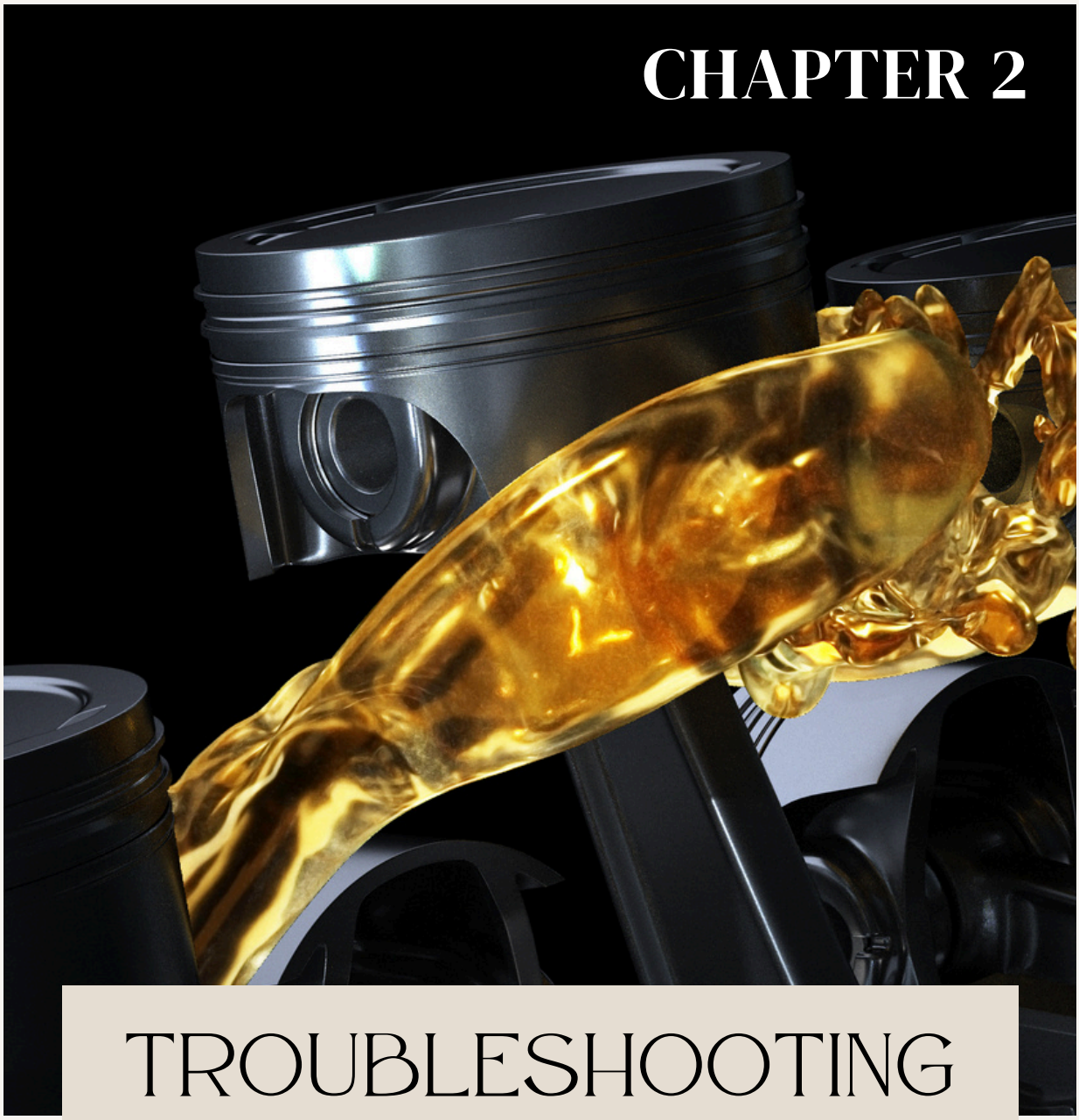

CHAPTER 2

TROUBLESHOOTING AND MAINTENANCE FOR MECHANICAL COMPONENTS

Amizan Yahaya bin Jamil
Leanna binti Mohd Yunos

TROUBLESHOOTING AND MAINTENANCE FOR MECHANICAL COMPONENTS

Chapter 2 : Lubrication

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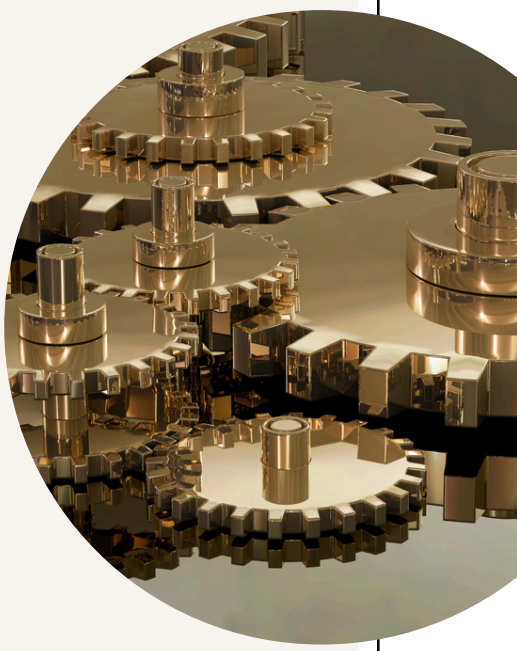

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SINOPSIS

TROUBLESHOOTING AND MAINTENANCE FOR MECHANICAL COMPONENTS covers basic mechanical components needs in Industry. The topic includes maintenance & troubleshooting principles and procedures, lubrication, power