A FRICTION MODEL OF THE MACHINE TOOL GUIDES

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ABSTRACT

The dynamic behaviour of the machine slides rectilinear movement depends mainly on the friction in the guides. In the present paper the main results of the performed theoretical-experimental investigations of the tangential contact deformations in the machine tool guides are presented as well as their influence on the friction force.

* A theoretical friction model in the machine tool guides is proposed to clarify the mechanism of friction force forming. The contact deformations arise out of the forces acting on the spot contacts. The microslidings in tangential and normal direction cause breaking of the microweldings in the contact, which leads an adhesion component of the friction force to appear. The theoretical model has been proved experimentally.

* Due to the experimental prove of the theoretical model an empirical dependence for the tangential contact deformations is obtained;

* By the Buckingham $\pi$-theorem and the Raley’s method a dimensionless number is obtained $\mathcal{X}$, which connects the tangential contact deformations with the four fundamental parameters of the system: the specific pressure $p$ (normal force $N$); the slide velocity $V$; the contact surface quality $R_a$ and the slide mass $m$. This number serves for finding the energetic functions, which define the criteria for the friction formation at the rectilinearly moving machine systems: the friction gives the correlation between the kinetic energy of the microslidings at the contact and the accumulated potential energy of the contact pre-deformation.

* The experimental investigations confirm that the movement velocity and specific pressure exert the strongest influence on the tangential contact deformations, i.e. on the friction force.

* It is proved experimentally that the slide movement at auto-oscillating regime is a two dimensional function of the tangential contact deformations while the amplitude of the self-excited oscillations is a directly proportional to the same deformations.