Oil Hydraulics and Pneumatics
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Part 1: Fluids, types and functions; Hydraulic fluid requirements, Suitable oils for typical applications,
Main classification- water, additives and inhibitors
Lecture - 61
Subsystems: Hydraulic Fluids, Conduits and Simple Numericals

My name is Somashekhar, course faculty for this course.

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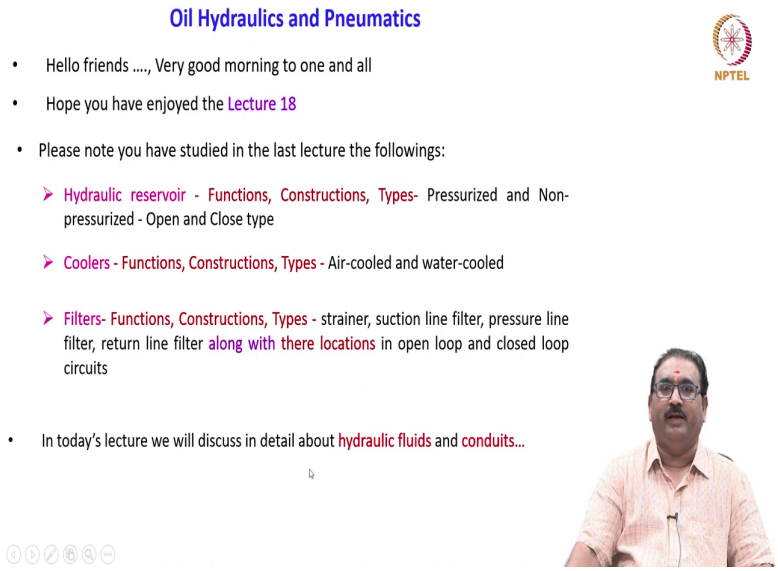

Hello friends, very good morning to one and all, hope you have enjoyed the lecture 18. Please note you have studied in the last lecture the followings: hydraulic reservoir, functions,

construction, types here we discussed pressurized and non pressurized, in non pressurized open and close type.

Coolers here we discussed function, constructions, types here air cooled and water cooled are discussed. Filters here we discussed a functions of various filters, constructions, types here basically we discussed about the strainer, suction line filter, pressure line filter, return line filter along with their locations in a open loop and a closed loop hydraulic circuits. In today's lecture we will discuss in detail about hydraulic fluids and conduits.

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Let us we will see the Organization of Presentation for lecture 19. Quickly we will see the introduction to fluids, here we will discuss types and characteristics and also I am requesting the student to recap what we have studied about the different types of fluids, fluid characteristics properties in the fluid mechanics course.

Next we will want to the hydraulic fluids here we will discuss characteristics, functions desirable properties for various applications. Different types basically in fluid power system water petroleum based fluids and fire or a flame resistant fluids, additives and inhibitors, in inhibitors includes the oxidation inhibitors and a rust inhibitors.

Next we will move on to the factors influencing the selection of a hydraulic fluid for different applications. We will move on to the conduits as I have told you in the previous class which includes the flexible hoses tubes and a connectors in the fluid power system. Finally, I will conclude today's lecture.

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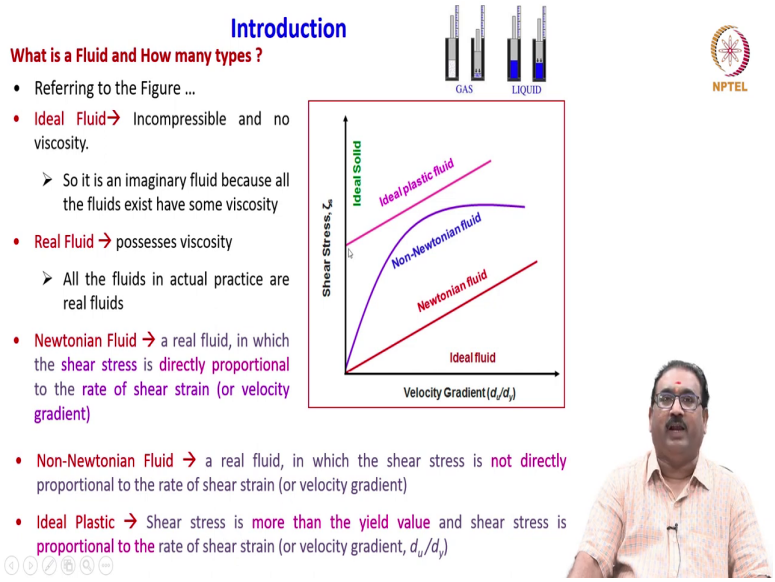

