Application of types of lubricant

A lubricant is a substance (often a liquid) introduced between two moving surfaces to reduce the friction between them, improving efficiency and reducing wear. They may also have the function of dissolving or transporting foreign particles and of distributing heat.

Basically there are many types of lubricants; solid lubricant, liquid lubricant and gaseous lubricant. They have their own purpose and application. They are as follows:

Purposes:

Almost all the Lubricants perform the following key functions.

Keep moving parts apart

Reduce friction

Transfer heat

Carry away contaminants & debris

Transmit power

Protect against wear

Prevent corrosion

Seal for gasses

Stop the risk of smoke and fire of objects

Applications:

Application of Semisolid and Solid Lubricants

Grease lubricants are semisolid and have several important advantages: They resist being squeezed out, they are useful under heavy load conditions and in inaccessible parts where the supply of lubricant cannot easily be renewed, and they tend to form a crust that prevents the entry of dirt or grit between contact surfaces. Grease is a mixture of a lubricant and a thickener; often it is made from a mineral oil and a soap. It may be applied in various ways: by packing enclosed parts with it, by pressing it onto moving parts from an adjacent well, by forcing it through grease cups by a spring device, and by pumping it through pressure guns. Solid lubricants are especially useful at high and low temperatures, in high vacuums, and in other applications where oil is not suitable; common solid lubricants are graphite and molybdenum disulfide.

Application of Liquid Lubricants

Liquid lubricants may be characterized in many different ways. One of the most common ways is by the type of base oil used. Following are the most common types.

Lanolin (wool grease, natural water repellant)

Water

Mineral oils

Vegetable (natural oil)

Synthetic oils

Other liquids

Mechanical devices to supply lubricants are called lubricators. A simple form of lubricator is a container mounted over a bearing or other part and provided with a hole or an adjustable valve through which the lubricant is gravity-fed at the desired rate of flow. Wick-feed oilers are placed under moving parts, and by pressing against them they feed oil by capillary action. Horizontal bearings are frequently oiled by a rotating ring or chain that carries oil from a reservoir in the bearing housing and distributes it along the bearing through grooves or channels. Bath oiling is useful where an oil-tight reservoir can be provided in which the bearing journal may be submerged; the pool of oil helps to carry away heat from contact surfaces. Splash-oiling devices are used where gears, bearings, or other parts contained in housings have moving parts that dip into the lubricant and splash it on the bearings or into distribution channels. Centralized oiling systems usually consist of a reservoir, pump, and tubes through which oil is circulated, while heaters or coolers may be introduced to change the viscosity of the lubricant for various parts of the system. Many oiling operations are automatically synchronized to start and stop with the machinery.

P2)

Describe the operation and maintenance of three different lubrication systems.

Oil lubricating systems can be divided into three categories:

Total loss.

Self contained.

Re-circulating.

Total loss: lubrication points are always supplied with fresh lubricant (oil, fluid grease or grease) at specific intervals (time or machine cycle-dependent) during the lubricating cycle. It is the only system that allows the lubricating oil to drain away or evaporate.

Self contained : With self contained lubrication, the oil is contained in a reservoir. A gearbox of a vehicle or a lathe is lubricated in this way. The gear are partly submerged in the oil, this process is called splash lubrication. Oil is carried up to the parts that are not submerged, and an oil mist is created inside the gearbox.

Ring oiling is another self contained system in which the oil from a reservoir is carried up to the rotating parts of a mechanism. The ring which is rotating with a shaft is partly submerged in the oil and carries it up to the shaft bearings.

Re-circulating: With re-circulating system, the oil from a reservoir is fed under pressure direct to the moving parts or delivered as a spray. The flow is continuous and after passing over the contact surfaces, the oil runs back into the reservoir under the effects of gravity.

Maintainance:

Oil lubrication systems should be checked weekly. This can be carried out by plant operators or maintenance engineering. If needed the tank or reservoir can be topped up taking care not to let any dirt into the system during the process. Systems should not be overfilled as this might caused increases

resistance to splash lubricated parts. It might also lead up to overheating of the oil due to excessive churning. Dip sticks and sight gauges are usually provided to indicate the correct level or depth in reservoirs.

