- **Q1. To what extend in general does a lubricant reduces friction b**
- **Q2.Whats the relationship between safety/reliability and lubrican relation between them and if so what is the proportionality const**
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- **Q6.What is adhesive wear? Adhesive wear causes uneven surface contact. For same imposed load, reduction in mechanical contacts chances of failure. Explain?**
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- **Q1.Abrasion causes interlocking and damaging between surfaces, then why is it less significant than adhesive in the reduction of friction?**
- **Q2.If lubricant reacts with corrosive product of combustion won't its own composition change which migh lead to loosing of its lubrication properties?**
- **Q3.Will boundary lubrication fail in the case of similar materials surfaces in contact?**
- **Q4.Are the products of boundary lubricants formed at high temperature corrosive?**
- **Q5.If we have a boundary layer on one surface and now a second surface which has higher adhesion properties compare to the first one is passes over it; will the boundary layer get transferred to the second surface.**
- **Q6.In the presence of boundary additive and mechanical contact interface of similar metals, will the boundary layer get equally divided on the surface of similar metals?**
- **Q7.Amount of lubricant vs. wear and friction, how do we decide which will be the guiding parameter in selection of type of lubrication?**
- **Q8.For a solid lubricant what is the ideal shape and size? Solid lubrication should cause three body abrasio then why are they used?**
- **Q9.If adhesion wear is becoming zero, then is metal-metal contact with lubrication is preferred or advisabl to use?**
- **Q10.Why corrosion does not come to zero, when the surface is covered with lubricants?**
- **Q11.In Bingham fluids if initial shear stress is a negative value, what does that would mean?**
- **Q12.Economy vs. environment (like in case of engine), how do we decide?**
- **Q13.If we rub two carpets on each other than there will be more friction due to entangling, so why do we use boundary lubrication where there can be entangling? Also longer the chain more the entangling then why we use them? If attachment and detachment is a continuous process then there should be lumps of entangled molecules this should increase the friction, comment.**
- **Q14.Can boundary lubrication be used in an application where we have to apply electric field or magnetic field?**
- **Q15.Why low shear strength at interface surface?**
- **Q16.In chemisorption we use active agents like Cl, S, P etc., what will happen if the contacting surface contain moistures? If it has damaging effect how can we reduce it?**
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- **Q24.Can pure sand with consistent composition be used as a lubricant?**
- **Q25.In which applications melted metals are used as lubricant, liquid metals must be having high viscosity then why are they used as lubricant?**
- **Q1.Is the thrust sliding bearing same as tilted pad/Michelle's pad bearing?**
- **Q2.Where aerostatic/aerodynamic bearings are used?**
- **Q3.Do we require seals for magnetic bearing?**
- **Q4.Does magnetic bearing act as both thrust and radial bearing?**
- **Q5.Do air bearings require same conditions as magnetic bearings? Do they act as both thrust and radial bearings?**
- **Q6.If the spherical roller bearing has more friction compare to ball bearing then why in railways which require continuous use of the bearing we use spherical bearing? Give reason other than load carrying capacity?**
- **Q7.Why seals are increasing friction even when there is no contact with rolling element?**
- **Q8.Can MR fluid act as ball bearing? What will decide the friction in such type of anti-friction bearing?**
- **Q9.What is the use of Tandem bearing? Give three practical applications of Tandem, O and X bearings.**
- **Q10.The table for coefficient of friction in bearing does not shows the dependence on material used, how**

will the coefficient of friction change with material? Will the trend remain same for different materials?

- **Q11.Can instead of steel balls we can use hard rubber balls? What will be the complications with this design?**
- **Q12.What does PV limit means physically? Is it possible that bearing is exceeding PV limit yet still works?**
- **Q13.Can hydrostatic and hydrodynamic bearings be used in outer space?**
- **Q14.Why lubricant gets ruptured? Why is there discontinuity of lubricant in long bearing?**
- **Q15.What is the optimum location of oil inlet with respect to the shaft rotation direction?**
- **Q16.How the flow of lubricant affects the temperature dissipation?**
- **Q17.Why the railway lines are not lubricated?**
- **Q18.What is negative friction?**
- **Q19.How will we determining the coefficient of friction for a magnetic bearing?**
- **Q20.Explain the reason why we are using high viscosity at lower pitch velocity and vice-versa?**
- **Q21.Wear factor vs. friction coefficient, which will be preferred more? Why?**
- **Q22.Is PV approach only for journal bearing?**
- **Q23.How can the wear be uniform when we know that the bearing will usually be in contact at the same position?**
- **Q24.Two well-spaced short bearings are better than one long one what about misalignment?**
- **Q25.Compare splash lubrication with completely immersed lubrication?**
- **Q26.What does graph contact stress vs. Brinell hardness signify?**
- **Q27.Give five criteria which will tell that the bearing has been mounted properly? Are there any standard techniques and guidelines for mounting of a bearing?**
- **Q28.Why did we choose NLGI 2, what is the criteria of choice?**
- **Q29.If NLGI 3 and 4 are hard, then why are we using them as lubricants? What type of grease is used in spherical roller bearing which is used by railways?**
- **Q30.Which NLGI would be suggested in robotic arms?**
- **Q31.Do we have magnetic gears like magnetic bearing?**
- **Q32.Hypoid gears the axis perpendicular or just offset? Why there will be more sliding in this gear?**
- **Q33.How will we stop lubricant bleeding?**
- **Q34.What will happen to solid lubricant after getting sheared?**
- **Q35.Can we give lubrication to open gear system?**
- **Q36.Its said rotation is preferred over linear motion, but we know that sliding bearings are capable of more load carrying capacity, then why don't we prefer them?**
- **Q37.What is scuffing? How many types of failure mechanisms are there for gears? Discuss some.**
- **Q38.What is the difference in the bearing when the shoulder is either on outer or inner ring?**
- **Q39.Can cages be replaced by lubricant which won't allow the roller to move from its position and only allow rotational motion?**
- **Q40.While finding pressure in spur gear, why didnt we consider the pressure applied due to lubricant? Wh will be the pressure due to lubricant included?**