transmission, bearing and pumps. This course also gives knowledge and skills regarding maintenance & troubleshooting of mechanical components and assemblies.

Editor

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OBJECTIVE

Upon completion of this course, student should be able to :

Apply the concept of mechanical components to solve related problems.

Organized appropriately experiments in groups according to Standart Operating Procedure

Perform the troubleshooting on mechanical components failure and damage

CHAPTER 2 :
LUBRICATION

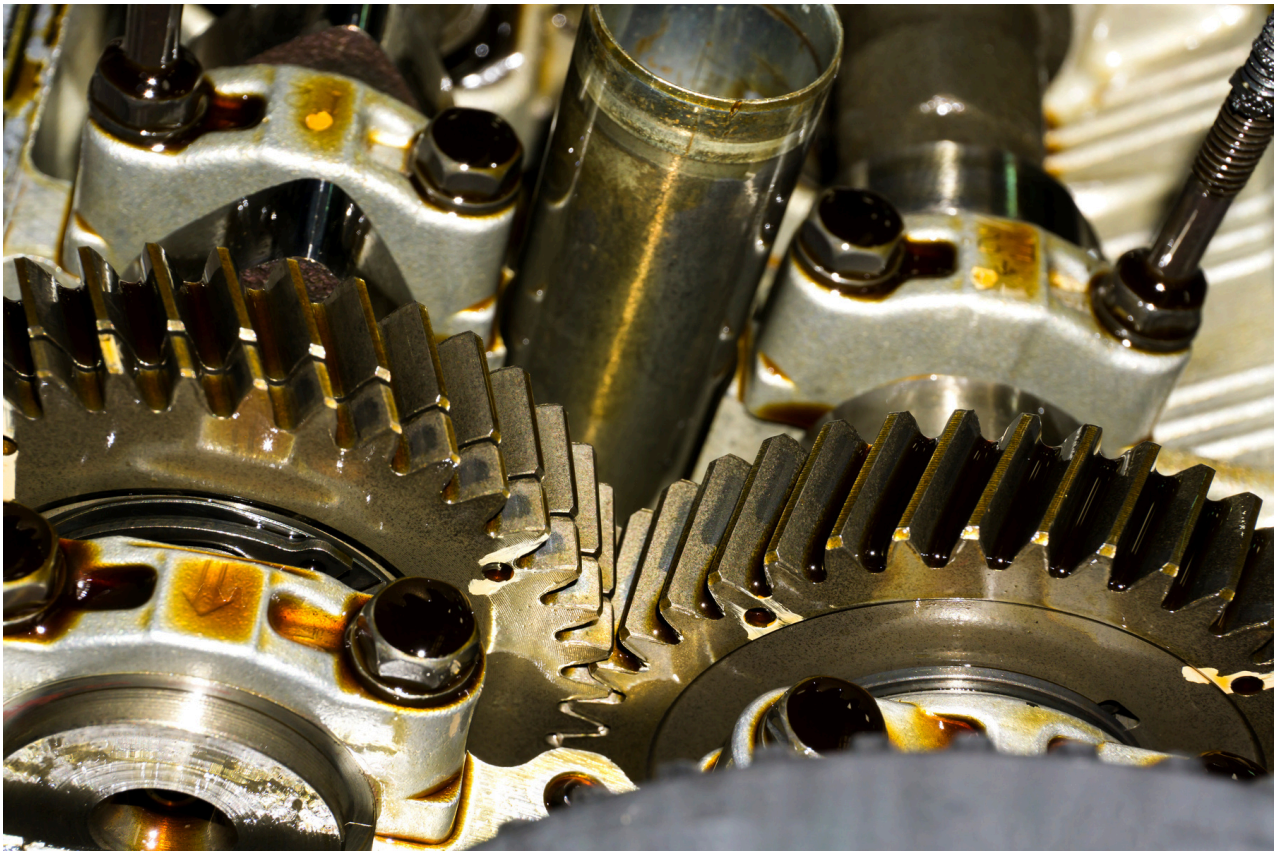
2.1 Explain lubrication principle.

