EFFECT OF SPECIMEN THICKNESS ON GROWTH OF REAL CONTACT AREA OF RUBBER WITH TWO-DIMENSIONAL REGULAR WAVY SURFACE

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ABSTRACT

The effect of the specimen thickness on the growth of the real contact area of silicone rubber with two-dimensional regular wavy surface is investigated. The experimental results indicate that the degree of influence of the specimen thickness is markedly affected by the shape of the valley of the wavy surface and environments under which the tests are conducted.

INTRODUCTION

Soft material like a rubber is easy to approach the complete contact. The authors [1] have shown from their study of the elastic contact of two-dimensional regular wavy surface with a flat surface that the formation of the percolation channels allowing the leakage of fluid and the dependence of the size of the real contact area on the load are markedly affected by the shape of the valley of the wavy surface. Furthermore the real contact area became the crucial factor for the friction force. In this study, the effect of the specimen thickness on the growth of the real contact is investigated form the first touch to the complete contact.

EXPERIMENTAL PROCEDURE

Four types of surface profiles A, B, C and D are formed on blocks of silicone rubber having a shape of quadrangular prism with a base 9 mm×9 mm. The pitch and the maximum height of asperities are 3 mm and 230 μm for specimen A and 1 mm and 75 μm for specimen B, respectively. Specimens C and D have surfaces with the reversed profiles of specimens A and B. The thicknesses of the block specimens are 0.5, 1, 3 and 5 mm. These surfaces of blocks are pressed into the bottom surface of a right angle prism. In order to elucidate the effect of fluid existing between the mated surfaces, the tests are conducted under two kinds of environments, that is, (a) vacuum condition; the test is conducted in decompression environments and (b) wet condition; the gap of two mated surfaces is filled with water before experiment.

RESULTS AND DISCUSSION

Figure 1 shows the relation between the real/apparent contact area A_r/A_0 and p of the mean pressure over the whole surface for the specimen D. In the case for the specimen thickness L = 5 mm, all asperities on the contact surface tend to be equally compressed with the load. On the other hand, in the case for L = 0.5 mm, the asperities are compressed from the center of the contact surface toward its periphery. In this case, the rate of increase in the real contact area shows sharp drop after the asperities in central part are flattened. When the gap of two mated surfaces is filled with water, the real contact area keeps almost the constant value after each contact spot touches the neighbors irrespective of the specimen thickness, as the coalescence of contact spots, which is resulting in the extinction of the percolation channels allowing the leakage of fluid, occurs before the influence of the specimen thickness appears in the contact area. The results of specimen C show almost the same aspect as those of specimen D.

On the other hand, in the cases of specimens A and B with V-shaped trough, the percolation channels could be hardly extinguished. In this case, not only the fluid between mated surfaces but also the specimen thickness has a little influence on the growth of the real contact area.

REFERENCES

[1] Matsuda, K., Hashimoto, D. and Nakamura, K., "Real Contact Area and Friction Property of Rubber with Two-Dimensional Regular Wavy Surface," Tribol. Int., 93, 2016, 523-529.

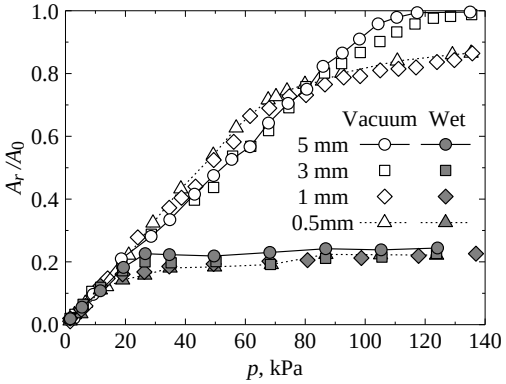

Fig. 1 Relation between A_r/A_0 and p for speimen D