Q1. To what extend in general does a lubricant reduces friction between surfaces?

Ans : The extent to which lubrication reduces the friction between two surfaces is governed by two factors: 1) The shear strength of lubricant layers. Lesser shear strength results in lesser friction. 2) Levitation capability of lubricant. If lubricant is able to separate two surfaces completely (no contact among asperities), it will reduce friction, provided separation between surfaces is not beyond a certain limit. In broad sense friction can be reduce by 10-1000 times.

Top

Q2.Whats the relationship between safety/reliability and lubricant efficiency? Is there any proportionality relati between them and if so what is the proportionality constant?

Ans : It is a very vague question, there is no definite answer. Lubricant is a substance that reduces friction.

Excessive friction may cause excessive wear which may reduce the efficiency of mating surfaces and lead to some other failure mode (i.e. excessive stress, fracture). Therefore there is no definite relationship between safety and lubricant efficiency.

Top

Q3.If magnetic bearings are able to provide frictionless and zero-wear performance, then why these bearings a not able to replace regular bearings?

Ans : Here regular bearings mean liquid/solid/gaseous lubricated bearings. The main advantage of these bearings is high value of load-carrying-capability/cost ratio compared to magnetic bearings. Magnetic bearings are restricted to ferromagnetic materials and may attract ferromagnetic debris from environment. Therefore at present magnetic bearings are limited due to low load/cost ratio and material usage.

Top

Q4.What kind of lubricant is applied on disks and why doesnt it get transferred to the users hand while handli it?

Ans : Hard disk drives are provided with monolayer lubricant, which act as solid lubricant. The work surface of hard disk is protected; therefore user cannot touch that surface. However, surface of CD/DVD does not contain any lubricant, as reading/writing is performed through optical means (without any mechanical contact) and there is no need of lubricant.

Top

Q5.What kind of lubricant is there in human joints? Can this lubricant be used as a substitute to the other lubrica used in various applications?

Ans : Synovial fluid lubricates the human joints. This is a natural boundary lubricant and research is being performed to make similar kind of lubricant. However, in manmade machines load - speed conditions are much more severe and we require much better (in terms of load speed temperature characteristics) lubricants compared to synovial fluid.

Top

Q6.What is adhesive wear? Adhesive wear causes uneven surface that leads to reduction in mechanical contact. F same imposed load, reduction in mechanical contacts, increases the level of stress and hence chances of failu Explain?

Ans : Adhesive wear is a mechanism of wear involving shear of localized welding of micro-asperities during sliding contact, as for example between two bearing surfaces. Micro-shearing or tearing causing the removal of surface material (wear) can be termed as adhesive wear. This micro-shearing of contacting surfaces may cause uneven surface and reduce the contact area. If stress is represented as Force/Contact_area; then reduction in

contact area increases the stresses. If stress increases beyond permissible stress, mechanical failure occurs.

Top

Q7.How many types of magnetic bearings are there? How are they different from each other? Where are they use

Ans : There are two types of magnetic bearing technologies in use today passive and active. Passive bearings (made of permanent magnets) are similar to mechanical bearings in that no active control is necessary for operation. In active systems (based on electromagnets), non-contact position sensors continually monitor shaft position and feed this information to a control system. This in turn, passes the current to the actuator via current amplifiers. These currents are converted to magnetic forces by the actuator and act on the rotor to adjust position. Magnetic bearings are used where lubricant is restricted to avoid continuous monitoring, maintenance, etc.

Top

Q8.Explain the Bath tub curve.