2.1.1 Describe lubrication system and benefits of implementing the lubrication system.

Lubrication

- Lubrication systems distribute the lubricant to the moving machine parts in contact.
- Lubricants reduce the friction between sliding or rolling machine elements, such as gears, spindles, bearings, chains, dies, screws, cylinders, valves, and cables, in order to prevent wear, heat generation, and premature failure and prolong the service life of the machine elements.
- Lubricants may also function as a coolant that prevents thermal expansion, which consequently degrades the accuracy of the machine element.

- Lubrication systems control the volume and pressure of the lubricant to be applied to the surfaces of the moving machine parts in contact. They promote the smooth and healthy operation of the machinery. Through lubrication systems, the lubricant is applied and distributed efficiently and regularly. These systems are widely used in the automotive, industrial manufacturing, oil and gas, power generation, and steel processing industries.
- Lubrication systems are also present in automotive engines. The complexity of lubrication systems ranges from manually operated grease guns to automated and centralized lubricant dispensing systems.



Benefits :

- **Keep Friction And Wear At Bay**

Lubrication does more than make surfaces slick and slippery. It provides a coating to prevent metal-on-metal contact between the surfaces of moving parts. No matter how polished and smooth these surfaces may appear, they actually have rough surfaces at a microscopic level. Tiny peaks (called asperities) stick out and scrape against opposing surfaces, causing friction. Friction interferes with smooth motion. It also causes heat, increases surface wear and can lead to equipment failure. Proper lubrication creates a layer of film between moving parts to thwart friction, thereby promoting smoother operation and longer equipment life.

- **Protect Equipment**

The protective layer formed by lubrication helps safeguard component surfaces against rust and corrosion by preventing them from coming in contact with water or other corrosive substances. Lubricants also serve as conduits that suspend and carry away contaminants to filters or other separators in the system where they can be removed and not harm components.

- **Enhance Temperature Control**

Lubricants absorb heat, drawing it away from surfaces. Depending on the application, a lubricant either dissipates the heat or transports it to a cooling device. In either case, lubricants help keep operational temperatures in balance and reduce the risk of heat-related component damage.

- **Improve The Life Span, Efficiency And Reliability Of Machinery**

By minimizing friction, wear, excessive heat, rust, corrosion, contamination and more, lubrication helps equipment do its job longer, more consistently and more effectively. Lubrication significantly reduces exposure to many causes of potentially costly equipment breakdowns and failures.

- **Reduce The Downtime And Costs Associated With Maintenance And Repair**

Because properly lubricated equipment runs longer and more reliably, operations don’t need to be interrupted as frequently for maintenance and repairs. Therefore, lubrication reduces costs to maintain, repair and replace equipment and parts. Plus, minimizing operational interruptions helps improve productivity which, in turn, increases revenue potential.

