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Wear Mechanics and Surface Engineering for wear resistance

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Abstract: Wear is the most important negative factor in engineering, it gives remarkable disorders to the material which we use to produces components. Wear can have different types in which we classifies, those wears are very costly to recover, may be remains some defects after recovery. Thus, in this research paper, we included the wear, surface fatigue, wear mechanics, and surface engineering to resist the wear. The surface engineering is applied as a pre-treatment on the surface of material, thus the material gain an extra ability to resist the wear.

I. Introduction

Wear and wear mechanisms:There is no simple relationship between wear and anyother materials property. Thus we always have to take into account that wear is not a materials property like e.g. strength, is a property of a specific tribesystem, has to be evaluated for every tribesystem, cannot be generalized in detail. On the basis of known mechanisms oncan understand the characteristics of a tribesystem andcan take care of well-aimed counter measureswithout the knowledge of the mechanisms you can follow „trial-and-error“. In order to understand the mechanism dependant counter measures on can follow the very simple model of Archard (1959).

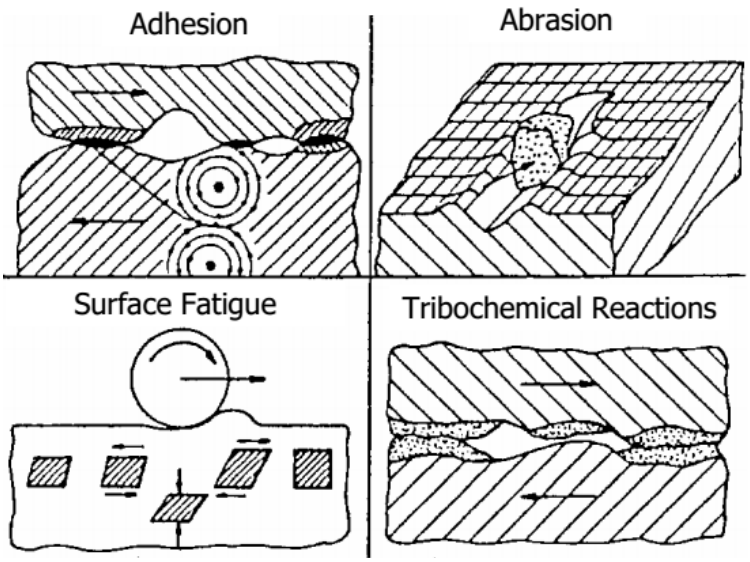
Archards equation is $$W_s = \frac{W}{s} = k\frac{F_N}{H_W}$$

The wear rate W related to the wear path s is proportional to the normal load $F_N$and the hardness of the worn surface $H_W$and a factor k.k describes the probability to generate a wear particle during the path sand contains all constants and variables of a tribesystem.

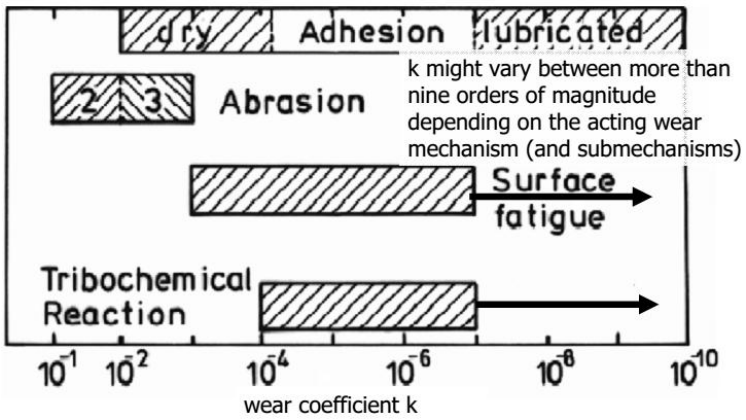
Surface engineering is a multidisciplinary activity intended totailor the properties of the surfaces of engineering components so that their function and serviceability can be improved. It is defined as “treatment of the surface and near-surface regions of a material to allow the surface to perform functions that are distinct from those functions demanded from the bulk of the material”

II. Wear mechanism

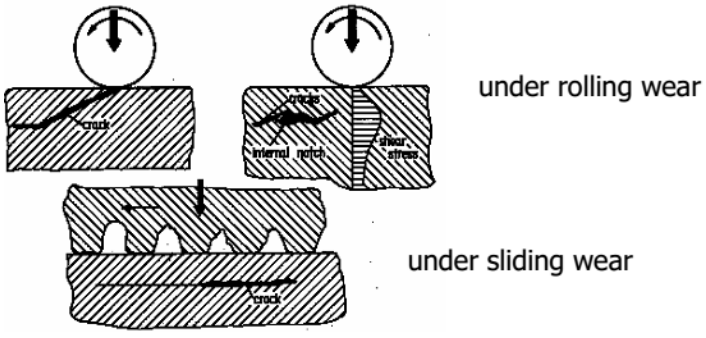
k depends on theacting wearmechanisms and can be describedonly qualitatively!



Types of wear



2.1 Surface fatigue: Surface fatigue is brought about by crack initiation and propagation, whichmight take place at the surface or in a certain distance below it. Thatdependson thecontactsituationand themicrostructureof thecontactingmaterials.



