DESIGN AND DEVELOPMENT OF ALUMINUM SULPHATE CRUSHER MACHINE

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ABSTRACT

As we know that, in many industries the major issue is of water supply, there is 75% water on the earth but useful water is only 3%. Useful water is very less so we have required to reuse the water in industry by purifying it. Aluminum sulphate(alumina) is use for purifying a large amount of water in industry as a purifier. Aluminum sulphate is directly available in market in the form of cubic block and it is very hard for crushing. By crushing process cubic block is converted into powder form. The powder form of aluminum sulphate rapidly dissolved in water as compared to solid form. In industry when crushing process is done at that time the crusher blade get damage during short period of time resulting delay time is increase and reduce production rate. For increasing the efficiency of the crusher & increasing production rate, we have selected this project.

Keyword: - *Aluminum sulphate[1], crushing process[2], cubic block[3], powder form[4]*

1. INTRODUCTION

A crusher is a machine designed to reduce large solid material objects into a smaller volume, or smaller pieces. Crushers may be used to reduce the size, or change the form, of waste materials so they can be more easily disposed of or recycled, or to reduce the size of a solid mix of raw materials, so that pieces of different composition can be differentiated. Crushing is the process of transferring a force amplified by mechanical advantage through a material made of molecules that bond together more strongly, and resist deformation more, than those in the material being crushed do. Crushing devices hold material between two parallel or tangent solid surfaces, and apply sufficient force to bring the surfaces together to generate enough energy within the material being crushed so that its molecules separate from (fracturing), or change alignment in relation to (deformation), each other. The earliest crushers were hand-held stones, where the weight of the stone provided a boost to muscle power, used against a stone anvil. Querns and mortars are types of these crushing devices.

1.1 Overview of Aluminium Sulphate

Aluminum sulfate is a chemical compound with the formula Al2(SO4)3. It is soluble in water and is mainly used as a flocculating agent in the purification of drinking water and waste water treatment plants, and also in paper manufacturing. Aluminum sulfate (Al2(SO4)3), commonly called alum, is produced as white crystals which are non-combustible and soluble in water.

Fig. 1. Aluminum Sulphate Cube

This dry hydrate (Al2(SO4)3.14H2O) is 17% Al2O3 and is also sold as a 47% aluminum sulfate solution which is 8% Al2O3. It is also sold in solid form as kibbled, ground or dust. Aluminum sulphate available in two types is as follows.

1.2 Problem Statement

A study conducted during our visit to Vidarbha chemical industry Nagpur where people crush Aluminum Sulphate block using rotor blades arrangement showed that a hardworking person could produce 500 kg powder per day ,but this powder is not uniform it contain some flexes of aluminum sulphate . This method is not very lucrative in its returns and cannot produce aggregates of desired mesh, and also powder dust exposes to environment. As opposed to the above method, mechanized crushers cannot produce marketable, high quality of precisely desired powder of aggregates, without high crushing and production rate but higher production cost.

1.3 Objectives: - The work follows bellow objectives of our

- Design and fabrication of Aluminium Sulphate crushing machine
- Increase production rate of Aluminum sulphate powder.
- To reduce power consumption required for the machine.
- To obtain fine powder as an output from the machine
- To reduce wear and tear of parts of a machine and increase the life of components

2. WORKING OPERATION

In our crushing machine operations perform in two stages first is compressive force generated by pressure rollers and another is applying impact force by rotating hammers.

2.1 First Stage

When electric supply is switch on electric motor get rotated at 1440 rpm, by using belts and pulleys arrangement at initial stage we reduced speed of pressure roller 30 rpm and hence torque increases up to 16.5 KN. At the initial stage aluminium sulphate cubes are inserted by manually in compressive rollers, in which cubes gets breakdown in number of pieces by applying compressive force by bolted roller. These pieces go downward towards hopper and pieces collected in hopper which is connected to inlet of second stage.

2.2 Second Stage

Second stage consists of impact crusher, when the numbers of pieces of cube are inserted from first stage. These break cubes pieces by impacting the small pieces with hammers/blow plates that are fixed upon the outer edge of a spinning rotor. Here the rotor shaft is aligned along the horizontal axis. The input feeded 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 plates and after completing the whole process cubes converted into fine powder.

Fig. 2. Working Model of Aluminum Sulphate Crusher

2.3 Working Principle

The Impact Crusher Machine rotor revolves in fixed direction by means of driving action of triangle belt that connects with motor. Above rotor, there are sets of suspended impact plates. Material enters into the crushing chamber through the charging hole and feeding guide plate. The blow bars fixed on rotor strikes the feed material onto impact plate and then fall from it to mutually shock material blocks. Therefore, material will be moved recurrently and repeatedly in the crushing chamber that is composed of rotor, impact plate/ anvils, hammers/ blow bars , by means of which intense shock phenomenon will act predominantly, and the material will be

crushed along its natural crack and hence bulge. The gap between impact plate and hammer/blow bar can be adjusted according to practical requirement by adjusting the angle and distance of the impact anvils. Product output is easily controlled by varying the rotor speed, input feed rate and the screen configuration.

