

A REVIEW ON STUDY OF JAW CRUSHER

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ABSTRACT

Crushers are machines which use a metal surface to break or compress materials mining operations use crushers, commonly classified by the degree to which they fragment the starting material with primary and secondary crushers handling coarse materials and tertiary and quaternary crushers reducing ore particles to finer gradations. This paper focuses on review of a work carried out by researchers in the field of kinematic & dynamic analysis of the jaw crusher attachment. Kinematic & Dynamic analysis is helpful for understanding and improving the design quality of jaw crusher. There are many researcher work done by researcher in the same field but still there is a scope to develop Kinematic & dynamic analysis to jaw crusher attachment.

Keywords – Jaw crusher, Kinematic analysis, Dynamic analysis

I. INTRODUCTION

Rapidly growing rate of industry crushing machinery. A jaw or toggle crusher consists of a set of vertical jaws, one jaw being fixed and the other being moved back and forth relative to it by a cam or pitman mechanism. The jaws are farther apart at the top than at the bottom, forming a tapered chute so that the material is crushed progressively smaller and smaller as it travels downward until it is small enough to escape from the bottom opening. The movement of the jaw can be quite small, since complete crushing is not performed in one stroke. The inertia required to crush the material is provided by a weighted flywheel that moves a shaft creating an eccentric motion that causes the closing of the gap. Single and double toggle jaw crushers are constructed of heavy duty fabricated plate frames with reinforcing ribs throughout. The crusher's components are of high strength design to accept high power draw. Manganese steel is used for both fixed and movable jaw faces. Heavy flywheels allow crushing peaks on tough materials. Double Toggle jaw crushers may feature hydraulic toggle adjusting mechanisms. It is shown below Figure 1 & Figure 2.

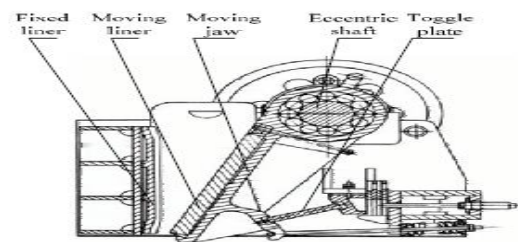


Figure 1 Single Toggle Jaw crusher

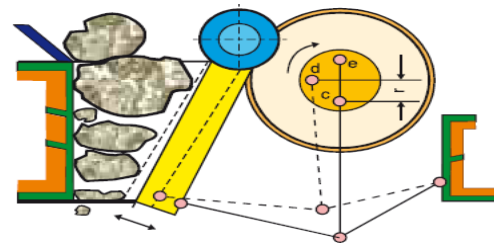


Figure 2 Double Toggle Jaw crusher

II. FORMULATION OF PROBLEM

The term size refers to the physical dimension or magnitude of an object and the reduction refers to the decrement or the process of decreasing the size thus size reduction refers to the process of converting the object from one physical dimension of higher order to another dimension of smaller order. More precisely size reduction is the operation carried out for the reducing the size of bigger particles into smaller ones of desired size and shape with the help of certain external forces. The basic problem in the study Predicts the size distribution of the product issued from crushing in function of the rotor strike radius and velocity, the material properties and size distribution of the feed well as the feed rate.

III. DYNAMIC ANALYSIS & KINEMATIC ANALYSIS

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 described by CHARLES H. DOWDING, in 1981, Department of Civil Engineering, Northwestern University. Evanston. IL (U.S.A.) 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 Load-Deformation Relationships and Design of Jaw

Crusher Plates” point-loading various sizes of materials: concrete mortar. A numerical model of the swing plate ‘A’ in Figure 3 had to be developed.