Samples of lubricating oil are taken for laboratory analysis at regular intervals as part of a condition monitoring procedure. They are examined to see if they contain any solid wear particles. This can provide useful information to the plant manager and maintenance engineer as to the condition of the plant and machinery.

All lubricating oils degrade over a period of time due to oxidation. They should be changed including the filters in a re-circulating system. Human should be careful of lubricating oils, since it can cause skin irritation, it can also lead up to cancer. So humans should always use safety equipments and should also wear protective clothing and maybe goggles for the eyes, when handling lubricating oils.

References: http://en. wikipedia. org/wiki/Lubricant, engineering book

P3)

Describe the operation of one seal, one type of packing and two different types of bearing with a typical application for each one.

Seals:

For the task , I will be doing oil seal. Oil seals are flange packing having an elastomer lip bonded to a metal cup, these lips are loaded to accommodate shaft running out and helps in sealing. There are two types of oil seals.

Single seals , which are recommended only for non-pressure service and are best against good lubricating media. And the other one is double sealing, which are normally used to handle pressure in eiher direction along the shaft. The main function of oil seal is to stop whatever fluid is inside from leaking out the clearance between the shaft and housing.

Packing

For packing, I will be explaining about gland packing seals. they are usually made of cotton, asbestos, flax or jute. In this packing, compressed synthetic fibers are also used and sometimes impregnated with graphite to assist lubrication. It has the advantage to withstand higher internal pressures than lip seals. in this packing, a collar is tightened so that packing material forms a seal around the shaft. A little amount of water for lubrication and cooling the packing is also allowed to drip to the atmosphere. It is normally used as a seal for both rotating and reciprocating shafts.

Bearing:

The purpose of the bearing is to support and locate rotating and reciprocating shafts or parts in machines and is to transmit force from one member to the other while allowing their relative motion/ movement to occur with the minimum resistance to motion.

Two bearing I will choose for this task are plain bearing and roller bearing.

Plain bearing: it is a typical bearing made of two parts. For e. g. a rotary plain bearing can be just a shaft through hole. A simple bearing can be pair of flat

designed to allow motion. It has flat , cylindrical or spherical surfaces which slide relative to each other.

It can be used to carry load in one of several ways depending on their operating conditions, surface, clearance and temperature. It may be used to comprise a rotating collar with a flat surface loaded against a plain or grooved thrust ring. It is also designed to withstand the forcve acting along the axis of the shaft, parallel to the axis of rotation.

Roller bearing: this bearing carries a load by placing round elements between the two pieces. The relative motion of the pieces causes the round elements to roll with very little rolling resistance and with little sliding.

A rolling element rotary bearing uses a shaft a much larger hole and cylinders called rollers tightly fill the space between shaft and hole. The bearing are often used for axles due to their low rolling friction.

References: handout given by teachers

P4)

Describe two different types of screwed fastening and two different types of rivet giving a typical application for each one.

Screwed fastening are used to make semi permanent joints which allow access and removal of fastened parts for maintenance and/or repairs. There are many types of screwed fastening of which the two I am going to mention here are nuts and studs and set screws.

stud and nuts: it is a length of bar which has been threaded at each end, the shorter threaded end is screwed into the major component. It is used for inspecting machine cover needs to be removed regularly for maintenance purpose.

Set screws: it is also known as machine screws however it does not used a nut. It is usually used to join a thin plate to a larger component. Screws are available with different shapes of head for different applications. It can be used as locking devices.

P6)Describe the arrangement and operation of two different kinds of belt drive, two different kinds of chain drive and two different kinds of gear train.

A) Belt drive: A belt drive is a method of transferring rotary motion between two shafts. A belt drive includes one pulley on each shaft and one or more continuous belts over the two pulleys. The motion of the driving pulley is, generally, transferred to the driven pulley via the friction between the belt and the pulley. Synchronous/timing belts have teeth and therefore do not depend on friction. Belt drives and gear transmissions have a much greater life expectancy than belt drives. Belt drives also have relatively high inspection and maintenance demands. There are many types of belt in which I am going to explain two of them;

1) Round belts

Round belts are a circular cross section belt designed to run in a pulley with a circular (or near circular) groove. They are for use in low torque situations and may be purchased in various lengths or cut to length and joined, either by a staple, gluing or welding (in the case of polyurethane). Early sewing

machines utilized a leather belt, joined either by a metal staple or glued, to great effect.