Ans : The bathtub curve is basically used to identify the failure rate with respect to operating life of components. It comprises of three parts: 1. Early failure rate (Infant mortality period). 2. Constant failure rate (Stable failure period). 3. Increasing failure rate (wear-out failure period). The initial region that begins at time zero when a product is new is characterized by a high but rapidly decreasing failure rate. Operating parameters need to be decided with a lot of care so that it is complied with other components and product can see its useful life. After infant mortality period roughly constant failure period (hopefully) start and that remains for the majority of the useful life of the product. This long period (also called as Stable failure period) is designed with optimum value of parameters. Finally, the failure rate begins to increase as materials wear out and product starts losing its design function. In other words product loses its intended function.

Top

Q1. Why similar materials have higher coefficient of friction compared to dissimilar materials?

Ans : This is an intrinsic property of a substance that is caused by the shape and structure of its molecules which makes the distribution of orbiting electrons irregular when molecules get close to one another, creating electrical attraction between similar materials compared to dissimilar materials. This attraction increases the value of coefficient of friction between similar materials compared to dissimilar materials.

Top

Q2. Why does Stick slip phenomena occur?

Ans : Stick-slip is a phenomenon where the instantaneous sliding speed of an object does not remain close to the average sliding speed. Insufficient power is being supplied to the sliding surface which is insufficient to overcome friction causing the surfaces to stick momentarily. This phenomenon occurs if the value of static

coefficient of friction is higher than the kinetic coefficient of friction. Lesser the difference in values of these coefficients of friction, lesser will be chances of stick slip phenomenon. In such circumstances the slower the feedrate used, the worse Stick-Slip occurs.

Top

Q3.Why only spherical and conical asperity surfaces are considered in explaining the friction due to ploughi effect? Which surface provide better estimation and why?

Ans. From experience it has been observed that asperities of new surfaces are similar to conical asperities and after running-period the shape of asperity approaches to spherical shape. Generally spherical asperity shape provides better approximation as it simulates working surface closely.

Top

Q4.To reduce junction growth it is suggested to use contamination (i.e. oxide) layer, but would not th contamination damages the surface once they get detached from the surface?

Ans. Basic purpose of contamination layer is to reduce the interface shear strength, which reduces the chance of junction growth. But the shear strength between parent material and contamination layer should be high. Therefore strong oxides attached to virgin surface is always preferred compared to weak oxides.

Top

Q5.What are similarities and differences between adhesive, abrasive and junction growth friction theories?

Ans. All three theories are related to resistance offered against sliding by interface of two surfaces. All three theories account the contact area, load on the surfaces and tangential force. There is difference in basic approaches adopted by these theories. The adhesion theory is based on the fact that all surfaces are made of atoms and they attract one another by attractive force. The abrasive theory is based on the fact that contact between tribo-pairs only occurs at discrete points, where the asperities on one surface touch the other. The slop of asperities governs the friction force. Sharp edges cause more friction compared to rounded edges. "Junction growth" theory is similar to "adhesive" theory except it considers growth in junction of contact area due to tangential force.

Top

Q6.Use of lubricant does not help to reduce rolling friction then why every roller bearing uses lubricants?

Ans. In every roller bearing, the motion is never perfectly rolling. Sliding occurs between inner ring and rolling elements, outer ring and rolling elements, and cage and rolling elements, therefore friction can be reduce by lubricating the roller bearings.

Top

Q7.As it is known that lubricant cannot reduce deformation of surface, is it true for all type of lubricants?

Ans. If lubricant is able to bear and share the imposed load, then lubricant can reduce the deformation.

Top

Q8.Which is the most preferred theory of friction?

Ans. "Junction Growth" theory provides better explanation of friction between surfaces.

Top

Q9.Between adhesion and abrasion which is more prevalent and which causes more damage to the surface?

Ans. It is very difficult to state which mode of friction is prevalent. If surfaces are virgin (no contamination, no lubrication) adhesion will be more prevalent compared to abrasion. If surfaces are new (surfaces are rough), then abrasion is more prevalent compared to adhesion. Further abrasion may leads to adhesion, and adhesion may leads to abrasion. Adhesion generally causes more damage to the surfaces compared to abrasion.

Top

Q1.Why subsurface cracks are formed due to cyclic load?

Ans: 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

Top

Q2.What is zero wear limit?

Ans: 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.

Top

Q3.If indium has so high affinity that causes adhesive wear then why do we use it? Can indium be used as lubrica between two steel surfaces?

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

Top

Q4.In adhesion wear taking place between similar materials, which surface is likely to get more damage? Wont t chuck of particles be with the lower surface in case of similar surface?

Ans: 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

Top

Q5.What is back transfer?

Ans: 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.

Top

Q6.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.

Top

Q7.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.

Top

Q8.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.

Top

Q9.Is 100% contact between surfaces desirable?

Ans: No

Top

Q10.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.

Top

Q11.If the assumption in the Quantitative Law for 2-B Abrasive Wear is dubious, why then we still are getti 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.

Top

Q12.Why three body abrasion less severe than two body abrasion?

Ans: Three body abrasion occurs 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 abrasion is severe compared to three body abrasion.

Top

Q13.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.

Top

Q14.Growth in thickness becomes liable for brittle fracture. Soft debris!! High temperatures enhance surfa 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.