Let us we will see quickly the introduction part of the fluids. Question arises what is a fluid and how many types? As we have seen in field power system we are using gases and a liquid

both are in the pressurized state. As we know the gas are compressible fluids they are used in the pneumatic applications, liquids are in compressible fluids and used in the oil hydraulics.

These are the main classifications of the fluids, but now we will see referring to this figure I have marked the different types of fluids on the figure. You will see ideal fluid, Newtonian fluid, non Newtonian fluid, ideal plastic fluid, ideal solid fluid. It is very important to know the some of the property here ideal fluid which is in compressible and no viscosity.

So, it is an imaginary fluid because all the fluids exists today have some viscosity. Real fluid possesses the viscosity all the fluids in actual practice or a real fluids. Newtonian fluid it is a real fluids in which shear stress is directly proportional to the rate of shear strain or the velocity gradient.

Non Newtonian fluid it is also a real fluid in which the shear stress tau s is not directly proportional to the velocity gradient d u by d y. Ideal plastic, here the shear stress is more than the yield value and shear stress is proportional to the rate of shear strain or a velocity gradient d u d y.

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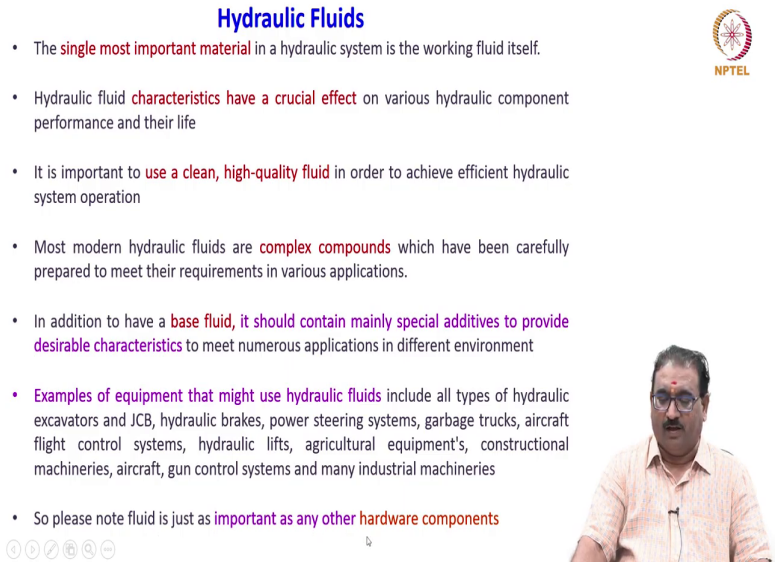

Now, we will move on to the hydraulic fluids, the single most important material in the hydraulic system is the working fluid itself. Hydraulic fluid characteristics have a crucial effect on various hydraulic component performance and their life, it is important to use a clean high quality fluid in order to achieve efficient hydraulic system operation.

Most modern hydraulic fluids are complex compounds which have been carefully prepared to meet their requirements in various applications. In addition to have a base fluid it should contain mainly special additives to provide a desirable characteristics to meet numerous applications in different environment.