2) Ribbed belt

A ribbed belt is a power transmission belt featuring lengthwise grooves. It operates from contact between the ribs of the belt and the grooves in the pulley. Its single-piece structure it reported to offer an even distribution of tension across the width of the pulley where the belt is in contact, a power range up to 600 kW, a high speed ratio, serpentine drives (possibility to drive off the back of the belt), long life, stability and homogeneity of the drive tension, and reduced vibration. The ribbed belt may be fitted on various applications : compressors, fitness bikes, agricultural machinery, food mixers, washing machines, lawn mowers, etc

B) Chain drive:

Device widely used for the transmission of power where shafts are separated at distances greater than that for which gears are practical. In such cases, sprockets (wheels with teeth shaped to mesh with a chain) take the place of gears and drive one another by means of a chain passing over the sprocket teeth. The chains used in conveyor belts are commonly block chains, and consist of solid or laminated blocks connected by side plates and pins. The blocks engage with teeth on sprocket wheels. Depending on the material being moved, buckets, hooks, or other devices are connected to the blocks.

1) Roller Chain: Motion transmitted using shaft mounted sprockets. Simplex chain consists of length of single links, duplex is length of double links, triplex is length of triple links. Chain drives should ideally be lubricated and

regularly cleaned . However experience shows that this drive method will work for long periods without lubrication or maintenance

2) Inverted Tooth: Also called silent. Motion transferred via shaft mounted pinions (similar to gear wheels.) Higher power power capacities, higher speeds and smoother operation. These drive system definitely requires lubrication. (Oil bath, or spray.)

C) Gear train: A combination of two or more gears used to transmit motion between two rotating shafts or between a shaft and a slide. It is a set or system of gears arranged to transfer rotational torque from one part of a mechanical system to another.

1) Simple Gear Train: It is made of few components, a small gear at the centre called the sun, several medium sized gears called the planets and a large external gear called the ring gear. The planet gear rolls and revolves about the sun gear and the ring gear rolls on the planet gear.

2) Simple Gear Train: The most common of the gear train is the gear pair connecting parallel shafts. The teeth of this type can be spur, helical or herringbone. The angular velocity is simply the reverse of the tooth ratio. The main limitation of a simple gear train is that the maximum speed change ratio is 10: 1. For larger ratio, large size of gear trains are required. The sprockets and chain in the bicycle is an example of simple gear train.

P7 – Describe the arrangement and operation of two different kinds of transmission shaft and coupling, two different kinds of clutch and two different kinds of brake

transmission shaft – rotating shaft that transmits rotary motion from the engine to the differential

Different types of shafts:

Plain transmission

Stepped shaft

Machine tool spindle

Railway rotating axle

Non-rotating axle

Crankshaft

Propeller shaft

Crankshaft

The crankshaft is that part of an engine which converts linear piston motion into rotation. The crank and connecting rod mechanism was first used in Roman water mills, to convert the reciprocating motion into rotation, the crankshaft has “ crank throws” or “ crankpins”. More than one piston is attached to the crank to provide a smoother delivery of power to the rotating part, though many small engines such as those found in garden machinery, use only a single piston. The configuration of pistons in relation to each other and the crank and their number leads to descriptions such as straight-4 (four pistons in direct line), V6 or V8.

Transmission shafts sizes vary from 10 to 100mm but it can go higher then these figures, the maximum length of shaft usually does not exceed 7m.

Propeller shaft

Propeller shafts transmit power between the source and the machine, the propeller shaft assembly consists of a propeller shaft, a slip joint, and one or more universal joints. This assembly provides a flexible connection through which power is transmitted from the transmission to the live axle. Axle is similar in shape to the shaft and support bending movements only. The propeller shaft may be solid or tubular. A solid shaft is stronger than a hollow or tubular shaft of the same diameter, but a hollow shaft is stronger than a solid shaft of the same weight.

