THREE - STAGES MODEL OF SCUFFING AND SCREEN ACTION OF THE LUBRICATED FILMS – AN EXPLANATION OF TRANSITION DIAGRAM FOR CONCENTRATED CONTACTS

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ABSTRACT
The transition diagram for the lubricated sliding concentrated contacts under friction presented by Begelinger and de Gee [1] and two possible ways for transition from partial EHD lubrication region to scuffing region (‘EHD regime – boundary lubrication regime – scuffing regime’ and ‘partial EHD regime – scuffing regime’) are discussed in paper presented.

Three-stage model of scuffing of heavy loaded lubricated contacts under boundary lubrication conditions [2] and the account of screen action of thin lubricated films for the calculation of contact temperature under friction [3] are used as an explanations of said different ways for transition to scuffing regime under lubricated friction.

It is possible to consider the process of scuffing as a kinetic one. The first stage of this process includes the lubricating layer breakdown and the second – formation and disruption of adhesive bond between contacting surfaces during relative sliding. Several surface sites naked in the result of lubricating film breakage are activated in the process of compatible plastic deformation and local heating of contacting elements. At the third phase the process of adhesive bond formation is accelerated due to more sever operating conditions. This leads to the arising of some critical number of adhesive bonds following by an avalanche-like scoring and scuffing and finally to seizure of contacting surfaces. For the supporting of this idea the calculation of thickness of lube films under different loads and speeds and investigation of screen effect of said films on the contact temperatures are presented.

For calculation of contact temperatures under friction, experimental results of de Gee and Begelinger’s [1] tribological tests were used. The effect of overheating of contact surfaces under high speeds of sliding friction is discussed as the reason of ‘partial EHD – scuffing’ transition. The influence of steel composition and oil’s composition and properties on the boundary lubrication regime (especially, in “Extreme pressure region”) also takes into account using Begelinger et al [1] and authors’ [4] experimental results. From another side the conditions stimulated lubrication film damage take place at the located zones of active gear tooth surfaces. Both analytical method for determination of distribution of minimal wear resistance sites and the equation for determination of distribution of temperatures on the active gear tooth surface are presented.

\[ T_{xyz} = \frac{1}{\lambda_1 + \lambda_2} \frac{1}{2\pi} \iint_S \frac{P \nu \tau}{R} dS \]
where \( T_{xyz} \) is temperature, \( \lambda_1, \lambda_2 \) – thermal conductivity of material contacted, \( P \) – load, \( \nu \) – velocity of moving of common line action, \( \tau \) – contact duration, \( S \) – the field of conjugate action, \( R \) – distance of both points of loading and observation.

The zones of minimal wear resistance are located at the zones of maximal temperatures.

REFERENCES