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Y. V. Kharchenko[1], Dc. Sc. (Eng.), Prof.,
V. M. Paliukh[2], Cand. Sc. (Eng.), Ass. Prof.,
V. I. Korsak[2], post-graduate

[1] University of Warmia and Mazury in Olsztyn (Poland)
[2] Lviv Polytechnic National University

REDUCTION OF DYNAMIC LOADS OF THE JAW CRUSHER MECHANISM COMPONENTS

At the enrichment plants, quarries, at the enterprises of coal industry, power engineering, construction sector, etc. machines for crushing rocks of various hardness (granite, limestone, gypsum, coal, slag, etc.) are widely used. Despite the variety of designs of such machines [1], at the small-productivity enterprises jaw crushers are the most expedient to be used. Such crushers are machines of periodic action. They crush stone by squeezing it between the two jaws, one of which is movable and the other is usually a stationary one. The surfaces of the jaws are mainly lined with crushing plates made of special wear-resistant manganese steel. Crushing plates fastening to the jaws is designed in a way to allow easy replacement of worn plates with new ones. Crushers capture angle is taken to be equal up to 24 ^{o} and oscillation frequency – within 90 – 300 min^{-1}.

In a jaw crusher with simple motion of the jaw the machine actuator executes oscillatory movements, periodically approaching the immovable jaw and moving away from it. When the jaws meet, the material is crushed, and when they move away one from the other, it falls under its own weight, unloading the crusher through the output slit in the working chamber. The size of the output slit could be varied, using a special control mechanism. As a rule, the rear toggle plate of the crusher simultaneously operates as a safety device and could fail under excessive overloads of the actuator, e.g. when foreign solid bodies get into the working chamber. In order to increase productivity of jaw crushers, movable jaws, executing complex movements, are used. However, complex motion trajectory of the actuator could cause intensive wear of the crushing plates. Therefore, for crushing hard rocks it is more expedient to use crushers with simple movement of the jaw.

An important feature of a jaw crusher operation is sharp increase of technological load when stone rock is crushed in the process of jaws approaching each other, which causes emergence of considerable dynamic forces in the machine components. This paper presents the developed mathematical model of the electromechanical system, which includes asynchronous motor, self-controlled elastic coupling of quasi-zero stiffness and the crusher actuator. Non-linear motion equations for the system components are obtained according to the scheme of the Lagrange equations of the second kind. To describe electromagnetic phenomena in the asynchronous motor, we use mathematical model of the electric machine, which is built taking into account the magnetic circuit saturation [2]. The influence of the stone rock mechanical characteristics as well as of the elastic-dissipative properties of the coupling on the load of crusher components has been investigated. The use of self-controlled elastic coupling of quasi-zero stiffness is shown to be an efficient means for reducing dynamic forces in impact machines and mechanisms.

References

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