A slip joint is put at one end of the propeller shaft to take care of end play. The driving axle, attached to the springs, is free to move up and down, while the transmission is attached to the frame and cannot move.

Couplings

A coupling is a device used to connect two shafts together at their ends for the purpose of transmitting power. The primary purpose of couplings is to join two pieces of rotating equipment while permitting some degree of misalignment or end movement or both. By using couplings, savings can be made in reduced maintenance costs and downtime.

Thompson coupling

Thompson coupling is a constant velocity universal joint that can be loaded axially and continue to maintain constant velocity over a range of input and

output shaft angles with low friction and vibration. It consists of two cardan joints assembled within each other, so eliminating the intermediate shaft along with a control yoke that geometrically constrains their alignment. The use of cardan joints within the Thompson Coupling is to reduce the wear, heat and friction.

The Oldham coupling

The Oldham coupling transmits rotary motion between shafts that are parallel but not always in perfect alignment. Oldham couplings consist of three members, a floating member is trapped by 90 displaced grooves between the two outer members which connect to the drive shafts. Oldham couplings can bear lateral shaft misalignments up to 10% of nominal shaft diameters and up to 3 angular misalignments.

Clutch:

A clutch is a mechanism for transmitting rotation, which can be engaged and disengaged. Clutches are useful in devices that have two rotating shafts. In these devices, one shaft is typically driven by a motor or pulley, and the other shaft drives another device.

Friction clutch: it connects two separate pieces of shaft, it also has levers and springs to disengage/engage plates. The primary disadvantage of friction clutches is the regular maintenance and adjustment that are required, mating parts will wear due to friction (resulting in slippage), springs will lose memory, and other parts will need replacement or adjustment.

Positive clutch:

A clutch designed to transmit torque without slip. It consists of two mating surfaces with interconnecting elements, such as teeth, that lock together during engagement to prevent slipping. Positive clutches are also known as mechanical lockup clutches.

Brake:

A specific type of clutch that slows and stops motion by engaging a rotating shaft and a fixed component.

Disc brake

The disc brake or disk brake is a device for slowing or stopping the rotation of a wheel. A brake disc (or rotor in U. S. English), usually made of cast iron or ceramic composites (including carbon, Kevlar and silica), is connected to the wheel and/or the axle. To stop the wheel, friction material in the form of brake pads (mounted on a device called a brake caliper) is forced mechanically, hydraulically, pneumatically or electromagnetically against both sides of the disc. Friction causes the disc and attached wheel to slow or stop. Brakes (both disc and drum) convert friction to heat, but if the brakes get too hot, they will cease to work because they cannot dissipate enough heat. This condition of failure is known as brake fade.

Hydraulic brake

The hydraulic brake is an arrangement of braking mechanism which uses brake fluid, typically containing ethylene glycol, to transfer pressure from the controlling unit, which is usually near the operator of the vehicle, to the actual brake mechanism, which is usually at or near the wheel of the vehicle.

P8 – Describe with the aid of diagrams the general layout and operation of a pneumatic actuation system, a hydraulic actuation system and a mechanical handling system

Pneumatic autuation system:

A pneumatic actuation system is capable of directing an amount of fluid to the contained volume such that a pressure within the contained volume exceeds a pressure external to the contained volume by a predefined positive pressure. With the pressure controller, It can also adjust the pressure within the contained volume when the pressure external to the contained volume changes. The educator can draw fluid from the contained volume to thereby decrease the pressure within the contained volume. The valve is controllably operable in either a pressure mode or a vacuum mode, where the valve either permits the pressure controller to provide fluid to the contained volume, or permits the educator to draw fluid from the contained volume. As such, the system provides precision pressure control over a broad range of external pressures while compensating for rapid pressure changes.

Fig. example of pneumatic aculator.

Hydraulic actuation system:

A hydraulic system for a sterndrive marine propulsion device directs the flow of hydraulic fluid through the body and peripheral components of a gimbal ring in order to reduce the number and length of flexible hydraulic conduits necessary to conduct pressurized hydraulic fluid from a pump to one or more

hydraulic cylinders used to control the trim or tilt of a marine drive unit relative to a gimbal housing.

