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A Review on Study of Jaw Plates of Jaw Crusher

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Abstract: *Crushers are major size reduction equipment used in mechanical , metallurgical and allied industries which crushes different types of soft and hard materials. swing jaw plates are takes direct part into this oprations.hence the design and analysis are very important .This paper focuses on review of a work carried out by researchers on analysis of swing jaw plate i.e. kinematic & dynamic analysis of the jaw crusher.due to which the design quality of jaw crusher are improved, though their were so many researcher work done on analysis, but still there is so many area of scope to develop the analysis of swing jaw plate.*

I. Introduction

A Jaws crusher consist of two plates one job being fixed and other being mount by pitman mechanism due which the crushing can be done in one stroke due small moment of jaw plates. these two plates form a taper chute so that material can be crushed, as the load acts on the plates its wearing rate is high hence high wear resistant material is used generally magnese still are used a heavy flywheel is use to crushed the tough materials which provides the required inertia. Double Toggle jaw crushers may feature hydraulic toggle adjusting mechanisms. It is shown below Figure

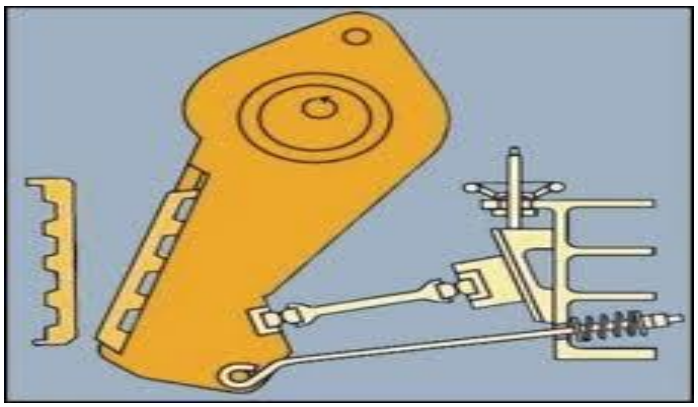

Fig.1 Elevation View of Jaw Crusher

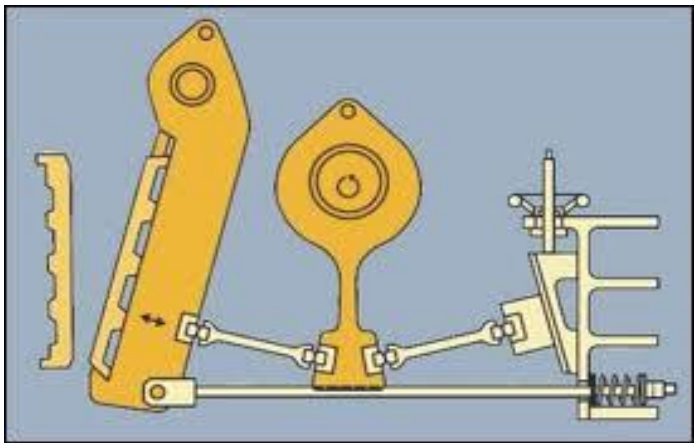

Fig.2 Elevation View of Jaw Crusher

II. Dynamic Analysis & Kinematic Analysis

CHARLES H. DOWDING, in 1981, Department of Civil Engineering, Northwestern University. Evanston. IL (U.S.A.)[1].works on reduction of weight of swing jaw plate by reduction of energy consumed in crushing by using "Point Load- Deformation Relationships along with interactive failure of rock particles and Design of Jaw Crusher Plates" point loading various sizes of materials

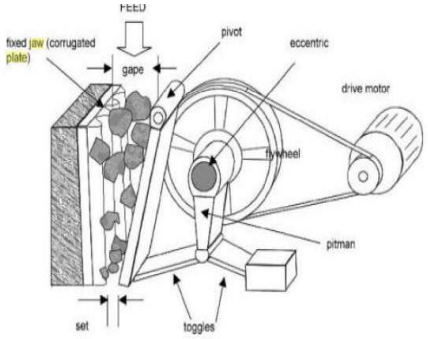

Fig.3 Elevation View of Jaw Crusher

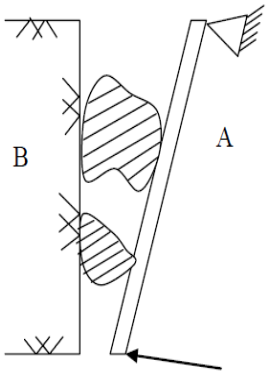

Fig.4 Idealized view

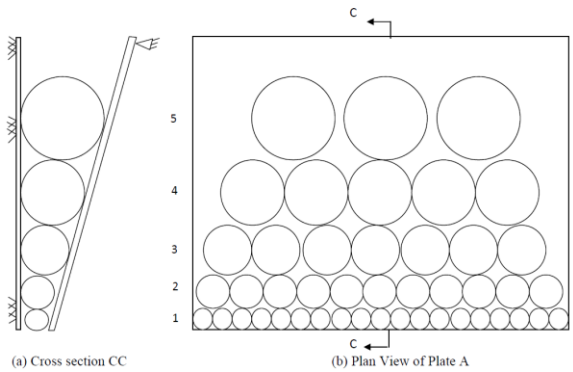

Fig.5 Cross section & plan view

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 Hamamatsu 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).

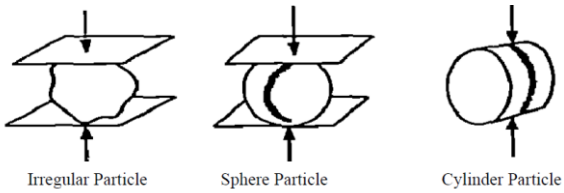

Figure 6: Comparison of plate point loaded particles

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.