3. CONSTRUCTION OF CRUSHING MACHINE

In crushing machine mainly consist of following components.

1. Electric motor
2. Frame
3. Bolted Pressure rollers
4. Spur Gears
5. Line Shafts
6. Casing
7. Hammer crusher
8. Hammer Set
9. Belts
10. Pulleys

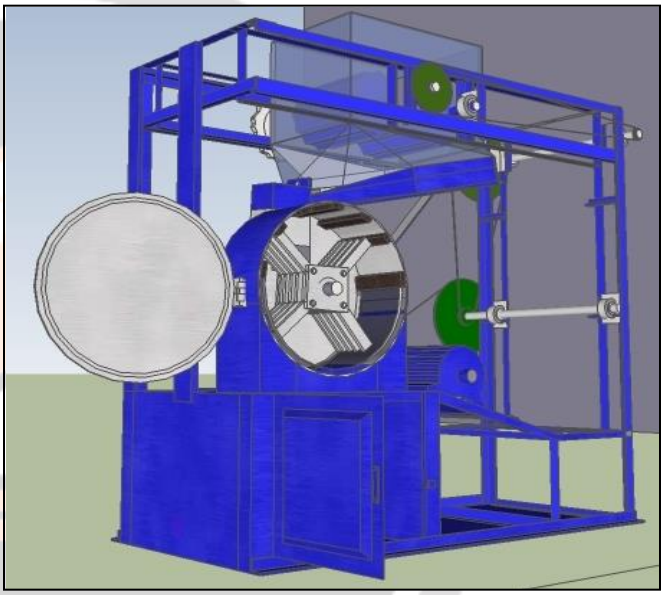

Fig. 3. Aluminium sulphate crusher (CAD model)

3.1 Bolted Pressure Rollers

Name indicates the type of roller in which numbers of bolts are mounted on a shaft in a circular path. There is two rollers are used to create a pressure on a raw material by rotational motion.

In this project pressure rollers are mounted on the upper side of body because it use at starting stage of machining operation, figure shows bolted pressure rollers.

Fig. 4. Bolted Pressure Rollers

3.2 Gears

A gear is a rotating machine part having cut teeth, or cogs, which mesh with another toothed part to transmit torque. Geared devices can change the speed, torque, and direction of a power source. In this project spur gears are used to

transmit opposite direction from one pressure roller to another pressure roller . In which gears are mountain on at the end of each roller shaft. Gears are made up of steel as shown in figure.

Fig. 5. Gears

3.3 Hammer Crusher

The horizontal shaft impact crushers (HSI) break aluminium sulphate cubes by impacting the sulphate cubes with hammers that are fixed upon the outer edge of a spinning rotor. These break cubes by impacting the rock with hammers/blow plates that are fixed upon the outer edge of a spinning rotor. Here the rotor shaft is aligned along the horizontal axis. The input feeded 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 plates. These have a reduction ratio of around 10:1 to 25:1, in it on spinning rotor 16 hammer plates are mounted.

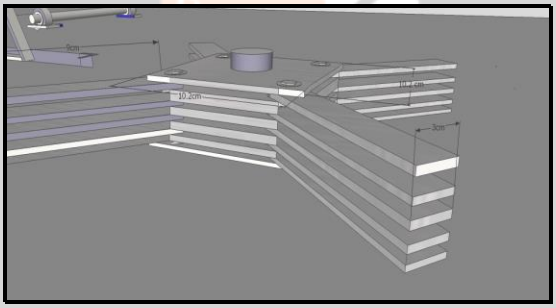

Fig. 6. Hammer crusher

4. Results & Discussion

After doing demonstrations on Aluminium Sulphate crushing machine the results obtained are time saving and efficient in working.The results obtained for crushing cubes are as follows**;**

Table 1. Comparison between Fabricated Machine and Existing Machine

Parameters	Fabricated Machine	Existing Machine
Input: Amount & Time	360 Cubs in 1 hr	5 Slab in 1 hr
Output: Amount & Time	85 Kg Powder in 1 hr	100 Kg in 1 hr
Quality of Powder	100 Mesh Powder	100 Mesh with small Crystals
Phases	Single phase 2HP electric motor	Three phase 7HP electric motor
Environment	Less dusty because machining in closed casing	High dusty because machining
Operation Stages	Operation occurs in two stage	Operation occurs in one stage
Product Size	Product size is adjustable	Product size do not adjustable
Machine Size	Small in size	Large in size

Machine Cost	28,000/-	60,000/-
Maintenance Cost	Low maintenance cost	High maintenance cost

5. CONCLUSIONS

a. It is concluded that, the designed horizontal hammer impact crusher machine took less time to crush aluminium sulphate material (solid blocks) and produced fine powder upto 100 mesh which is very fine as compared to the existing machine currently used in industry at Vidarbha Chemicals Pvt. Ltd. Kalmeshwar, Nagpur
b. The energy consumption rate of this machine is less as compared to present machine to crush the same size of quantity.
c. It also be beneficial to used at various industries, entrepreneurs and companies where crushing / pulverizing operations are normally carried out

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