Top

Q15.Can the knowledge of angle of impingement be useful in designing air strips especially during emergen 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.

Top

Q16.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.

Top

Q17.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.

Top

Q1.Abrasion causes interlocking and damaging between surfaces, then why is it less significant than adhesive the reduction of friction?

Ans: Continuous abrasion process causes rounding of asperities and reduces the magnitude of friction. On the other hand adhesion causes formation and rupture of cold junctions, which does not guarantee the reduction of friction. In other word, with improving manufacturing processes controlling adhesive friction is more important compared to abrasive friciton.

Top

Q2.If lubricant reacts with corrosive product of combustion won't its own composition change which might lead loosing of its lubrication properties?

Ans: Corrosion inhibitors are used as additives in lubricating oils. The main purpose of these additives is to prevent the reaction of chemicals with the tribo-surfaces; they do not play much role to lubricate the surface. However with continuous usage depletion of corrosion inhibitors occur and lubricant needs to be replaced after certain km (mile) usage.

Top

Q3.Will boundary lubrication fail in the case of similar materials surfaces in contact?

Ans: No. Boundary lubrication works well with similar materials. Boundary additives form a thin layer between similar materials and maintain separation between those materials.

Top

Q4.Are the products of boundary lubricants formed at high temperature corrosive?

Ans: Yes. Chemisorption mechanism (high temperature boundary lubrication) corrodes the contacting surfaces to mild level to make low shear strength interface layer.

Top

Q5.If we have a boundary layer on one surface and now a second surface which has higher adhesion properti compare to the first one is passes over it; will the boundary layer get transferred to the second surface.

Ans: If attached boundary layer is formed due to the physisorption, then that layer can be destabilized by supplying more energy than the bound energy between first surface and polar additives. If the supplied energy is lesser than the bound energy between polar additives and second surface, then the boundary layer will get

transferred to the second surface.

Top

Q6.In the presence of boundary additive and mechanical contact interface of similar metals, will the bounda layer get equally divided on the surface of similar metals?

Ans: Local surface defects and surface roughness may affect the equal division.

Top

Q7.Amount of lubricant vs. wear and friction, how do we decide which will be the guiding parameter in selecti of type of lubrication?

Ans: In most of the cases, the effect of lubricant is greater in reducing wear of contacting surfaces, therefore amount of lubricant vs. wear get priority compared to amount of lubricant vs. friction.

Top

Q8.For a solid lubricant what is the ideal shape and size? Solid lubrication should cause three body abrasion, th why are they used?

Ans: Solid lubricants can be used as: 1. loose particles carried by liquid or semi-liquid (i.e. grease) at the interface; or 2. Coating on the surface. In both the cases nano-size particles are preferred. To reduce abrasion often spherical shape is preferred.

Top

Q9.If adhesion wear is becoming zero, then is metal-metal contact with lubrication is preferred or advisable to us

Ans: If there is no possibility of adhesive junction formation, then lubrication is not required.

Top

Q10.Why corrosion does not come to zero, when the surface is covered with lubricants?

Ans: Often lubricants contain moisture and acid, which cause the corrosion of metal surface.

Top

Q11.In Bingham fluids if initial shear stress is a negative value, what does that would mean?

Ans: There is no possibility of negative shear stress. Negative signs are used to define the direction. In the words there is no possibility of negative shear stress in Bingham fluids.

Top

Q12.Economy vs. environment (like in case of engine), how do we decide?

Ans: Polluting environment with cheap technology is going to cost to society. Therefore better environment is main concern. Let us take example of sulphur contents of lubricant provide lubricity and reduce the wear rate, but we minimize its usage to prevent the environment pollution. In other words we born additional cost to filter sulphur from lubricant and mix other additives to reduce the wear rate. This is done to reduce the environment pollution.

Top

Q13.If we rub two carpets on each other than there will be more friction due to entangling, so why do we u boundary lubrication where there can be entangling? Also longer the chain more the entangling then why we u them? If attachment and detachment is a continuous process then there should be lumps of entangled molecul this should increase the friction, comment.

Ans: In boundary lubrication, polar head has affinity towards the metal surface, while non-polar tails repel other non-polar tails. Due to this repulsion force, entangling does not happen. As entangling does not happen, lump of entangled molecules does not form.

Top

Q14.Can boundary lubrication be used in an application where we have to apply electric field or magnetic field?

Ans: Boundary lubrication can be used to support part load even in the presence of electric and magnetic fields.

Top

Q15.Why low shear strength at interface surface?

Ans: Low interface shear strength causes lesser friction resistance; therefore to reduce the friction losses low shear strength at interface is required.

Top

Q16.In chemisorption we use active agents like Cl, S, P etc., what will happen if the contacting surface conta moistures? If it has damaging effect how can we reduce it?