As the rock particles comes between the fixed and moving plate it get crushed hence the design of plates must be improved .on this domain 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. this faces of plate made up of hardened steel it may be flat or corrugated. He puts some equations for designing of plate of crusher

Height of jaw plate = 4.0 X Gape
Width of jaw plat (W) > 1.3 X Gape
< 3.0 X Gape
Throw (T) $=0.0502(\text{Gape})^{0.85}$
Where the crusher gape is in meters

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.

Guangjun FAN, Fusheng MU [3] worked on the certain domain, called the liner domain, of the coupler plane is chosen to discuss the kinetic characteristic of a liner or a crushing interface in the domain. Based on the computation and the analysis of the practical kinetic characteristic of the points along a liner paralleling to the direction of coupler line, some kinematics arguments are determined in order to build some kinetic characteristic arguments for the computing, analyzing and designing

Bharule Ajay Suresh in 2009[4] Department of Mechanical Engineering National Institute of Technology, Rourkela works on the swing jaw plate for Design of lighter weight jaw plate by using and varying no of stiffeners for different thickness. as the energy required for the crushing the material decrease due to which the weight of swing jaw plate is decrease. This paper use point-load deformation failure (PDF) relationships along with interactive failure of rock particles as a model for such a weight reduction for the design and analysis of the swing plate.

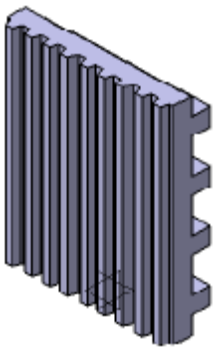

Fig.7: Jaw plate with stiffeners

The present jaw plate models accurately predict the various stresses for plates. As the as the number of stiffener increases the strength/weight ratio of the jaw plate increases making it stronger than that of without stiffener. And hence the stiffened plate models which leads to 25% saving in energy, of course this 25% is an estimate.

Gabor M. Voros [5] presents the development of a new plate stiffener element and the subsequent application in determine impact loads of different stiffened plates. In structural modeling, the plate and the stiffener are treated as separate finite elements where the displacement compatibility transformation takes into account the torsion – flexural coupling in the stiffener and the eccentricity of internal forces between the beam – plate parts. The model becomes considerably more flexible due to this coupling technique. The development of the stiffener is based on a general beam theory, which includes the constraint torsional warping effect and the second order terms of finite rotations. Numerical tests are presented to demonstrate the importance of torsion warping constraints. As part of the validation of the results, complete shell finite element analyses were made for stiffened plates

Kadid Abdel rim [6] carried out investigation to examine the behavior of stiffened plates subjected to impact loading. He worked to determine the response of the plates with different stiffener configurations and consider the effect of mesh dependency, loading duration, and strain-rate sensitivity. Numerical solutions are obtained by using the finite element method and the central difference method for the time integration of the non-linear equations of motion. Special emphasis is focused on the evolution of mid-point displacements, and plastic strain energy. The results obtained allow an insight into the effect of stiffener configurations and of the above parameters on the response of the plates under uniform blast loading and indicate that stiffener configurations and time duration can affect their overall behavior

CAO Jinxi, RONG Xingfu, YANG Shichun, in 2006[7] 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

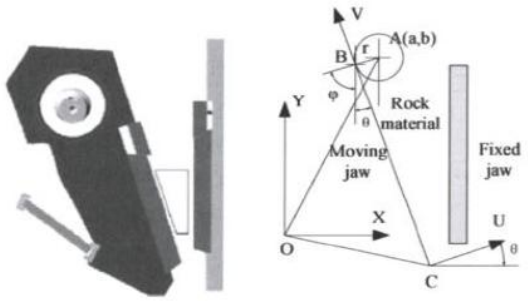

Figure.8: Single toggle jaw crusher & jaw crusher structure

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[8], 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

So many 3-D parametric software are use for modeling function To reduce the development cycle and improve the design quality of jaw crusher, by using this point Yuming Guan, Zhitao Zhang, Qianwei Zhang, Hebei University Of Technology Hebut Tianjin, China 2011[9] 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

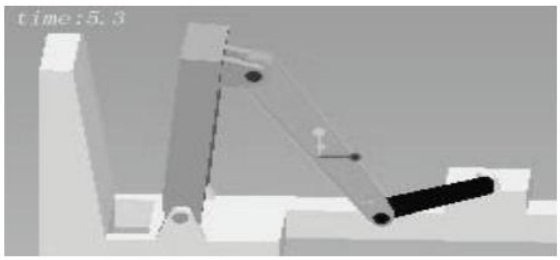

Figure.9: The complete virtual assembly chart of jaw crusher

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

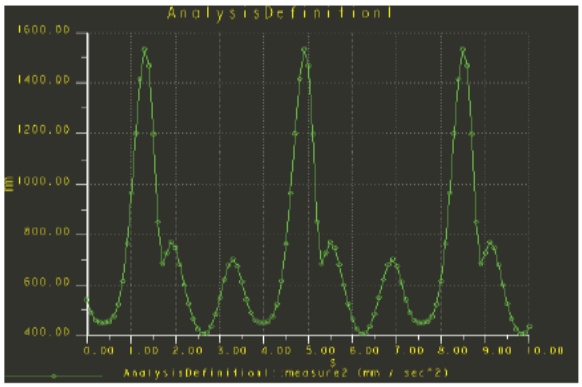

Figure.10: The output image of the acceleration

III. Conclusion

As the jaws plate of jaw crusher are very important part hence study its Kinematics and dynamic analysis are very important for improved design and also improving the operating performance of the plate This concept of kinematics is followed by number of researches for their application. This paper provides the background of swing jaw plate of jaw crusher Kinematics to carried out further research work in fature.

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