WEAR IN STONE CRUSHER PLATE

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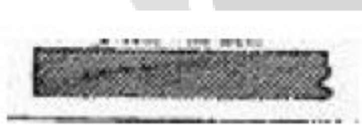
ABSTRACT

This paper describes the weight reduction of jaw plate and materials for jaw crushers in mining industry.. The interaction between the jaw plates and material is an necessary process in crushing of stone. Where moving and fixed jaw is used. The movement of the moving and fixed jaw is described in detail. The continuous crush of mining results in wear of jaw plates which results in reduction of weight of jaw plates due to which efficiency of plates decreases in jaw crusher and after certain period plate failure occurs which require continuous change of plates due to which cost increases. A suitable material selection may avoid the this failure an improve the life of jaw crushers.

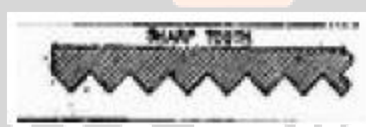
Keyword: - *Jaw crusher, Crushing, Abrasive wear, material.*

1. INTRODUCTION

Jaw crushers generally of heavy duty steel box, fitted with fix vertical crushing "jaw" at one end and a moving "jaw" opposing it, with a method of transferring motion to the moving jaw. The moving jaw swing towards and away from the fixed jaw, creating a compression action on the rock. The opening between the fixed and moving jaw tapers vertically from wide at the narrow at the bottom, thus gradually reducing the size of the rock as it move down through the crushing chamber. The jaw plates can be flat, ribbed, corrugated or a combination of these.



Flat Jaw Profile



Ribbed Jaw Profile

Corrugated Jaw Profile

There are two types of jaw crushers : single toggle and double toggle crushers

The double toggle Blake machine is considered the original design of jaw crusher. It was designed in 1857 by Eli Whitney Blake. In the double toggle machine the moving jaw (swing jaw) is pivoted at the top on the concentric swing-jaw shaft fitted with plain bushes, either in the frame of the crusher or in the swing jaw. A reciprocating action is imparted to the swing jaw through the toggles, on either side of, and actuated by eccentric shaft, generally with roller bearings. The eccentric shaft generally has two flywheels fitted, depending on the design of the machine. The swing jaw is held against the toggles by tension rods and springs. Adjustment of crusher setting is achieved by moving the toggle block and adding or removing shims as required. The toggles are the overload protection devices for the machine, being designed to fail in the event of a crusher overload, thus protecting the main crusher components.

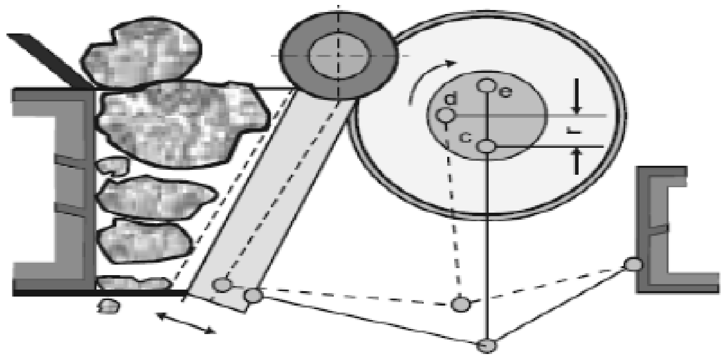


Fig. 1. Double Toggle Jaw crusher

A later development of the Blake design is the single toggle jaw crusher. These machines were originally called Roll Jaw Breakers due to the rolling crushing action imparted to the rock. They differ from the Blake design in that the eccentric shaft and the swing jaw are incorporated in the same component, removing the necessity for the second toggle plate and the swing jaw shaft, and providing a generally lighter machine for an equivalent size. Improvements in technology and subsequent design changes are allowing these machines to become more efficient than the double toggle type.

