CHAPTER 10
EFFECT OF THICKNESS OF PLASTIC INSERTS ON EXCITATION RESPONSE

10.1 INTRODUCTION

In all the experiments discussed in Chapters 6, 7 and 8 on slideways fitted with four different plastics, the thickness of plastic insert was kept constant at 3 mm. In the absence of any specific experimental data, the thickness was arbitrarily chosen as 3 mm from the recommended range of values. The recommended thicknesses of plastic insert for slide-way application are 2 - 4 mm for medium size machine tools and 3-5 mm for heavy machine tools [4].

Several machine tool builders are using Turcite B insert. At PSG Industrial Institute where this investigator carried out a part of the studies, these inserts are used in CNC lathes. The thickness of the insert used was 1.6 mm. Discussion with other manufacturers and suppliers of Turcite B indicated that many designers use Turcite B sheets of thickness 1.6 mm.

But investigation [5] shows that PTFE based slideway materials exhibit some degree of flow under load; about 0.5% a year under a pressure of 2 MN/m², a peak load common on machine tool slideways. Hence under this loading, a thickness of about 2.5 mm insert can be expected to change by about 12.5 micro-metres per year. A thickness of 1.6 mm insert will undergo a change of 8 micrometers per year. This means that for precision machine tools, creep limits the thickness of PTFE based plastic insert to 1.6 mm.
However, no creep data is available for thermosetting epoxy resins such as Diamant Moglice and SKC 3 under investigation. But manufacturers of these materials recommend a thickness of only 1.5 mm or less.

It is therefore, a need is felt to investigate the effect of varying thickness of plastic inserts when subjected to harmonic excitation, to determine the optimum thickness of plastic inserts for minimum vibration amplitude.

10.2 EXPERIMENT WITH VARYING THICKNESS OF PLASTIC INSERTS

The plastic materials used for this experiment were SKC 3, Turcite B and Teflon. Sliding tables, coated with materials of 3 mm thickness were excited over a frequency range of 1 to 200 Hz. As in the previous cases the vibration response at a point close to the excitation point was measured. The experiments were repeated for thicknesses of 2.5 mm, 2 mm, 1.5 mm, 1.0 mm and 0.5 mm under identical conditions. The reduction of thickness was achieved by successive surface grinding process. Plots of vibration response against frequency of excitation for different thicknesses are shown in Fig. 10.1, 10.2 and 10.3 for the materials SKC 3, Turcite B and Teflon, respectively. The measured data are given in Tables A5.6, A5.7 and A5.8 in Appendix 5.

10.3 DISCUSSION OF TEST RESULTS

The response curves reveal that excepting at resonant frequency no appreciable variation in vibration amplitude is observed for different thickness of SKC 3, Turcite B and Teflon. It is also seen from the response curves that the natural frequency of the system remains almost same
FIG. 10.1. VIBRATION RESPONSE CURVES FOR SKC-3 FOR VARYING THICKNESS
FIG. 10.2. VIBRATION RESPONSE CURVES FOR TURCITE-B FOR VARYING THICKNESS
FIG. 10.3. VIBRATION RESPONSE CURVES FOR TEFLOM FOR VARYING THICKNESS
for all the three materials investigated. Since the natural frequency is a function of stiffness and mass, the possible reason for the this behaviour may be that there is no significant variation in stiffness and mass of different plastics for the same thickness.

While the thickness of the insert has apparently no influence on natural frequency, it is observed that it has got substantial effect on the vibration amplitude at resonance.

It is seen from the response plots that at resonant frequency of 100 Hz, the amplitudes of vibration for thicknesses of 3 mm, 2.5 mm, 2 mm, fluctuate from 6 to 10.5 micrometres for all the materials. Amplitudes of vibration is only 4 to 5 micrometers for a thickness of 1.5 mm for all the materials. When the thickness was reduced to 1 mm and 0.5 mm it is found that the vibration amplitude shoot up to a range of 11 to 12 micrometer for all the materials.

Hence it is established from this experimental study that plastic inserts of 1.5 mm thickness is optimum for machine tool slideways for better dynamic performance.