Consideration Factors in Analysis of Wear by FEM

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Wear of mechanical components often lead to failure of the mechanical system. Hence it is important to be able to predict the amount of wear that is expected to occur in a given tribological system. However, wear quantification using analytical methods has limited accuracy due to complexity of the wear phenomenon. In this work, factors that need to be considered in FEM analysis of wear were investigated systematically. Particularly, the effects of mesh construction and wear coefficient selection were assessed. The findings of this work are expected to contribute to better prediction of wear by FEM analysis.

Keywords (from 3 to 5 max): wear, wear analysis finite element method, contact

1. Introduction

Wear of mechanical components is a key problem that deteriorates the performance, precision and life of a mechanical system. In order to overcome the wear problems occurring in actual industrial applications, various anti-wear technologies are being actively investigated. However, assessing the effectiveness of such techniques by experiment can be time consuming and expensive. Hence there is a great demand for prediction of wear by analytical methods. For this purpose, finite element method (FEM) is often utilized to predict the amount of wear that occur in a given tribological system [1, 2]. However, the accuracy of wear analysis depends on many factors such as mesh construction scheme and wear rate used in the analysis. In this work, some important factors to consider in the analysis of wear by FEM are discussed. It is expected that the results of this work will aid in improving the predictability of wear by FEM analysis.

2. Methods

FEM analysis of wear was conducted for a model consisting of a pin sliding against a flat surface under a given contact pressure. The basic algorithm used for prediction of wear amount was based on the Archard's wear equation. For the wear coefficient of the equation, experimental data was used.
The effect of mesh construction was investigated by varying the scale of the contact model and the surface profile. Also, the effect of variation of the wear coefficient with respect to the contact condition was investigated. As output, the stress condition and amount of local depth variation were obtained. Specifically, variation in contact pressure, stress distribution in the contact region and wear profile of the contact surface were calculated.

3. Discussion

The reliability of the FEM analysis depended strongly on the mesh construction. In certain cases, an initially flat and smooth surface became rough as wear occurred. This was determined to be due to uneven local contact pressure generated at the nodes of the mesh. In addition, a surface with sinusoidal undulations that represent the surface roughness was used as the model in the wear analysis. In this case, a more reasonable wear profile was achieved. Overall, proper construction of the mesh was a critical factor in proper analysis of wear.
As for the wear coefficient, the experimentally obtained value was used in the FEM analysis. Since in actual contact sliding situation the wear rate varies with sliding condition, it was important to adjust the wear coefficient depending on the contact condition. Selection of the wear coefficient or the wear rate for a given contact condition was a key factor that needed to be considered to improve the reliability of the analysis.
The important factors that need to be considered in the analysis of wear by FEM were identified in this work. By considering these factors, a more accurate prediction of wear by FEM analysis is expected to be achieved.

4. References

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