Tribology
Module3: Wear

Q.1. Why subsurface cracks are formed due to cyclic load?

<u>Ans</u>: Cyclic loading often causes repetitive reversal of stresses, such as compressive stress to tensile stress. Due to such change in stresses, material experiences tiredness. Microstructure in-homogeneity, under tiring load condition, helps the formation of subsurface cracks.

Q.2. What is zero wear limits?

<u>Ans</u>: "Zero wear" means wear of material surfaces remains within the order of the surface finish. In other words "Zero wear limit" is the initial surface roughness of the material.

Q.3. If indium has so high affinity that causes adhesive wear then why do we use it? Can indium be used as lubricant between two steel surfaces?

<u>Ans</u>: Because of high affinity of indium, it is used to bond certain non-metallic such as glass, glazed, xeramics, mica, quartz, various metallic oxides, etc. It can be used as solid lubricant between two steel surfaces.

Q.4. In adhesion wear taking place between similar materials, which surface is likely to get more damage? Won't the chuck of particles be with the lower surface in case of similar surface?

<u>Ans</u>: The outcome of adhesive wear is growing roughness and creation of lumps above the original surface. Lose of material from the surface depends on the softness of material. Softer material loses more material compared to harder material. In other words nothing can be said about which surface (lower/upper) will lose more material. Lose of material will depend on local hardness of the material.

Q.5. What is "back transfer"?

<u>Ans</u>: In adhesive wear, material is transferred from one material to other. If two material surfaces A & B undergo sliding and material is transferred from A to B then from B to A, the process is called "back transfer".

Q.6. What wear volume range will be denoted as mild wear and which range is for severe wear?

Ans: Materials under sliding conditions are bound to wear. After run-in wear, wear of systems are categorized as “mild wear” and “severe wear”. This division is often based on the maximum dimension of wear debris, which is often subjective. Wear debris of dimension lesser than 10 micron may be treated as mild wear, while wear debris having dimension greater than 100 micron is categorized as severe wear.

Q.7. Is there any relation of wear volume in terms of speed, atmosphere, and temperature?

Ans: Increase in speed; change in environment and variation in temperature affect the wear volume. There are many relations available in open literature.

Q.8. Would cold junctions reduce with decrease in temperature?

Ans: Reduction in temperature increases the surface hardness, which in turn reduces the formation of cold junctions.

Q.9. Is 100% contact between surfaces desirable?

Ans: No

Q.10. How 2-body abrasion different from adhesive wear?

Ans: Two body abrasion occurs when the hard asperities remove material from the opposite surface by cutting or plowing action, while adhesive wear occurs due to rupture of cold junctions formed between two surfaces.

Q.11. If the assumption in the Quantitative Law for 2-B Abrasive Wear is dubious, why then we still are getting accurate experimental results?

Ans: Accuracy depends on the experimentally measured wear constant, which can be evaluated after performing a number of experiments. In this process variation in height and shape of asperities is accounted based on the experimental results.

Q.12. Why three body abrasion less severe than two body abrasion?

Ans: Three body abrasions occur when hard particles are not constrained, and are free to roll and slide down a surface. In other words some energy is lost in rolling action, which is far less harmful compared to sliding action. While in two body abrasion hard particles are attached and can only slide on the opposite surface. Therefore two body abrasions is severe compared to three body abrasion.

Q.13. "The most corrosion films passivate or cease to grow beyond a certain thickness". Explain it.

Ans: Corrosion film on engineering material occurs due to its chemical reactions with surroundings medium. Typical example of such films are electrochemical oxidation of metals in reaction with an oxidant such as oxygen. The growth of corrosion largly depends on the porosity of corrosive layer or its removal from the surface. Lesser the porosity, lesser chance of virgin material to react with environment and therefore lesser will be the growth of corrosive layer. In other words "the most corrosion films passivate or cease to grow beyond a certain thickness".

Q.14. "Growth in thickness becomes liable for brittle fracture. Soft debris!! High temperatures enhance surface energy, thereby increase thickness." Explain.