Mechanical handling system:

Mechanical handling is simply a row of roller/cylindrical or triangle cross-sectional component. They are mostly covered by a long belt but it is not necessary.

The rollers or what ever it is used are rotating and the product/component will be moving along and the other rollers will pull it along like the image is shown below. The component/product will move until it reaches its destination or the end of the roller

P9 – Describe with the aid of diagrams the general layout and operation of a steam power generation plant, a refrigeration system and an air conditioning system.

refrigeration system

BASIC REFRIGERATION PRINCIPLES

If you were to place a hot cup of coffee on a table and leave it for a while, the heat in the coffee would be transferred to the materials in contact with the coffee, i. e. the cup, the table and the surrounding air. As the heat is transferred, the coffee in time cools. Using the same principle, refrigeration works by removing heat from a product and transferring that heat to the outside air.

REFRIGERATION SYSTEM COMPONENTS

There are five basic components of a refrigeration system, these are:

– Evaporator

– Compressor

– Condenser

– Expansion Valve

– Refrigerant; to conduct the heat from the product

In order for the refrigeration cycle to operate successfully each component must be present within the refrigeration system.

The Evaporator

The purpose of the evaporator is to remove unwanted heat from the product, via the liquid refrigerant. The liquid refrigerant contained within the evaporator is boiling at a low-pressure. The level of this pressure is determined by two factors:

– The rate at which the heat is absorbed from the product to the liquid refrigerant in the evaporator

– The rate at which the low-pressure vapour is removed from the evaporator by the compressor

To enable the transfer of heat, the temperature of the liquid refrigerant must be lower than the temperature of the product being cooled. Once

transferred, the liquid refrigerant is drawn from the evaporator by the compressor via the suction line.

When leaving the evaporator coil the liquid refrigerant is in vapour form.

The Compressor

The purpose of the compressor is to draw the low-temperature, low-pressure vapour from the evaporator via the suction line. Once drawn, the vapour is compressed. When vapour is compressed it rises in temperature. Therefore, the compressor transforms the vapour from a low-temperature vapour to a high-temperature vapour, in turn increasing the pressure. The vapour is then released from the compressor in to the discharge line.

The Condenser

The purpose of the condenser is to extract heat from the refrigerant to the outside air. The condenser is usually installed on the reinforced roof of the building, which enables the transfer of heat. Fans mounted above the condenser unit are

used to draw air through the condenser coils. The temperature of the high-pressure vapour determines the temperature at which the condensation begins. As heat has

to flow from the condenser to the air, the condensation temperature must be higher than that of the air; usually between – 12°C and -1°C. The high-pressure vapour within the condenser is then cooled to the point where it becomes a liquid

refrigerant once more, whilst retaining some heat. The liquid refrigerant then flows from the condenser in to the liquid line.

The Expansion Valve

Within the refrigeration system, the expansion valve is located at the end of the liquid line, before the evaporator. The high-pressure liquid reaches the expansion valve, having come from the condenser. The valve then reduces the pressure of the refrigerant as it passes through the orifice, which is located inside the valve. On reducing the pressure, the temperature of the refrigerant also decreases to a level below the surrounding air. This low-pressure, low-temperature liquid is then pumped in to the evaporator

M1) . Compare and contrast the operation and uses of flat plate clutches, centrifugal clutches and fluid couplings in mechanical power transmission systems

flat plate clutches

centrifugal clutches

fluid couplings

The fluid coupling is operated simply by a hydraulic fluid and the driver bladed wheel. The driver wheel rotates and rotates the fluid in between follows it along and cause the driven bladed wheel to rotate along the hydraulic fluid. The hydraulic and driven bladed wheel are still under motion even if the driver bladed wheel stops.

The friction disc is sandwiched between the machined surfaces of the flywheel and the pressure plate when the pressure plate is bolted to the outer edge of the flywheel face.

The clamping force on the friction facings is provided by the diaphragm spring. Unloaded, it is a dished shape. As the pressure plate cover tightens, it pivots on its fulcrum rings, and flattens out to exert a force on the pressure plate, and the facings.

It is used in gears, turbine and many more.