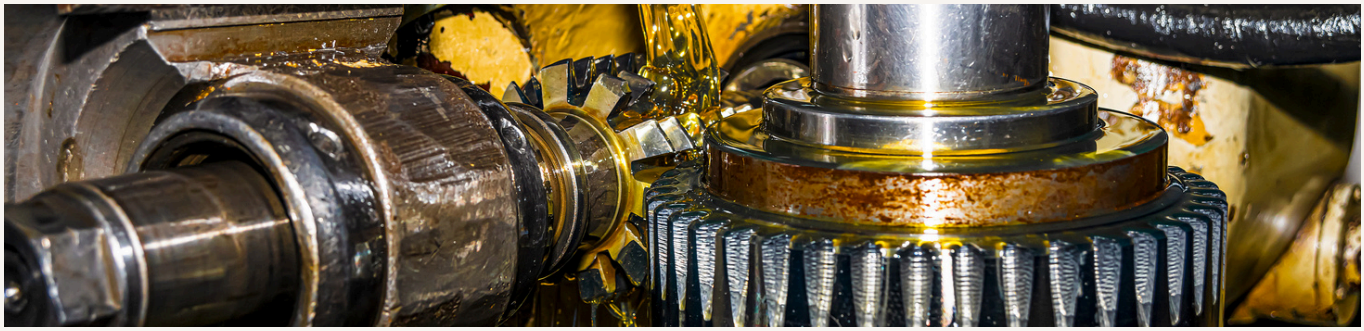
2.1.2 State the terms and principle of selecting the appropriate lubrication.

There are 10 terms and principles as stand below :

- Viscosity
- Cloud point and pour point
- Flash point and fire point
- Neutralization number
- Total base number
- Water content
- Demulsibility
- Hardness
- Water washout
- Load carrying ability

1. Viscosity

The most important physical property of a lubrication is its viscosity. Viscosity which may be defined as a fluid's resistance to flow, is the characteristic most frequently stipulated by equipment manufacturers when making lubrication recommendations. The selection of proper lubrication viscosity is often a compromise between selecting on high enough to prevent metal to metal (wear) contact, and on low enough to allow sufficient heat dissipation. In the past, viscosity was measured in such units as Say bolt Universal Second (SUS).



2. Cloud Point and Pour Point

Since petroleum stock consist of a mixture of molecular components, lubricants do not exhibit sharp freezing point. Rather, as a lubricant is cooled, certain components such as waxes will began to precipitate out and become evident in the liquid as a cloud. The temperature at which this occurs is called the cloud point of the lubricant. If the product is further cooled, a point will reach at which the lubricant will no longer flow or be efficiently pumped. The pour points of high -wax lubricants may be depressed by becomes important in applications such as refrigerant compressor lubrication where the oil is subjected to low temperatures.

3. Flash Point and Fire Point

As a lubricant is heated, lighter components begin to vaporize. The temperature at which sufficient vapor concentration exists above the surface of the lubricant so that ignition with a test flame is possible is called the flash point of the product. Flash point is useful for both product storage requirements and for the detection of contamination of one product with another. The fire point of a lubricant is that temperature at which sufficient vapors are present above the surface of the lubricant to sustain combustion upon ignition. This parameter is useful for storage and safety considerations.

4. Neutralization Number

As petroleum products are subjected to elevated temperatures, the process of oxidation occurs. Oxidation leads to the formation of organic acids in the lubricant. This increase in acidity reduces the water-separating ability of certain oils and may also prove corrosive to certain alloys. The neutralization number measures the amount of acidity present in the lubricant. It is quantitatively defined as the amount of potassium hydroxide (KOH) required neutralizing the acid present in one gram of sample. This quantity is also referred to as the Total Acid Number (TAN).

5. Total Base Number

Internal combustion engine oils are formulated with a highly alkaline (base) additive package designed to neutralize the acidic by-products of combustion. The Total Base Number (TBN) is a measure of this additive package, and it may be used as an indication of when diesel engine oil should be changed.

6. Water Content

The most common contaminant in Naval lubricating systems is water. Common sources of water include lube oil cooler leaks, condensation, steam turbine gland seal leaks, and diesel engine piston blow-by and jacket water leaks. The acceleration of system corrosion by water contamination cannot be overemphasized. In addition, excessive water contamination increases the viscosity and decreases the fluid film strength of oil. This may result in accelerated wear due to rupture of the oil film and resultant surface to surface contact. A qualitative assessment of the amount of water present in some lubricants may be made by inspecting the oils' appearance. Another method for determining water contamination levels is the Bottom Sediment & Water (B.S.& W.) test.