Ans: Often chemisorptions and chemical reactions are differentiated based on their interaction with the surface. In chemisorptions, electron interchange between the chemisorbed species and solid surface occurs and adsorbed species are covalently bonded to the solid surface. Therefore from this type of classification, chemisorption does not cause any damage to the surface. The chemisorbed layer is limited to monolayer; therefore in the presence of moisture on the surface, chemisorption does not occur. However, if chemisorption is treated as chemical reaction (ionic bond) between chemisorbed species and solid surface, a new chemical species (i.e. corrosive layer, oxide layer) is generated, which slowly damages the surface. Such damage (which is generally much lesser than the damage caused in the absence of such layer) can be reduced by reducing the volume percentage of active chemicals (i.e. Cl, S, P).

Top

Q17.If chemisorption is a process of chemical action between additives and solid surface, then how do we deci the dimensions of a component, since whenever chemisorption is taking place it reacts with a certain thickness component and as it gets removes of more part of component is required? How many times a surface can g chemisorbed?

Ans: The thickness of chemical layer formed on the solid surface increases with increase in applied load and operating temperature, but limited by increased wear rate. Therefore the formation and rupture of chemical layer is a continuous process, which is either hindered by depletion, below certain percentage, of chemical additives (mixed in lubricating oil) or increase in operating clearance, beyond permissible limit, between contacting surfaces. In other words, the replacement of machine components or lubricating oil is a function of operating load, materials, operating relative velocity, and operating environment (i.e. temperature, presence of other chemicals).

Top

Q18.If elastodynamic region is best, then why dont we just use elastodynamic lubrication only?

Ans: A designer must aim for elastohydrodynamic lubrication regime. However, there is very short span of EHL regime compare to hydrodynamic and mixed lubrication, therefore exact knowledge of operating conditions (which is often very difficult) is a must for EHL design.

Top

Q19.In which applications are gas lubricants used?

Ans: Gas lubrication is recommended for high temperature, high speed and light load conditions. Typical applications are gyroscopes for inertial navigation, scientific instruments (i.e. rheometer) ,drilling machines,

etc.

Top

Q20.What is the maximum weight that a lubricant support (not getting squeezed out)? Can we put lubricant between 1 ton-100ton weights?

Ans: In static condition, we cannot put any load on the lubricant. Lubricant will squeezed out under load. However, under dynamic condition we can load the lubricant. The magnitude of lubricant will depend on the frequency, viscosity of the lubricant and boundary conditions.

Top

Q21.Why friction increases with speed?

Ans: Friction resistance depends on interface shear stress. If interface shear stress increases (like in hydrodynamic lubrication) with speed, friction will increase with speed.

Top

Q22.Why pressure is the maximum in the middle or shifted a little from middle rather than at the end in case tilted bearing?

Ans: At the end of tilted bearing (narrow exit), pressure will be atmospheric (zero gauge pressure), therefore to conserve the mass flow pressure needs to be higher well before exit location. The location of maximum pressure will be between middle and exit locations, depending on the angle of inclination, load, speed and viscosity.

Top

Q24.Can pure sand with consistent composition be used as a lubricant?

Ans: Hardness of pure sand is generally higher compared to surfaces to be lubricated. The usage of sand as lubricant may cause the damage of the surfaces, which is highly undesirable. Therefore pure sand cannot be used as lubricant.

Top

Q25.In which applications melted metals are used as lubricant, liquid metals must be having high viscosity th why are they used as lubricant?

Ans: In some applications we prefer to use working fluids as lubricants. These are often referred as close loop

lubricants. For example mercury, potassium, rubidium which are used as working fluids as these metals are vaporized in heat source (i.e. nuclear, solar boiler), the hot vapors are then expanded to drive a turbine which drives a generator; the exhaust vapor is condensed in a heat exchanger and pumped back in heat source. A small portion of these working fluids, after leaving the pump, is diverted to the bearings as lubricant.

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Q1.Is the thrust sliding bearing same as tilted pad/Michelle's pad bearing?

Ans: Thrust bearing is a terminology used for Axial bearing (load is along the axis of bearing). If the relative motion is sliding and applied load normal to the face of the bearing, then bearing is named as Thrust sliding bearing. If the relative motion is rolling and applied load is normal to the face of the bearing, then bearing is called as Thrust rolling element bearing. Tilted pad bearing use the adaptive tilt of the pad and vary load carrying capacity as per the required. Tilted pad may be Radial bearing or Thrust bearing. Michelles pad bearing is titled pad (pad on pivots) sliding bearing.

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Q2.Where aerostatic/aerodynamic bearings are used?

Ans: Gas lubrication is recommended for high temperature, high speed and light load conditions. Aerostatic bearings require external pressure source and can support its designed load at zero speed. Aerostatic bearings are commonly used in grinding, machining, and micro positioning applications, where ever precision is required. Aerodynamic bearings, which are self acting bearings, generate load carrying capacity based on the relative motion between two very closely mating surfaces. Typical example of these kinds of bearings is magnetic read/write head-disk used in disk memory storage devices.

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Q3.Do we require seals for magnetic bearing?