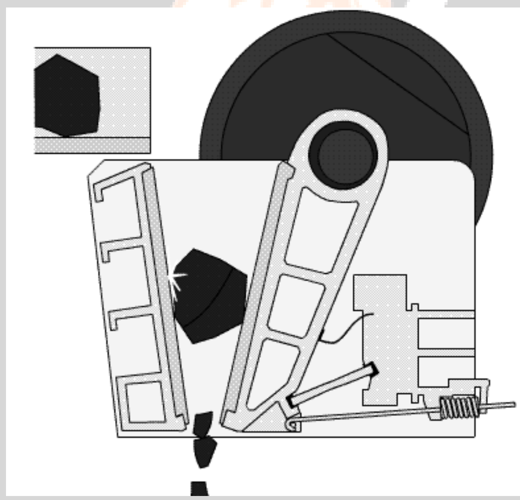


Fig. 2. Single Toggle Jaw crusher

A jaw crusher is one of the main types of primary crushers in a mine or ore processing plant. The size of a jaw crusher is designated by the rectangular or square opening at the top of the jaws (feed opening). For instance, a 24 x 36 jaw crusher has a opening of 24″ by 36″. Primary jaw crushers are typically of the square opening design, and secondary jaw crushers are of the rectangular opening design.

2. LITERATURE REVIEW

Lindqvist M.and Evertsson C. M. [1] worked on the wear in rock of crushers which causes great costs in the mining and aggregates industry. Change of the geometry of the crusher liners is a major reason for these costs. Being able to predict the geometry of a worn crusher will help designing the crusher liners for improved performance. Tests have been conducted to determine the wear coefficient. Using a small jaw crusher, the wear of the crusher liners has been studied for different settings of the crusher. The experiments have been carried out using quartzite, known for being very abrasive. Crushing forces have been measured, and the motion of the crusher has been tracked along with the wear on the crusher liners. The test results show that the wear mechanisms are different for the fixed and movingliner. If there were no relative sliding distance between rock and liner, would yield no wear. This is not true for rock crushing applications where wear is observed even though there is no macroscopic sliding between the rock material and the liners. For this reason has been modified to account for the wear induced by the local sliding of particles being crushed. The predicted worn geometry is similar to the real crusher. A jaw crusher is a machine commonly used in the mining and aggregates industry. The objective of this work, where wear was studied in a jaw crusher, is to implement a model to predict the geometry of a worn jaw crusher.

Gupta Ashok and Yan D.S. [2] worked in design of jaw crushers which impart an impact on a rock particle placed between a fixed and a moving plate. The faces of the plates are made of hardened steel. Both plates could be flat or the fixed plate flat and the moving plate convex. The surfaces of both plates could be plain or corrugated. The moving plate applies the force of impact on the particles held against the stationary plate. Both plates are bolted on to a heavy block. The moving plate is pivoted at the top end or at the bottom end and connected to an eccentric shaft. In universal crushers the plates are pivoted in the middle so that both the top and the bottom ends can move. The Blake crushers are single or double toggle drives. The function of the toggle is to move the pivoted jaw. The retrieving action of the jaw from its furthest end of travel is by springs for small crushers or by a pitman for larger crushers. As the reciprocating action removes the moving jaw away from the fixed jaw the broken rock particles slip down, but are again caught at the next movement of the swinging jaw and crushed. This process is repeated until the particle sizes are smaller than the smallest opening between the crusher plates at the bottom of the crusher (the closed set). For a smooth reciprocating action of the moving jaws, heavy flywheels are used in both types of crushers.

Dowding Charles H. [3] designed jaw plates to reduce efforts to decrease energy consumed in crushing have lead to consideration of decreasing the weight of the swing plate of jaw crushers for easily crushed material. This paper presents the results of an investigation of the feasibility of using point load-deformation-failure (PDF) relationships along with interactive failure of rock particles as a model for such a weight reduction. PDF relationships were determined by point-loading various sizes of materials: concrete mortar, two types of limestone, amphibolites and taconite. Molling [3], who proposed this hypothetical distribution, was only concerned with the total loading force. The parameter which most controls the design of the swing plate is the load distribution. Instrumentation of toggle arms in has since led to correlation of measured with rock type. Ruhl [3] has presented the most complete consideration of the effect of rock properties on Q and the toggle force. His work is based upon the three-point loading strength of the rock, which he found to be one-sixth to one eleventh the unconfined compressive strength. He calculated hypothetical toggle forces based upon the sum of forces necessary to crush a distribution of regular prisms fractured from an initial cubical rock particle. These approaches involved both maximum resistance and simultaneous failure of all particles and thus neither can lead to an interactive design method for changing stiffness (and weight) of the swing plate. In this study point-loading of cylinders are undertaken to model behavior of irregular rock particles.