7. Demulsibility

Demulsibility refers to a lubricant's ability to readily separate from water. Oils used in force-feed lubrication systems should possess good water reparability to prevent emulsification.

8. Hardness

Greases are classified according to a hardness scale developed by the National Lubricating Grease Institute (NLGI). According to this system, softer greases are assigned a low NLGI number, and stiffer greases a high NLGI number (see Table 2.4). The penetration numbers refer to the depth, in tenths of millimetres, that a weighted cone penetrates the grease. Most Naval greases have NLGI numbers from 1 to 2 and are classified as medium consistency greases.

9. Water Washout

Greases subjected to splashing or impinging water must possess good water washout resistance. Greases with good resistance will maintain an adequate lubricating film under excessive water contamination conditions.

10. Load Carrying Ability

The ability of a lubricant to maintain an effective lubricating film under high loads or pressures is a measure of its load carrying or extreme pressure (EP) characteristics.

2.1.3 Identify the condition or physical appearance of lubrication.

A condition that lies between unlubricated sliding and fluid film lubrication is referred to as boundary lubrication.

- Viscosity
- Chemical stability
- Sulphur content
- API gravity
- Neutralisation number
- Demulsibility
- Oxidation stability
- Corrosion resistance
- Pour Point
- Flash Point
- Fire Point
- Cloud Point
- Freezing Point

2.2 Derive the lubrication service life.

Proper handling and storage of lubrications and greases are important to ensure longevity and satisfactory performance. Premium- grade products should be stored inside to prevent contamination with dirt and water to protect against temperatures extremes.

Lubrication protection in term of:

- Location and personal
- Facilities for handling container
- Lighting
- Bulk storage
- Fire protection

Location and personal

- A clean, well- lighted room or building is advisable, with provisions for heating in cold weather.
- It should be specifically kept for lubricant storage and reserve lubricating equipment
- One or two individuals are assigned the responsibility for inventory and dispensing of lubricants.
- Drums should be labeled clearly to ensure applications/ use of correct lubricants

Facilities for handling containers

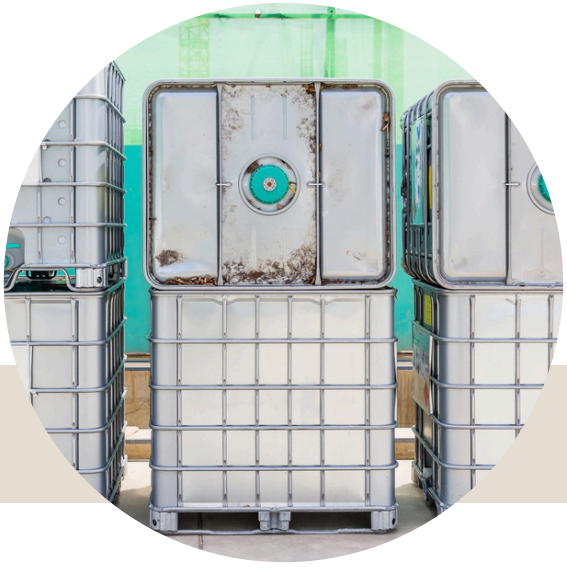
- one- level handling is an important item wherever possible in planning for lubricant storage
- This facilities rolling of drum into the storeroom, where racks can be arranged along one or more wall so that oil drums can be raised by a forklift truck and spotted in order to draw the contents off with the least effort into distribution containers.
- Each drum should have its own spigot to avoid commingling of product.
- Grease drum are normally stored on end because the contents are removed by paddle, scoop or pressure pump, according to the consistency of grease.
- Paddle, scoops, and other devices must be kept clean to protect against abrasive particle and dirt

Lighting

- The lubrications and maintenance departments can function most effectively when they have complete record as to lubricant consumption per machine of oil and grease issued.
- This requires careful inventory (monthly) and recording of amounts of oil and grease issued.
- If the storeroom is painted gloss white, if light outlets are well located to obviate glare, and if a comfortable records desk is installed, personnel will keep more careful records.