If we assume that surface fatigue is similar to fatigue even though the stress filed is much more complicated we can use the general rules of fatigue e.g. Mason&Coffin(1959) adapted to contact mechanics:

$$N_f = \left(\frac{\varphi_f}{\varphi} \right)^m$$

$N_f$is the number of cycles to fracture, $\varphi_f$theequivalent (plastic) deformation to fracture under one loading cycle, φthe equivalent deformation per loading cycle, and m an exponent, which is 2 to 3 formetals undera plasticcontact.

$$N_f = \left(\frac{\sigma_{vf}}{\sigma_v} \right)^{m*}$$

$N_f$is the number of cycles to fracture, σ_{vf}theequivalent stress to fracture under one loading cycle, $\sigma_v$the equivalent stress per loading cycle, and m* an exponent, which is 1.2 to 8 for metals underan elastic contact.

III. Surface Engineering

The desired properties or characteristics of surface-engineered components include:

- Improved corrosion resistance through barrier or sacrificial protection
- Improved oxidation and/or sulfidation resistance
- Improved wear resistance
- Reduced frictional energy losses
- Improved mechanical properties, for example, enhanced fatigue or Toughness
- Improved electronic or electrical properties
- Improved thermal insulation
- Improved aesthetic appearance

3.1. Methods to Control Corrosion: Owing to its many favourable characteristics, steel is well suited and widely used for a broad range of engineering applications and is referenced here to demonstrate the various corrosion-control steps that can be considered. Steel has a variety of excellentmechanical properties, such as strength, toughness, ductility, and dent resistance. Steel also offers good manufacturability, including formability,weld-ability, and paint-ability. Other positive factors include its availability,ferromagnetic properties, recyclability, and cost. Because steel is susceptible to corrosion in the presence of moisture, and to oxidation at elevatedtemperatures, successful use of these favourable characteristics generallyrequires some form of protection.

Methods of corrosion protection employed to protect steel include:

• Altering the metal by alloying, that is, using a more highly alloyed and expensive stainless steel rather than a plain carbon or low-alloy steel

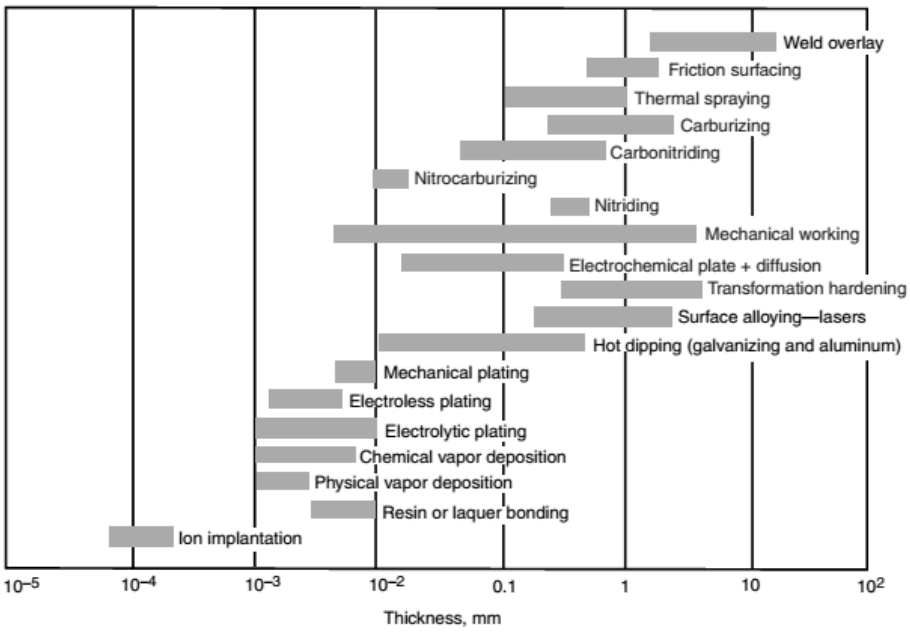
• Changing the environment by desiccation or the use of inhibitors

• Controlling the electrochemical potential by the application of cathodic or anodic currents, that is, cathode and anodic protection

• Applying organic, metallic, or inorganic (glasses and ceramics) coatings

Application of corrosion-resistant coatings is one of the most widely usedmeans of protecting steel. As shown in Table 1, there are a wide varietyof coatings to choose from, and proper election is based on the component size and accessibility, the corrosive environment, the anticipated.

3.2. Surface Engineering for Corrosion and Wear Resistance:



Conclusion

Thus, for the research we concluded that, wear is controllable by using the surface engineering. Rather it is recovered, by the material filling techniques, the surface engineering is used at the safe condition and it is to be considered as a preplanning or design for wear.

References

[1] Wear Mechanismswww.uni-due.de/wtUniversidad Duisburg-EssenLotharstr 1, 47057 Duisburg, Germany.

[2] C.M. Cotell and J.A. Sprague, Preface,Surface Engineering, Vol 5,ASM Handbook,ASM International, 1994, p v

[3] Economic Effects of Metallic Corrosion in the United States,BattelleColumbus Laboratories and the National Institute of Standards andTechnology, 1978 and Battelle updates in 1995

[4] D.J. Dunn. Metal Removal Mechanisms Comprising Wear in MineralProcessing,Wear of Materials,K.C. Ludema, Ed., American Societyof Mechanical Engineers, 1985, p 501–508.

[5] THE SCIENCE OF COMBATTING WEAR, By William A Glaeser (Member, STLE), Richard C Erickson (Member, STLE), Keith F Dufrane (Member, STLE)and Jerrold W Kannel Battelle Columbus, Ohio.