3. CRUSHERS

3.1 Jaw and Gyratory Crushers.

Jaw and gyratory crushers are used mostly for primary crushing. They are characterized by wide gape and narrow discharge and are designed to handle large quantities of material.

The capacity of the crusher is determined by its size.

The gape determines the maximum size of material that can be accepted. Maximum size that can be accepted into the crusher is approximately 80% of the gape.

Jaw crushers are operated to produce a size reduction ratio between 4:1 and 9:1. Gyratory crushers can produce size reduction ratios over a somewhat larger range of 3:1 to 10:1.

Primary operating variable available on a crusher is the set and on jaw and gyratory the openside set (OSS) is specified. This reflects the fact that considerable portions of the processed material fall through the crusher at OSS and this determines the characteristics size of the product. The set of a crusher can be varied in the field and some crushers are equipped with automatically controlled actuated for the automatic control of the set. The open- and closed-side sets and the gape are identified in Figure 3.1. The throw of the crusher is the distance that moving jaw moves in going from OSS to CSS.

Throw = OSS-CSS.

The capacity is a function of size and OSS. Manufacturers publish tables of capacity for their crushers of various size as a function of the open-side set.

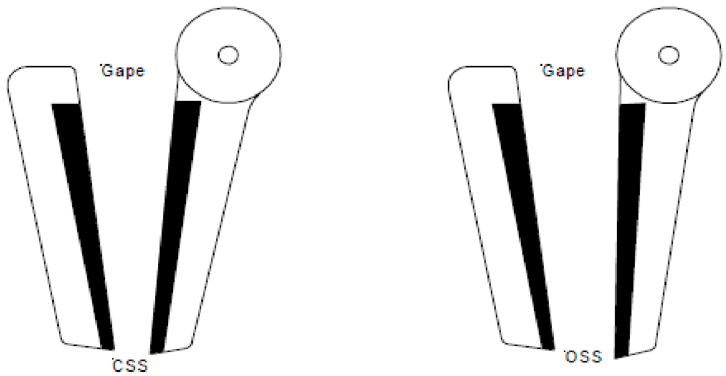


Fig.3.1 close side set (CSS) and open side set (OSS)

3.1.1 Cone crushers
Cone crushers are commonly used for secondary, tertiary and quaternary crushing duties. Two variations are available - standard and short head
The chief difference between cone and gyratory or jaw crushers is the nearly parallel arrangement of the mantle and the cone at the discharge end in the cone crusher.
Reduction ratios in the following ranges are common for cone crushers:
6:1 - 8:1 for secondaries
4:1 - 6:1 for tertiary and quaternary crushing.

3.1.2 Impact crushers
Breakage is achieved by impact using either hammer action on the individual particles or by sudden impact from a high velocity trajectory.
High reduction ratios of between 20:1 and 40:1 can be achieved with hammer type impact crushers.
Only low reduction ratios of about 2:1 can be achieved with kinetic energy type impact crushers.

TECHNICAL STRUCTURE

Ore crushing production line, stone crusher occupies a position of absolute importance, and therefore the choice of crusher equipment for ore crushing production line, it is a very important decision. Production line to the ore crusher stone crusher includes jaw crusher, cone crusher, impact crusher, impact crusher and so on. Ore crushing production line will be broken based on the principle of different material properties and requirements plus a comprehensive selection of stone crusher. According to the method usually crushed stone crushing technology can be divided into four crushing type. The first is crushed silica crushing technology, materials and silica realized by crushing pressure between the two work panels broken equipment, such crushing method is suitable for crushing bulk materials, stone crushing technology uses laminated crushing principle method, resistance Wearing of wear parts is the school, followed by the split pieces, this method requires crushing the material placed between a plane and a sharp edge with the face, the face of the material for extrusion through with a sharp edge and, ultimately, the material along the direction of the line pressure to achieve chipping. Is broken off again, this time the material is subjected to the bending stress and broken. Can be said to be broken. Finally, impact crusher, then the impact force of the material and broken, this stone crushing high crushing efficiency technologies, crushing ratio, low energy consumption.