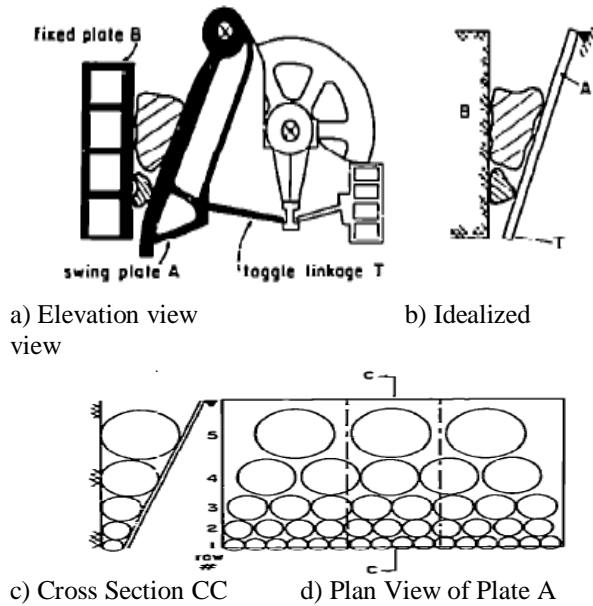


Figure 3 Idealizations of particles within jaw crusher

In this study point-loading of cylinders (or discs) was undertaken to model behavior of irregular rock particles. Modeling irregular particle behavior with that of cylinders can be appropriate by consideration of work presented by Hiramatsu and Oka. From photo elastic studies of plate-loaded spheres and point-loaded cubes, prisms and ellipsoids, they determined that the stresses produced in plate- and point-loaded spheres of identical diameter were equal. Thus, the plate idealization may be replaced by the point load shown in Figure 4. They also showed that point-load failure of a sphere was equal to that of a point-loaded ellipsoid. Therefore ultimate point loads on spheres will be approximately equal to ultimate point loads on cylinders (or discs).

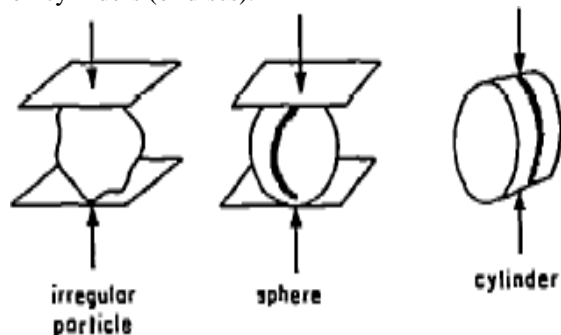


Figure 4 Comparison of plate point loaded particles

The interactive model of rock and swing-plate deformation shows a calculated reduction in both swing plate mass and maximum toggle force

compared to the no interactive assumption of simultaneous failure. These theoretical reductions indicate that design of new energy-efficient systems should include deformation properties of the crushed material. Design of crushers for specific rock types must consider the variability of point load strength and deformability implicit in any rock type name and quarry sized sampling region.

The product size distribution is obtained as function of the crusher’s rotor radius and angular velocity, the feed rate and the feed size distribution. The model is based on the standard matrix formulation that includes classification and breakage matrices. It can be applied to both hammer and vertical-axis impact crushers with the help of the corresponding estimations for the impact energy per unit mass. Here we propose classification and breakage functions for impact crushers taking into account the dynamic character of the impact breakage. The classification function has the form of a cumulative Weibull distribution incorporates a minimum breakable size of the particles depending on the impact energy and the feed rate. The breakage function is modeled as the sum of two Broadbent–Callcott distributions. It is assumed to depend on the impact energy and the feed rate through the proposed expression for the proportion of the fine fraction in the product describes “A performance model for impact crushers” by S. Nikolov 2002. The model predictions are compared with experimental data for limestone treated in a pilot-plant hammer crusher. The variations of the product size distribution resulting from changes in the rotor velocity and the feed rate are investigated.

