**Lubrication.**

Basic Principles of Lubrication

Lubrication, or lack of, is probably the biggest cause of failure of mechanical systems in industry.

* The fundamental function of a lubricant is to keep moving parts from making contact with each other by placing a thin film between the parts. Imagine rubbing your dry hands together hard and feel the heat that is generated.

Now cover your hands in lots of soap and repeat the exercise…. the heat generated is much reduced and it is a lot easier to move your hands over themselves. This is how a lubricant works. In engineering terms, when two surfaces come into contact, they must be separated by a film of lubricant or they will very quickly wear away and failure of the machine will occur.

* A secondary purpose of a lubricant is to cool the working parts, this is done by the lubricant spreading any heat generated over a wider area, and thus allowing the whole machine to cool down. Heat is generated whenever work is done and needs to be safely dissipated (got rid of).
* Helps to keep dirt out of the working parts. With grease lubrication this is achieved by filling the spaces with the grease and creating a seal around the moving parts. Oil lubrication actually picks up dirt as it moves around the machine and can then often be filtered out or will settle out in the ‘sump’ of the machine.
* Helps to reduce the running noise of the machine. The lubricant tends to ‘muffle’ any noise generated and so keeps the overall noise of the machinery down. This effect can be extremely important in some machinery and lubricants are sometimes chosen specifically because they are good at reducing noise.
* Protect the bearing from corrosion. This can be very important, and additives are often added to oils and greases to enhance this property. They do this by removing moisture from the machinery, and by providing a protective layer over the parts so that any corrosive materials (such as the acids created by the internal combustion engine) do not eat into the parent metal of the machine.

**Friction Definition**

Friction is caused when any two parts move relative to one another. It ALWAYS acts to oppose the movement, and so friction will try and stop anything moving. In any mechanical system this will increase the amount of energy required to make the machine run. Note friction is not always bad, we use it to good effect for brakes in a car!

**Dynamic** or **Sliding** friction force which occurs when motion is taking place

**Static** friction force which occurs before motion takes place

**The Types of Lubricant**

There are basically **three types** of lubricant:

* **Liquid**: usually an oil of some sort, which can easily flow around the moving parts of a machine.
* **Semi-solid**, or **greases**, these are made from oils and mixed with a thickening agent (soap).
* **Solid**. Graphite is a solid lubricant and is commonly found in the ‘lead’ of pencils (it slips easily over the surface of the paper). Other types of solid lubricant are being developed using hi-tech materials, they have some benefits (they stay where they are put) but are not so good at ‘flushing’ away dirt or cooling.

**Application Methods**

Lubrication can be applied to a machine in many ways. There are basically **three** ways of oil application.

* **Force Feed**. The lubricant is pumped around the machine under pressure, such as in a car engine where the oil needs to be distributed to many and diverse moving parts. The lubrication system will normally have a store of oil in a sump, and be ‘sucked’ up into a pump and then distributed around the machine through pipes or oil ways. Such systems will normally have a filter system to clean the oil, and may also have an oil cooler to remove excess heat from the machine. The oil is fed under pressure to the moving parts, and will then normally flow back into the sump before being picked up by the pump again.
* **Splash Feed**. This is used in smaller more compact machinery. Gears, wheels, or ‘flingers’ pick up the oil from a sump and literally throw the oil around the machine to ensure all parts become lubricated (think of what happens when you ride your bike through puddles).
* **Drip Feed**. This is used to lubricate individual bearings or other simple moving parts. Oil is kept in a reservoir or tank (often small replaceable cartridges) and under the force of gravity ‘drips’ through a small orifice onto the machinery (an orifice is an accurately sized hole, designed so that a known amount of the oil will escape over a specific time). In this type of lubrication the lubricant is usually ‘lost’ and has to be constantly topped up.

Grease is usually applied in one of three ways.

* **Utilising a ‘grease gun’** which injects grease through a ‘nipple’ in a bearing. The nipple is a one way self sealing valve, which allows the grease to enter, but not to escape the bearing.
* **Automated grease units**, which can be either single cartridges mounted on a bearing which inject grease into the bearing over a period of time, or multiple units which pump grease from a central point through distribution pipes direct to the bearings. Note unlike oil, grease is a ‘wasted’ lubricant in that it is not collected and pumped back into the bearing again.
* **Manually packed**. Some bearings have no method of adding fresh grease and have to be manually packed with grease (the cap is removed and grease added, then the cap is replaced). This type of greasing is used where re-lubrication periods are very long.

The Importance of the Safe Environmental Disposal of Used Lubricants.

Used oil and other lubricants are carcinogenic (cause cancer), they are also a hazard to wildlife and kill plants. It is now a legal requirement to ensure that used oils and greases are safely disposed of, and industrially they can only be removed from site by a licenced carrier. Often used oils are recycled for further use. Domestically the local authority will have provision for safe disposal. Note that contaminated soil can remain infertile for many years.