer during processing of Impact Crusher

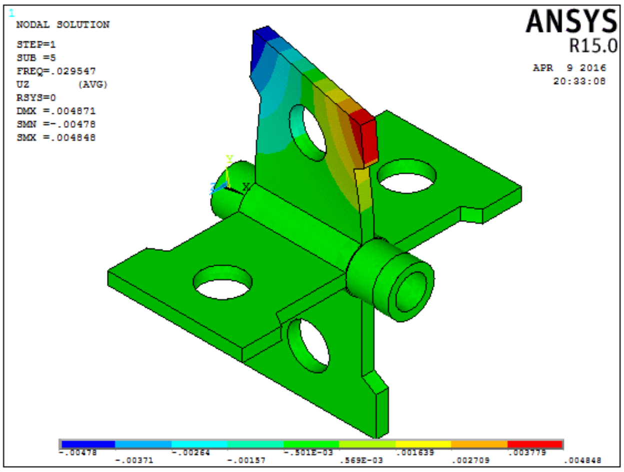

Figure 5:- Shaft analysis of Horizontal impact Crusher

VI. FABRICATED MODEL

Figure 6:-Front View of Horizontal Impact Crusher

Figure 7:- SIDE VIEW OF Horizontal Impact Crusher

VII. ADVANTAGES

- Dust does not spread in atmosphere.
- More efficient
- Less cost
- Continuous production
- Less time taking
- Fulfill customers requirement

VIII. APPLICATIONS

- Brittle material can be crushed.
- Materials:-
  1) charcoal
  2) Rock salt
  3) Alum
  4) Ferric alum
  5) Non- ferric alum etc..

IX. CONCLUSION

The Rotor hammers were checked for their bending and shear stress and were found within the allowable limits in the maximum load condition. The rotor plate was also checked for shear stress and was found safe. The anvils were checked for bending and shearing strengths and were found under the limits of failures. The rotor shaft was checked for torsion and bending and was found safe.

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