Bulk storage

- Can be investment that provides benefits in improved efficiency, reduced handling costs, reduced risk contamination, and simplified inventory.
- The tank should be equipped with a water draw-off line, sampling line, and entry to permit periodic tank cleaning.
- If the tank are equipped with electric heating coils or steam lines, precaution must be taken to prevent overheating and thermal degation of the lubricant.
- Tank lines and valves should be checked to ensure sufficient room.
- Tank lines and valves should be checked to ensure that the product is being unloaded into the correct tank.
- If dedicatd lines and pumps are not being used, the system should be flushed with one to three times the volume of the lines to prevent cross-contamination of products.



Fire protection

- The possibility of fire in a well- planned lubricant storage area is remote, assuming that no- smoking rules are observed, that casual visit from other plant personnel are prohibited, that oil drip is prevented or cleaned up promptly, that waste or wiping rags are stored in metal containers and in minimum quantity and that sparking or arcing tools are used under conditions of good ventilation.
- Insurance regulations will require installation of suitable fire-extinguishing equipment and possibly a sprinkler system



2.3 Investigate the leakages and wastages of lubrication.

Improper installation or maintenance:

- If the lubrication system is not installed or maintained properly, it can lead to leakage and wastages of lubrication.

Over-lubrication:

- Over-lubrication can result in excessive oil or grease accumulation in the system, leading to leakage and wastages.

Poor quality seals:

- Poor quality seals can cause lubricant to leak out of the system, resulting in wastages.



Mechanical damage:

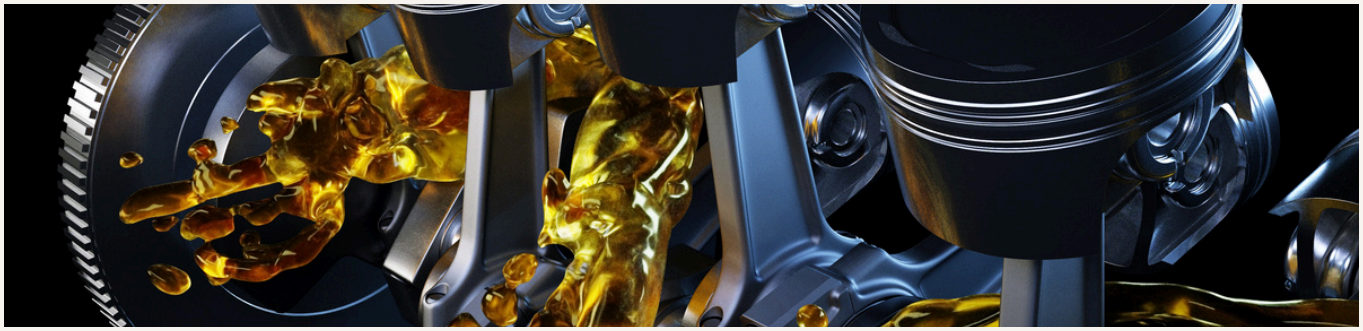
- Mechanical damage to the lubrication system, such as cracks or holes in pipes or tanks, can cause leakage and wastages.

Improper handling:

- Mishandling of lubricants, such as spills or using the wrong type of lubricant, can result in wastages.

Overgreasing

- Most plants do not recognize that grease guns are precision instruments. They also fail to see the problems that can be caused by the misuse of grease guns.
- Overgreasing is a very common problem and can result in higher operating temperatures, premature bearing failure and an increased risk of contaminant ingression.