Examples of equipment that might use a hydraulic fluids include all the hydraulic excavators and JCB, hydraulic brakes, power steering systems, garbage trucks, aircraft flight control system, hydraulic lifts, agricultural equipments, constructional machinery, aircraft or airbus

hydraulic systems, gun control systems and many industrial machineries which uses the hydraulic system.

So, please note fluid is just as important as any other hardware components.

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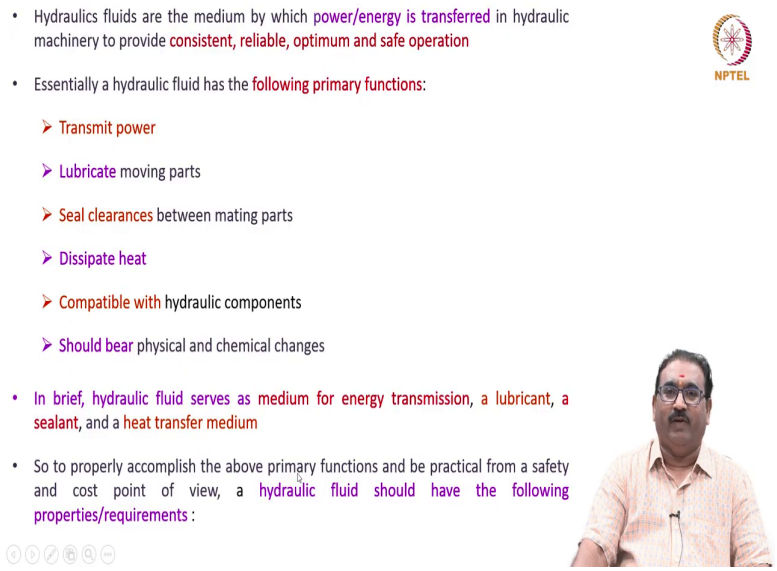

Hydraulic fluids are the medium by which power or energy is transferred in hydraulic machinery to provide consistent reliable optimum and a safe operation. Essentially a hydraulic fluid has the following primary functions. Transmit power or energy lubricate moving parts, seal clearances between mating parts dissipate heats.

These are 4 important functions of the hydraulic fluid, apart from this compatible with the hydraulic components like a seals and bearing and should bear physical and chemical changes

during the operation. In brief hydraulic fluid serve as a medium for energy transmission, a lubricant a sealant and heat transfer medium.

So, to properly accomplish the above primary functions and be practical form a safety and a cost point of a view hydraulic fluid should have the following properties or a requirement, these will vary from applications to application.

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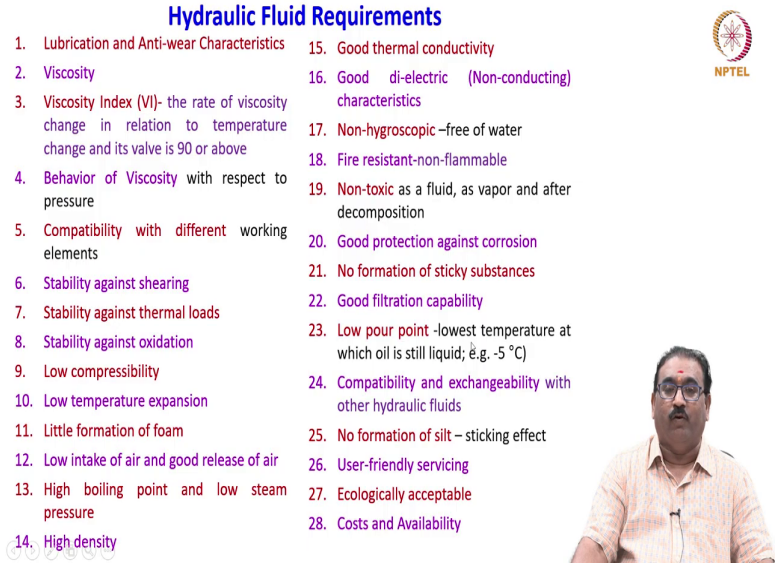

Now, quickly I will list it out all the fluid requirements for various applications. First one is a lubrication and anti-wear characteristics of the fluid is very important, viscosity index generally it is known as VI. The rate of viscosity change in relation to the temperature change and its value is 90 or above for desirable properties in the hydraulic fluids.