Ans: Seals are used to prevent crossing of fluid from one region to other region. For example seal in rolling element bearings are used to prevent leakage of lubricant from bearings to outside environment and prevent dust (& moisture) to ingress in bearings. In common magnetic bearing applications we do not requires such sealing arrangement.

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Q4.Does magnetic bearing act as both thrust and radial bearing?

Ans: Magnetic bearings can be designed to support thrust load, radial load, and combined load.

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Q5.Do air bearings require same conditions as magnetic bearings? Do they act as both thrust and radial bearings?

Ans: Air and magnetic bearings are often recommended for oil-free high speed environment. Both kinds of bearings lack in damping and require active control system to handle instabilities. Air bearings can be designed to support thrust load, radial load and combined loads.

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Q6.If the spherical roller bearing has more friction compare to ball bearing then why in railways which requi continuous use of the bearing we use spherical bearing? Give reason other than load carrying capacity?

Ans: Spherical roller bearings can handle misalignment and poor (i.e. contamination, starved) lubrication. Due to self aligning properties of these bearings, deviation in the centerline of railway axle relative to the railway tracks is possible. Therefore these bearings are suited for the railways.

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Q7.Why seals are increasing friction even when there is no contact with rolling element?

Ans: Seals, in rolling element bearings, remain in mechanical contact with inner and outer rings. Either inner or outer ring needs to relatively rotate, therefore seal sliding against rotating rings. Such sliding motion between ring and seal cause additional friction force in rolling element bearings.

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Q8.Can MR fluid act as ball bearing? What will decide the friction in such type of anti-friction bearing?

Ans: The aim of MR fluids is to provide controllable rheological properties. On one hand MR fluid should provide very low friction, so spherical shape of MR particles provides desirable results. On the other hand MR fluid must provide very high friction on demand, so high magnetic saturation limit and irregular particle shape is desired. However, to minimize wear rate of contacting surfaces spherical shape of particles is preferred. In other words due to spherical shape of particles, MR fluid in off-state (zero magnetic field) may act as ball bearing by allowing particle to roll compared to slide. In such case viscosity of carrier fluid, relative sliding speed and applied load shall decide the friction force.

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Q9.What is the use of Tandem bearing? Give three practical applications of Tandem, O and X bearings.

Ans: Tandem is an arrangement of bearings where a team of bearings are lined up one behind another all facing in the same direction. For example double row tandem angular contact ball bearing is required to sustain high axial load in one direction. To support axial load in both the directions O or X arrangement of

double row angular contact ball bearing is used.

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Q10.The table for coefficient of friction in bearing does not shows the dependence on material used, how will t coefficient of friction change with material? Will the trend remain same for different materials?

Ans: Material of commonly available rolling element bearings is SAE52100. The operating hardness (i.e. hardness during bearing operations) ranges between 55HRC to 64 HRC and bearing surfaces are very smooth. Due to these characteristics friction force, under normal operating conditions, the friction force is negligible. The trend of friction force shall remain same for different materials.

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Q11.Can instead of steel balls we can use hard rubber balls? What will be the complications with this design?

Ans: Rubber is known for its elasticity and deformability. With increase in elastic deformation, roll to slide ratio is reduced. Therefore bearing will not act as rolling bearing, but act as sliding bearing. Further increase in hardness of rubber increase its brittleness and chances of cracking. Therefore instead of increase the hardness of rubber we prefer to reduce the applied load. Under very low load condition rubber balls may provide rolling action.

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Q12.What does PV limit means physically? Is it possible that bearing is exceeding PV limit yet still works?

Ans: PV limit is a useful parameter in the section of tribo-materials used for dry lubrication, which is related to heat dissipation capabilities of material. This limit defines a boundary line between mild wear and severe wear. In other words material experience operating conditions exceeding PV limit will be subject to rapid wear or overheating.

Top

Q13.Can hydrostatic and hydrodynamic bearings be used in outer space?

Ans: Lubricants in outer space are subject to radiant energy, temperature extremes and ultrahigh vacuum environments, therefore solid lubricants are preferred over liquid lubricants. In other words rolling element and dry bearings, which can be lubricated with solid lubricants, are better choices compared liquid based hydrodynamic and hydrostatic bearings.

Top

Q14.Why lubricant gets ruptured? Why is there discontinuity of lubricant in long bearing?

Ans: In divergent region of lubrication, the fluid pressure may decrease below the ambient pressure. Under sub-ambient pressure conditions liquid experiences tensile stress, which cannot be sustained by liquid lubricant and rupture of lubricant-film occur. The discontinuity of lubricant also occur in short and finite bearings, it is not restricted to long bearing.

Top

Q15.What is the optimum location of oil inlet with respect to the shaft rotation direction?

Ans: The location of oil inlet is referred with respected to load line. Sixty to ninety degrees (in the direction of rotation) with respect to load line is a preferable choice.

Top

Q16.How the flow of lubricant affects the temperature dissipation?