EFFECTIVE MEASURES TO REDUCE THE LARGE STONE CRUSHER WEAR

Stone crushing production jobs among professional production line will be designed for large-scale stone crusher, stone crusher so as to allow to get a very high quality of crushing quality. Many companies in the purchase of equipment are key consideration stone crusher offer, and then the selection of equipment. In fact, most related to the quality of the stone crushing machines offer is not the device, but the large stone crusher in the work process, if they can get the wear particle size reduction, then that is a very good value equipment. Stone crushing equipment used variety, jaw crusher, hammer crusher, impact crusher, of which the wear rate of the most jaw crusher fast and, secondly, hammer crusher. But the high cost of hammer crusher, so now many manufacturers in the stone crusher when optional equipment cost will be very high value, even considering the life of the crusher. Allow large stone crusher in the production process, is to reduce the wear on the stone crushing production more smoothly key. But also in the choice of equipment, considering the stone crusher quotes and other factors, so as to make the stone crushing costs more in line with the company's expectations.

CONSIDERATION WHILE SELECTING A JAW CRUSHER

- Maximum feet size should be no greater than 80% of the gap.
- The operating setting of the crusher (close side setting) is the smallest distance between the fixed jaw plate and moving jaw plate, measured plate to plate or tip to valley.
- Maximum product size will generally be about 1.5 times the close side setting of the machine. However, if the feed is a particularly slab by material this may not be the case.
- After crushing 50% to 60% of product will pass closed side setting.
- Reduction ratio of jaw crushers is generally around 6:1.
- The primary crusher should be selected to exceed the average capacity of the plant, as primary feed to a plant is generally of cyclic nature, relying on trucks or loaders in most cases.
- Jaw crusher operate at their maximum efficiency when all feed smaller than closed side setting is removed by pass the jaw crushers.
- Jaw crusher should be selected based on maximum feet size, not required capacity. Putting too fine a feed into a jaw crusher will over load the machine, leading to possible equipment failure.

TECHENICAL SCALE FOR JAW CRUSHER

Crusher Size		**Average capacity in tons/P.H. with Jaw setting**								**Drive H.P.**	**RPM**	**App. Wt.**
INCHES	M.M.	1/2"	3/4"	1"	2"	3"	4"	5"	6"			
16x 10	405x255	3	4	5						25	305	3200
18 x 12	450x300	7	11	13	20	30				30-35	325	3950
20 x 12	505x 300	10	15	18	30					40-45	325	4800
24 x12/15	610x300	15	20	27	34	36				45-50	315	7800
30 x15/18	750x450					38	44	50	60-75	60-70	300	1200
36 x6/8	900x150	12	18	25						45-50	325	9800
36x9	900x230	15	22	28						50-60	310	11000
36x24	900x600					67	75	80	80-125	85-100	305	19000

4. MATERIAL SELECTION

The materials used for manufacturing the jaw plate is manganese steel as it has very high resistance to impacts received by the crusher when large stones enter the machine.

The profile of the jaw plate differs depending on the hardness of the aggregates that the crusher processes, the desired size of the rocks at the exit of the crusher etc. Foundry process can help to select the correct jaw plate profile that can be straight, with sharp teeth, with curved teeth, sparse or dense mounted.

The manganese content is critical to the wear life of crusher parts and the cost efficiency of operation. Manganese content can range between 9% - 24% and is usually referenced as;

- 14% = 13-14% MN
- 18% = 17% - 19% MN
- 21% = 21% - 24% MN

Castings with any of these manganese percentages could be the right ones for application. It just depends on crushing. While one could use a higher percentage of manganese for crushers jaw plates, 14% manganese can work fine for hard non-abrasive materials especially with Wear and Spare Parts heavy duty Jaws. Manganese must "work-harden" for optimum performance, which should be matched with material hardness. The hardness & abrasiveness of the rock to be crushed should determine the manganese content for operation.

Critical factors for jaw crusher wear parts are how long they last and how efficiently they crush the material. Jaw weight, tooth profile and proper fit are all important considerations for efficient crushing. Efficiency requires proper tooth profile and this can be determined for each crushing application at Wear and Spare Parts.

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