S. Nikolov, in “Modeling and simulation of particle breakage in impact crushers” Centre Terre et Pierre, 55 Che’e d’Antoing, Tournai, in 2004 worked a phenomenological model that predicts the size distribution of the product issued from impact crushing in function of the rotor strike radius and velocity, the material properties and size distribution of the feed as well as the feed rate. The model is based on the standard matrix representation including classification and breakage matrices. It can be applied to both horizontal- and vertical-shaft impact crushers by means of the corresponding estimations for the average impact energy per unit mass presented here. We propose a new classification function for impact crushers in the form of a Weibull cumulative distribution. The minimum size of the particles that undergo breakage is assumed to be a function of the impact energy and the feed rate. The model predictions are compared with experimental data obtained for limestone treated in a pilot-plant hammer crusher. The dependence of the product size distribution on the rotor velocity is investigated. The

influence of the feed rate on the product size is also simulated. Feed rate graph is shown figure 5

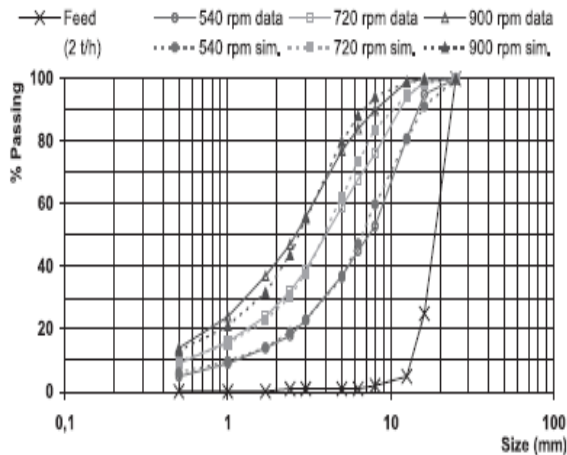


Figure 5 Experimental and simulated product size distributions at different rotor velocities for feed rate $Q=2$ t/h.

Dynamics analysis, it has been shown that the impact energy per unit mass in vertical shaft impact crushers is greater than that in horizontal shaft crushers. It is useful for prediction of the performance of both horizontal and vertical shaft impact crushers.

CAO Jinxi, RONG Xingfu, YANG Shichun, in 2006 have developed Jaw Plate Kinematical Analysis For Single toggle Jaw Crusher Design, College of Mechanical Engineering, Taiyuan University of Technology, Taiyuan, China. Jaw crusher is a kind of size reduction machine which is widely used in the mining and aggregates industry. The interaction between jaw plates and material particles brings the inevitable and serious wear to the jaw plates during the jaw crusher operation, which not only decreases the efficiency, but also increases the cost and the energy consumption of the jaw crusher. The movement of the moving jaw is described in detail. The breakage force is tested in the experiment and some information on the particles flow is gained by analyzing the force distribution. Based on the movement analysis of the moving jaw and the crushing force distribution analysis, the jaw plates wear is analyzed on a macroscopic level. The result of the wear analysis can explain some of the phenomenon in practice. With the rock material breakage character taken into consideration, the blindness brought by the traditional empirical designing can be greatly decreased. It is helpful to design the crusher for improved performance. Jaw crusher structure diagram shown in figure 6

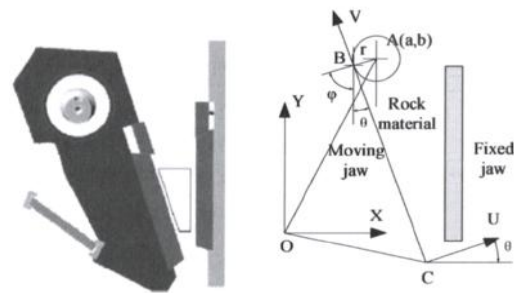


Figure 6 Single toggle jaw crusher & jaw crusher structure

The breakage force is measured in the experiment and some new information on the material flow in jaw crusher chamber is illustrated with the particle breakage character taken into consideration. Based on the movement analyses of the moving jaw and the crushing force distribution analysis, the jaw plates wear is analyzed. The relationship between the slide and the wear is reasonable and some results of the wear analysis are validated in practice. Predicting the jaw plates wear on a macroscopic level will be helpful to the jaw crusher design for better performance. Since the slide between the particles and the jaw plates is replaced by the vertical movement distance of the moving jaw plate in this paper, the further study is needed to predict the accurate wear rate.