A clutch operated by centrifugal force from the speed of rotation of a shaft, as when heavy expanding friction shoes act on the internal surface of a rim clutch, or a flyball-type mechanism is used to activate clutching surfaces on cones and disks.

Weights wherein each weight has an arc-shaped clutch shoe and is pivotally mounted with a lever foot on a carrier disc on the drive end of the clutch. After reaching a specific rpm, the clutch shoes are pressed under the action of centrifugal force against the inner wall surface of a clutch drum for providing friction-tight torque transmission. The clutch drum surrounds the clutch shoes. The centrifugal clutch includes a carrier disc on which the centrifugal weights are pivotally mounted. A cover disc is held axially tight at the sides of the centrifugal weights which lie opposite the carrier disc. This cover disc radially covers the clutch shoes so that axial guide play is provided.

It is used in generators.

Device used to transmit rotating mechanical power. It has been used in automobile transmissions as an alternative to a mechanical clutch.

There is no mechanical interconnection between the impeller and the rotor (i. e. the driving and driven units) and the power is transmitted by virtue of the fluid filled in the coupling. The impeller when rotated by the prime mover imparts velocity and energy to the fluid, which is converted into mechanical energy in the rotor thus rotating it.

It is used n aviation, engineering companies and many more.

M2)

Compare and contrast the operation and use of pneumatic and hydraulic actuation systems

Pneumatic autuation system:

A pneumatic actuation system is capable of directing an amount of fluid to the contained volume such that a pressure within the contained volume exceeds a pressure external to the contained volume by a predefined positive pressure. With the pressure controller, It can also adjust the pressure within the contained volume when the pressure external to the contained volume changes. The educator can draw fluid from the contained volume to thereby decrease the pressure within the contained volume. The valve is controllably operable in either a pressure mode or a vacuum mode, where the valve either permits the pressure controller to provide fluid to the contained volume, or permits the educator to draw fluid from the contained volume. As such, the system provides precision pressure control over a

broad range of external pressures while compensating for rapid pressure changes. pneumatic actuator system provides the advantage of lower weight and more economical construction. One distinct advantage of a pneumatic system is that it may utilize a source of bottled gas or the like as a potential energypower source.

Fig. example of pneumatic aculator.

Hydraulic actuation system:

A hydraulic system for a sterndrive marine propulsion device directs the flow of hydraulic fluid through the body and peripheral components of a gimbal ring in order to reduce the number and length of flexible hydraulic conduits necessary to conduct pressurized hydraulic fluid from a pump to one or more hydraulic cylinders used to control the trim or tilt of a marine drive unit relative to a gimbal housing.

advantages of pneumatic acutators over hydruallic actuators

– Relatively cheaper.

– The force transmitter, air, is freely available.

– Cleaner system as air leakage do not create a mess.

– Hydraulic oil becomes very hot after continuous use. Can cause injury if someone comes in contact.

– Generally have open circuits and we don’t have to worry about the return circuit.

Justify the use of Shell Tellus oil 27 lubricant and the splash lubrication system in the lathe machines in the College machine shop.

Shell Tellus Oils oil 27 are premium quality hydraulic oils generally acknowledged to be the ‘ standard-setter’ in the field of engineering hydraulic and fluid power lubrication.

The Shell Tellus oil 27 lubricants are mineral oils. It has an active anti-corrosion additive effectively protects hydraulic systems from corrosion. Water collects in the lubrication system due to condensation with soluble cutting fluid and is emulsified to provide further protection. It has excellent anti wear which means that lathe machine can be used for longer unlike other lubricants, it also helps improve the efficiency of filtration systems to reach system cleanliness targets. The dirt can also clean easily off. The lubricant provides anti-war and increase the resistance of the lathe material surface. It also helps to operate under high temperature; actually it works as a coolant. The lubricant also does a quick air release without excessive foaming. Other point is that the lubricant has very low environmental impact because of the zinc free technology. It also doesn’t react with other chemical when it is in use.

Shell tellus oil 27 has high lubrication properties and excellent low friction characteristics in hydraulic systems operating at low or high speed. Prevents stick-slip problems in critical applications enabling very fine control of machinery.