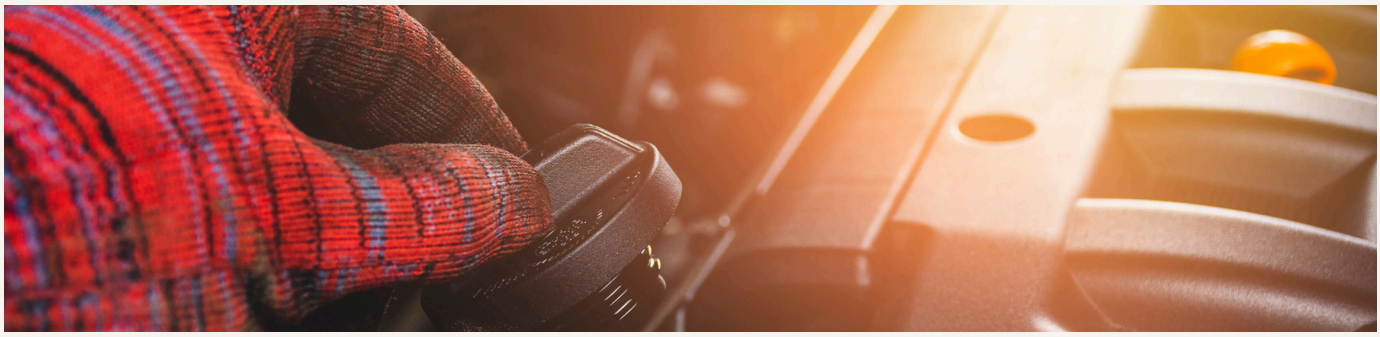


Improper storage:

- Storing lubricants in unsuitable conditions, such as extreme temperatures or exposure to sunlight, can cause degradation of the lubricant, leading to wastages.

To prevent leakage and wastages of lubrication, it is important to ensure proper installation, maintenance, and handling of the lubrication system. This can involve regular inspection and repair of the system, use of high-quality seals and components, proper training of personnel handling the lubricants, and appropriate storage of lubricants.

Additionally, implementing a lubrication management program can help to optimize lubrication usage and reduce wastages.



2.4 Show the proper method of disposal used lubrication.

The proper method of disposal of used lubrication depends on the type of lubricant and any local regulations. In general, the following steps can be taken:

- Collect the used lubricant in a clean, leak-proof container. Make sure to label the container as "used lubricant" and keep it separate from other waste materials.

- Check with your local waste management authority or environmental agency to determine if there are any regulations regarding the disposal of used lubricants. Some types of lubricants may be considered hazardous waste and require special handling.

- If the used lubricant is not considered hazardous waste, it may be possible to recycle or reuse it. Contact a recycling or re-refining company to find out if they accept used lubricants.

- If recycling or reuse is not an option, the used lubricant should be disposed of at a designated waste facility. Do not pour it down the drain or dump it in the environment.

- Follow any additional instructions or guidelines provided by your local waste management authority or environmental agency.

- Store used lubricants properly: Keep used lubricants in a clean, dry, and labeled container. Do not mix different types of lubricants together.

- Recycle if possible: Many communities offer recycling programs for used lubricants. Check with your local recycling center to see if they accept used lubricants.

- Dispose of hazardous lubricants properly: If the used lubricant is hazardous, it must be disposed of through a hazardous waste disposal program. Contact your local environmental agency for guidance.

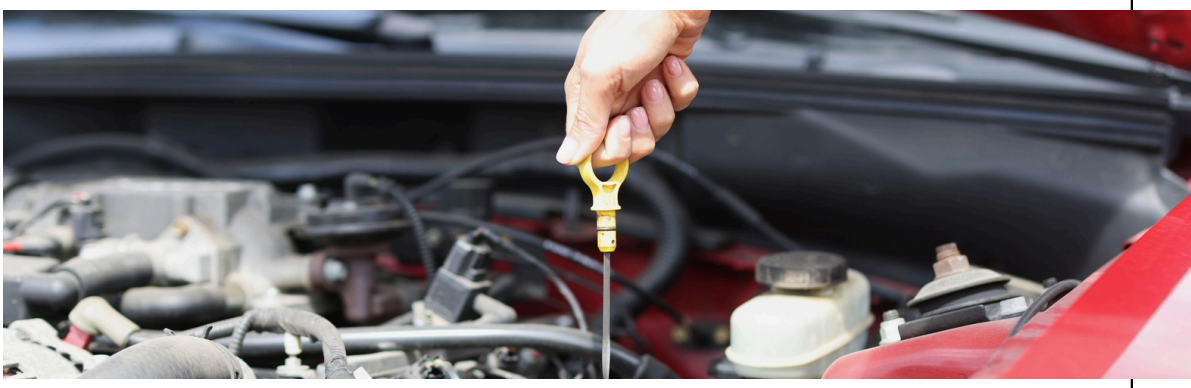
Overall, it is important to handle used lubricants properly to prevent harm to human health and the environment.

2.5 Diagnose the lubrication states above.

To diagnose a lubrication problem, you can follow these steps :

- **Check the lubricant level:**

The first thing to do is to check the lubricant level in the system. If the level is low, it may cause a lubrication problem.