Ans: The corrosive films are porous and brittle. Increase in the thickness of corrosive film increases the chances of its brittle fracture and as a result irregular shape debris is generated. Increase in environment temperature increases the activity of material to react with environment, therefore the possibility of increase in thickness of corrosive film increases.

Q.15. Can the knowledge of angle of impingement be useful in designing air strips especially during emergency landings e.g. belly landing?

Ans: Landing of an aircraft on its belly (underside without its landing gear fully extended) is termed as "Belly landing". During a belly landing, there is normally extensive damage to the airplane. Special tribological materials on the underside of airplane are used to reduce the friction and wear of airplane. In addition to that designing air strips to minimize the erosion shall reduce the damage to aircraft.

Q.16. What is the relation between "temperature" and coefficient of friction?

Ans: The relation between "temperature" and "coefficient of friction" largely depends on the change in properties of material with temperature. If reducing temperature causes an increase in the hardness and reduction in chemical activity of material, then coefficient of friction will reduce. Further, such dependence may not be uniform. For example decrease in temperature may change the material behavior from ductile to brittle, visco-elastic to elastic, and then there will a jump in the behavior of coefficient of friction.

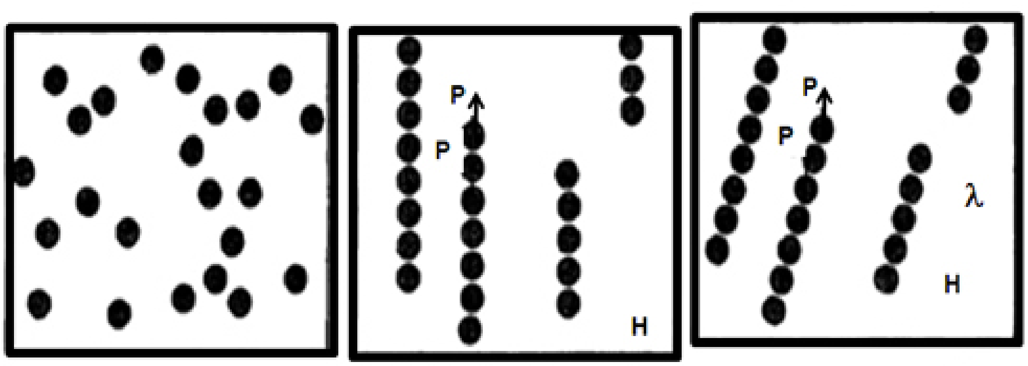
Q.17. Would Fretting Wear reduce if we regularly unscrew and screw the components?

Ans: Regularly unscrew and screw will reduce the accumulation of particles and ensure tight fitting (reduce micro slip), therefore there will be reduction in fretting wear.

Q.18. Why true area is not given by Elastic deformation of their highest asperities and why lower contacting asperities can't undergo plastic deformation?

Ans: The area of true contact is in general only a small fraction of the apparent area (represented by geometric dimensions) of contact. Since the whole of the applied load is supported on the small contact (true) area, the local pressures at high asperities cause plastic flow and relatively low pressure (≤ elastic pressure) is experienced at low contacting asperities. This is the reason to consider to plastic deformation of high contacting asperities and elastic deformation of low contacting asperities. However, if the applied load is very low then high contacting asperities shall experience only elastic deformation. Similarly if the applied load is too high then low height asperities shall experience plastic deformation.

Q.19. Explain abrasion by M.R. particle. Explain the figure and difference in the last two?



Ans: M. R. Particles are iron particles. In most of devices (i.e. damper, brake, engine mounts), these particle are subject to relative sliding motion, therefore cause three body abrasion. To reduce the three body abrasion, particles are made in spherical shape. Functioning of M.R. particle is illustrated in a set of three figures shown above. First figure indicates the dispersion of micron sized iron particles in liquid medium. Second figure shows chaining of iron particles in magnetic field direction. Third figure demonstrate the shear strain of particle chains.