Ans: An increase in the flow of lubricant enhances the convective heat transfer, therefore increases the temperature dissipation. To simplify the calculation, often we consider bulk flow and average temperature approach (same body temperature at any instant of time) to estimate the temperature dissipation.

Top

Q17.Why the railway lines are not lubricated?

Ans: Lubrication of railway tracks reduces the lateral force (increase fuel economy), the wear of rails, the noise and ground born vibration. Due to these advantages railway lines are grease lubricated. Relatively thick bio-degradable grease mixed with solid lubricants is used to lubricate railway lines.

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Q18.What is negative friction?

Ans: Negative friction is just a concept to prove the importance of friction. In reality negative friction does not exist.

Top

Q19.How will we determining the coefficient of friction for a magnetic bearing?

Ans: Ideally the coefficient of friction for a magnetic bearing is zero, however there will air drag on the rotating

shaft that cause the friction loss. In addition to this energy loss, active magnetic bearings (control + bias current required for electromagnets; power supply for control unit) require drive energy to float the shaft. As required drive energy is a loss, therefore often it is treated as friction loss. By evaluating these losses coefficient of friction can be estimated.

Top

Q20.Explain the reason why we are using high viscosity at lower pitch velocity and vice-versa?

Ans: In hydrodynamics a combination of higher velocity and higher viscosity causes thick lubrication, but this combination will cause high friction loss. Therefore to maintain sufficient film thickness and lesser friction at high pitch velocity lesser viscosity lubricant and at low pitch velocity high viscosity lubricant is recommended.

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Q21.Wear factor vs. friction coefficient, which will be preferred more? Why?

Ans: It depends on the application. For example in writing with pencil lesser friction and moderate wear of graphite is preferred. Similarly during walking moderate friction but minimum shoe wear is desired. Typically reduction in wear is preferred over reduction in friction.

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Q22.Is PV approach only for journal bearing?

Ans: PV approach is for every tribo-pair operating under dry lubrication conditions.

Top

Q23.How can the wear be uniform when we know that the bearing will usually be in contact at the same position

Ans: Uniform wear is an assumption. In reality it does not happen. In bearings, on surface wear local clearance changes, therefore equilibrium position of shaft changes.

Top

Q24.Two well-spaced short bearings are better than one long one what about misalignment?

Ans: In short bearing, the resistance to lubricant leakage (from ends) is relatively lesser compared to long bearing, which means for same supply pressure and relative velocity, lubricant leakage will be more in short bearing compared to long bearing. This will help avoid metal to metal and reduce misalignment of the rotating

shaft.

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Q25.Compare splash lubrication with completely immersed lubrication?

Ans: Immersed lubrication, often termed as Oil bath lubrication, is widely used for low to medium speeds application. Major drawback of this type of lubrication method is churning loss, which restricts usage of this lubrication method to lubricate rotating components lying on one horizontal line. With an increase in speed the churning loss increases and level of oil requires a reduction to decreases the churning loss. Splash lubrication is used where relatively high speed rotating components are on various levels, rendering the bath method useless. Higher peripheral speeds of rotating component helps to generate the oil mist, required for lubrication.

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Q26.What does graph contact stress vs. Brinell hardness signify?

Ans: Graph of contact stress vs. Brinell hardness is Contact stress is of compressive nature; therefore an increase in surface hardness can tolerate higher contact stress. This behavior of typical gear materials was plotted by published by AGMA (American Gear Manufacturers Association) as a graph for gear designers.

Top

Q27.Give five criteria which will tell that the bearing has been mounted properly? Are there any standa techniques and guidelines for mounting of a bearing?

Ans: Bearings are designed with a specific internal clearance to allow free rotation of rolling elements, to compensate the thermal expansion, and to distribute load on rolling elements. If after bearing installation, the internal clearance remains same as the designed clearance, then one can state with confidence that bearing is mounted properly. Apart from maintain designed clearance it is a must to retain bearings rings on their seating surfaces (shaft for the inner, housing bore for the outer). Relative motion of inner with respective to shaft surface or/and relative motion of outer ring with respective to housing lead ring-wear and reduce bearing life. The internal clearance, running noise, vibration, heat build-up and radial retention of bearing rings on their respective seats are typical measurable criteria which indicate whether bearing is mounted properly or not. For proper mounting of rolling element bearings, following guidelines shall be useful: 1. Anything that may come into contact with bearings should be kept clean, including worker's hands and tools. 2. When bearings have to be mounted in unprotected places, steps should be taken to protect the bearing and mounting position. 3. Depending on bearing type and size, mechanical, hydraulic or thermal methods are used in mounting. Make every effort to avoid nicking bearings. 4. Prevent loose particles entering into bearings while being mounted. 5. In heating bearings for easier mounting, heating temperature should not exceed 100C.

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Q28.Why did we choose NLGI 2, what is the criteria of choice?