- **Inspect the lubricant:**

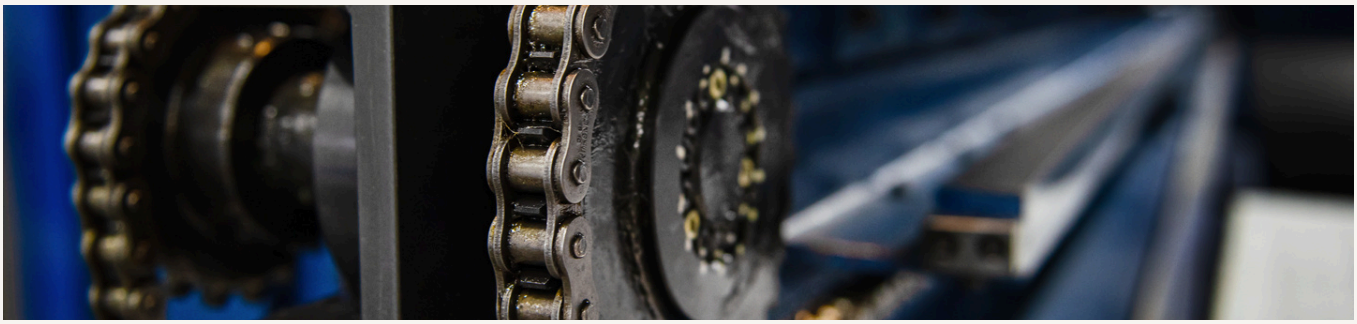
If the level is okay, check the condition of the lubricant. Look for signs of contamination, such as dirt or water, and check for any changes in color or viscosity. If the lubricant is dirty or contaminated, it may not be able to provide adequate lubrication.

- **Check the lubrication system:**

Inspect the lubrication system for any signs of damage or wear, such as leaks or clogs. Check the oil lines, filters, and pump to ensure they are working correctly.

- **Check the temperature:**

Check the temperature of the lubricant to ensure it is within the recommended range. High temperatures can cause the lubricant to break down and lose its effectiveness.



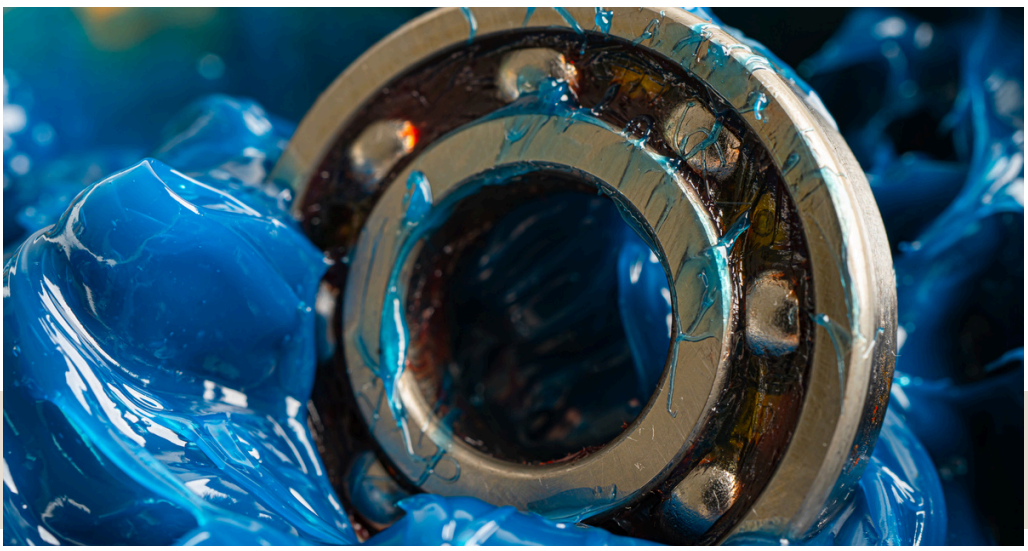
- **Check the load:**

Check the load on the equipment. Heavy loads can cause increased friction and wear, which can lead to a lubrication problem.

- **Check the lubricant application:**

Check the method of lubricant application. If the lubricant is not being applied correctly or evenly, it may not be able to provide adequate lubrication.

By following these steps, you should be able to diagnose the lubrication problem and take the necessary steps to address it.



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