The performance of jaw crusher is mainly determined by the kinetic characteristic of the liner during the crushing process. The practical kinetic characteristic of the liners which are located in certain domain of the coupler plane are computed and discussed in the paper titled "Investigation on Kinetic Features of Multi-Liners in Coupler Plane of Single Toggle Jaw Crusher" by Cao Jinxi, Qin Zhiyu, Wang Guopeng, Rong Xingfu, Yang Shichun 2007, IEEE, College of Mechanical Engineering, Taiyuan University of Technology, Taiyuan. Based on those computing results and analysis for the points chosen from the liners paralleling coupler plane, unique Swing features and kinematics arguments are determined in order to build the kinetic characteristic arguments. The job is helpful for a design of new prototype of this kind of machine on optimizing the frame, designing the chamber and recognizing the Crushing character. Kinetic characteristic of the crushing interface or the liner. Based on the computation and the analysis of the practical kinetic characteristic of the points in the liner domain, some traditional motion parameters and some kinetic arguments are calculated. According to the requirement for the squeezing motion of different zone in the crushing chamber, the chamber geometry can be improved.

Now use Pro/Engineer is a parametric feature-based design of 3D software, with parametric modeling functions. To reduce the development cycle and improve the design quality of jaw crusher, this paper discussed by Yuming Guan, Zhitao Zhang, Qianwei Zhang, Hebei University Of Technology Hebut Tianjin, China 2011, IEEE, "Modeling simulation and Kinematic analysis base on Pro/Engineer for Jaw Crusher mechanism" takes full advantage of the Function module of the Pro/Engineer platform to make model simulation and dynamic analysis on the actual jaw crusher mechanism, and provided the updated path for the design and manufacture of Jaw Crusher. Interference detection module is one important module of the Pro/E simulation platform, and is also one key technology of the computer graphics, and has been widely applied in the fields of virtual simulation. The appropriate level of interference detection is selected according to the need of motion simulation and collision detection of the system is carried according to the settings. The model will be shown in figure 7

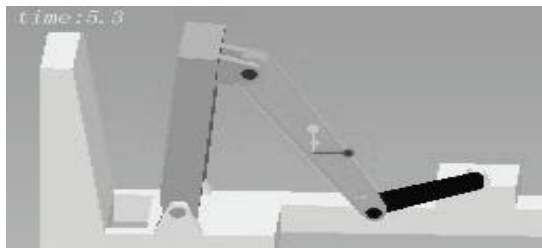


Figure 7 The complete virtual assembly chart of jaw crusher

In this module, many types, such as the reaction force, impulse, and static load of different positions can also be defined to carry out static analysis, kinematics analysis and dynamic analysis. It has very important significance for the life of the specific parts. Specific process will be no longer introduced. The dynamic analysis diagram shown in figure 8

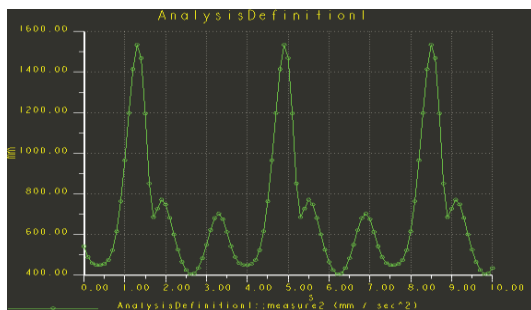


Figure 8 The output image of the acceleration

Through the application Pro/E platform on the jaw crusher, not only the result of the assembly can be expressed in the form of animation, but also can be output in the form of parameters. Thus, it is easy to know that whether to produce interference between

the parts. It makes the original motion relationships in the 2D view are difficult to be expressed become intuitive and easy to modify. At the same time, the development cycle of the jaw Crusher can be shortened and the design process of the mechanism can be simplified. And it is an important means of the modern product design.

IV. CONCLUSION

Kinematic analysis is helpful for understanding and improving the operating performance of the size reduction machine. Kinematics and dynamic analysis have very important significance for the life of the specific parts. Specific process will be no longer introduced. This concept of kinematics is followed by number of researches for their application. This review provides the background of Jaw crusher Kinematics to carried out further research work in same era.

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