Behavior of viscosity with respect to pressure, compatibility with different working elements, stability against shearing, stability against thermal loads, stability against oxidation, low compressibility, low temperature expansion little forming of foam, low intake of air and good release of air.

High boiling point and a lower steam pressure, high density, good thermal conductivity, good dielectrics characteristics, non-hygroscoping meaning free of water, fire resistant meaning nonflammable, non toxic as a fluid as a vapor and after decomposition, good protection against corrosion no formation of sticky substances, good filtration capability, lower pour point meaning lowest temperature at which oil is still liquid example minus 5 degree centigrade, compatibility and exchangeability with other hydraulic fluids.

No formation of silt meaning sticking effect as you have seen in the last class the accumulation of the finer particle between the mating parts, user friendly servicing ecologically acceptable, cost and availability you will see friends there are various fluid requirements are there in industrial application. But you will see all are difficult to found in one fluid.

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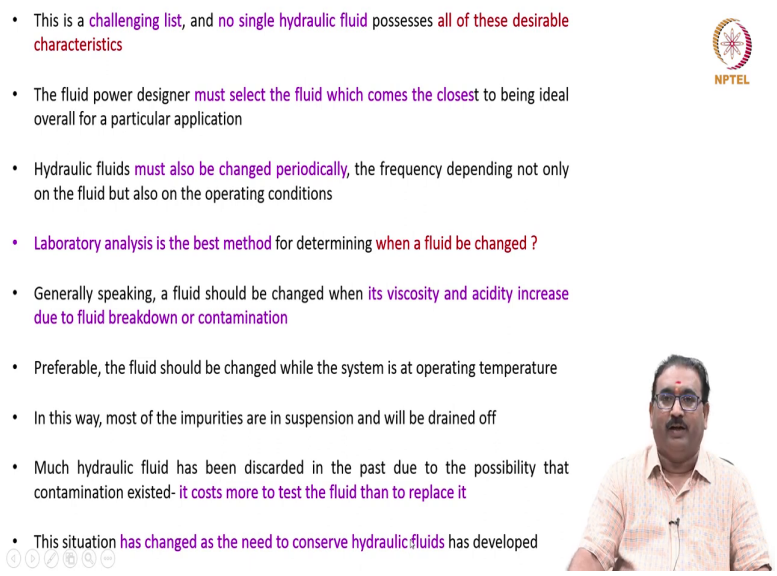

This is a challenging list no single fluid possesses all these desirable characteristics. The fluid power designer must select the fluid which comes to the closest of being ideal overall for a particular application. Hydraulic fluids must also be changed periodically, the frequency depending not only on the fluid but also on the operating conditions. Laboratory analysis is the best method of determining when the fluid be changed.

Generally speaking, a fluid should be changed when it is viscosity and acidity increases due to fluid breakdown or contamination. Preferably, the fluid should be changed while the system is at operating temperature, in this way most of the impurities are in suspension and will be drained off, much hydraulic fluid has been discarded in the past due to the possibility that contamination existed it costs more to test the fluid than to replace it.

This situation had changed as the need to conserve hydraulic fluids has developed.

