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Study on the Grinding Chatter and the Redress Life of Grinding Wheel

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The use of grinding in the manufacture is widespread nowadays as the productive precision machining. On the other hand, vibrations between the grinding wheel and the workpiece, so-called chatter vibrations, frequently occur during the grinding process. Not only are they detrimental to the precision requirement of workpiece but they may also cause a reduced grinding rate. In order to eliminate or avoid these vibrations, knowledge of their source and their nature is required. The purpose of this paper is to investigate these problems of chatter vibrations caused by the grinding wheel itself during the surface grinding process. From these results it would be possible to obtain the most suitable grinding condition for increasing the geometrical accuracy of workpiece and the redress life of grinding wheel.

The first chapter in the paper gives the outline of this study.

In the following chapter, a general survey of this field is given and the problems remaining yet unsolved are pointed out.

The third chapter, entitled "Forced Vibrations Caused by the Grinding Wheel" discusses the influence of grinding wheel unbalance and eccentricity on the geometrical accuracy and on the surface roughness of workpiece. In the theoretical analysis, the relation between the grinding stiffness, i.e. the coefficient of grinding force, and the geometrical accuracy of workpiece is given and is verified through the experiments. From this series of studies, useful suggestions for increasing the accuracy of workpiece geometry are obtained.

The fourth chapter "Self-excited Vibrations During Grinding Process" concerns with the chatter vibrations which occur without the periodic exciting force. This type of vibrations sometimes occurs after a considerable time of grinding. In the first place, it is pointed out that this phenomenon is closely related to the waves generated on the grinding wheel surface. From the results of experiments on the effect of grinding conditions, or the characteristics of grinding wheel wear on the generation of waves, it is concluded that the development of attritious wear of grinding wheel plays an important role in the generation of waves. Further experimental observations are carried out in finding out the cause of generation of waves. Then, it is shown that the fluctuations of grinding force caused by the non-uniformities of wheel surface act as an initiator of the generation of waves. The result obtained from this study seems to be an important fact to explain the mechanism of self-

excited vibrations during the grinding process. In the remaining section of this chapter, the problem of parametric resonance, caused by the non-uniformities of grinding wheel surface, is discussed theoretically.

The relation between the genesis of chatter vibrations and the redress life of grinding wheel is discussed in the first section of chapter five. Thereafter, practical method is given by which chatter vibrations in grinding may be reduced.

The last chapter gives a summary of results obtained from these studies.

From the studies reported in this paper, some new interpretations about the nature of grinding chatters are obtained and these results should be turned to account for increasing the grinding accuracy and the grinding rate.