Ans: NLGI (National Lubricating Grease Institute) grade is a qualitative measure to classify lubricating grease. There are nine grades (000, 00, 0, 1, 2, 3, 4, 5 ,6) and NLGI 2 average of these grades. NLGI 000 grease will bleed (requires extra sealing measures) and NLGI 6 cause high resistance (pumping loss), therefore until unless there is specific demand NLGI 2 is the first choice.

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Q29.If NLGI 3 and 4 are hard, then why are we using them as lubricants? What type of grease is used in spheri roller bearing which is used by railways?

Ans: To lubricate any tribo-pair, lubricant needs to be maintained at the interface of tribo-pair. This can be achieved by pumping lubricant at the interface or increasing its resistance against its leakage from the interface. NLGI 3 and NLGI 4 are resistant against their leakage from the tribo-interface, which allow maintenance team to lubricate tribo-interface intermediately (i.e. once in a day, once in a week, etc.). Hence NLGI 3 & NLGI 4 can be used as lubricants. NLGI 3 is preferable choice for spherical roller bearings used in railways.

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Q30.Which NLGI would be suggested in robotic arms?

Ans: Robots have many moving elements. Using grease to lubricate robotic arms allow smooth proper function of robotic arms. Often low NLGI grade greases (NLGI 00 and NLGI 0) with proper sealing arrangement are recommended for robotic arm. For example molygrease (NLGI 00) which contains solid lubricants is recommended for planetary gear reduction units if robotic arm.

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Q31.Do we have magnetic gears like magnetic bearing?

Ans: Yes. The repulsive magnetic forces are used to transmit power without any mechanical contact. A magnetic gear uses rare earth permanent magnets to transmit torque between an input and output shaft without any mechanical contact.

Top

Q32.Hypoid gears the axis perpendicular or just offset? Why there will be more sliding in this gear?

Ans: Hypoid gears are type of spiral bevel gears (bevel gear with helical teeth) whose axes do not intersect with the axis of the meshing gear. In other words axes of pair of hypoid gears are perpendicular (generally, angle may be other than ninety degrees) with an offset. As there is offset in axes, sliding is bound to come.

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Q33.How will we stop lubricant bleeding?

Ans: To reduce lubricant bleeding, effective viscosity of lubricant needs to be increased. To complete stop leakage, effective sealing arrangement is essential.

Top

Q34.What will happen to solid lubricant after getting sheared?

Ans: Solid lubricants, after getting sheared, either squeezed out from interface or acts as soft debris between tribo-surfaces. To re-utilized sheared solid lubricant often liquid lubricant is used along with solid lubricant. Liquid lubricant acts as carrier fluid.

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Q35.Can we give lubrication to open gear system?

Ans: Low speeds and very high torque are typical operating characteristics of open gear drives. Due to such extreme operating conditions there is hardly any possibility of hydrodynamic lubrication, so grease mixed with solid lubricants (i.e. graphite) is preferable choice.

Top

Q36.Its said rotation is preferred over linear motion, but we know that sliding bearings are capable of more lo carrying capacity, then why don't we prefer them?

Ans: Sliding bearings are preferred over rolling element bearings only if the continuous relative motion is sufficient to separate two surfaces, otherwise rolling element bearings (most commonly available in market) are common choice.

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Q37.What is scuffing? How many types of failure mechanisms are there for gears? Discuss some.

Ans: Gear teeth are subject to wear, bending fatigue and surface fatigue. The sliding motion, below and above pitch line, causes wear of gear teeth, which in turn increases clearance and reduces contact ration; and finally leads to failure of gears. Gear teeth also flex as they go in and out of mesh, which leads to bending fatigue of gears. Surface fatigue may be moderate, localized or destructive. It can be caused by failure of the lubricant film (i.e. due to overheating in the mesh area, misalignment, excessive load, etc.). The resulting metal to metal contact produces alternative welding and tearing that quickly removes metal from the gear surfaces.

Destructive surface fatigue, often termed as SCUFFING, occurs due to high meshing temperature. In this failure material may be displaced radially over the tip of the gear teeth. Material may be missing from above and below the pitch line, causing the pitch line itself to stand out prominently. At this stage, the gear is unfit for further service.

Top

Q38.What is the difference in the bearing when the shoulder is either on outer or inner ring?

Ans: Shoulder on outer or inner rings provides axial support and can tolerate some thrust load. Often the location of shoulder on inner/outer ring is decided from the convenience of rolling element bearing (filing of rolling element between inner and outer rings) assembly and bearing mounting.

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Q39.Can cages be replaced by lubricant which won't allow the roller to move from its position and only allc rotational motion?

Ans: We have not come across such lubricant which restrict sliding of rollers and allowing only rolling action of rollers. In other words lubricants cannot act as cage of rolling element bearings.

Top

Q40.While finding pressure in spur gear, why didnt we consider the pressure applied due to lubricant? What w be the pressure due to lubricant included?

Ans: The contact pressure in spur gear is generally very high compared to lubricant supply (ranging between 2 to 5 bar) pressure, therefore accounting supply pressure does not affect the contact pressure.

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