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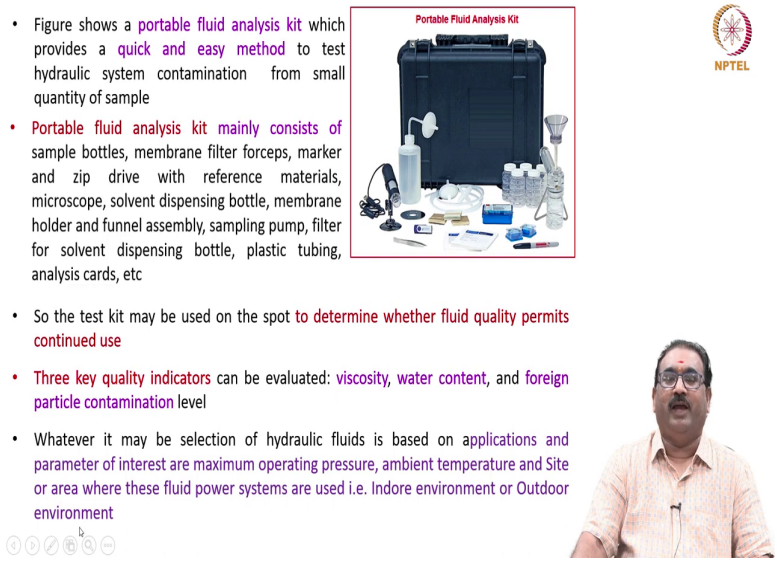

Here you will see the figure shows a portable fluid analysis kit which provides a quick and easy method to test hydraulic system contamination from a small quantity of sample. The portable fluid analysis kit mainly consists of a sample bottles membrane filter forceps, marker and zip drive with reference materials, microscope, solvent dispensing bottle, membrane holder and funnel assembly, sampling pump, filter for solvent, dispensing bottle, plastic tubing, analysis cards.

And many more in the portable analysis kit, the maintenance people they are using very quickly to test a very small quantity of sample during the maintenance work. So, the test kit may be used on the spot to determine whether the fluid quality permits continued to use.

Three key factor indicators can be evaluated viscosity, water content and foreign particle contamination level.

Whatever it may be selection of hydraulic fluid is based on applications and a parameters of interest are maximum operating pressure, ambient temperature and a site or area where these fluid power systems are used. That is the indoor environment or a outdoor environment. As you have seen many fluid power components are used inside the factory and many times the outside environment like a agricultural, construction, navigation systems and many more.

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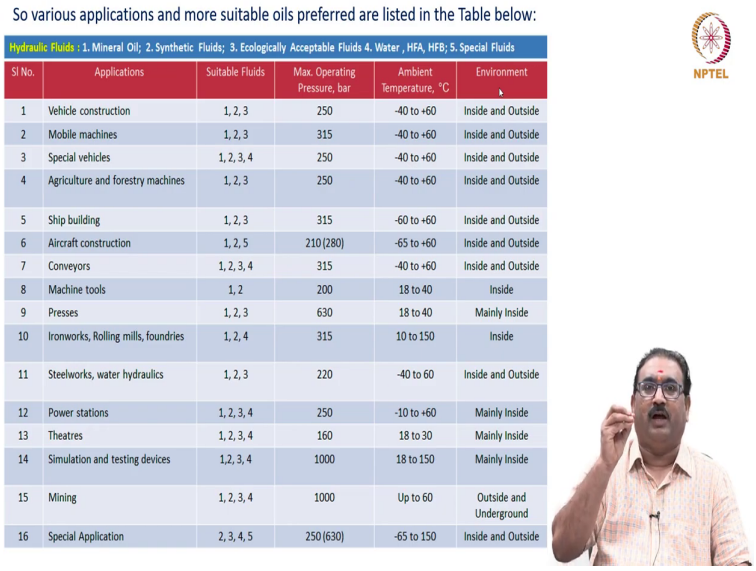

So, various applications and more suitable oils preferred are listed in the following table. You will see here friends I have shown the some of the hydraulic fluids like a mineral oil, synthetic oils, ecologically acceptable fluids water in which we are having the so many categories I will tell you what are these and a special fluids.

Now, we will see I have shown the various applications starting it vehicle construction, mobile machines, special vehicles, agricultural, shipbuilding, aircraft conveyor, machine tools, presses and many more correct, this list will show. Here which type of fluids out of the 5 are listed here and also as I have told you operating pressure is very important I have mentioned here in the bar.

Similarly, the ambient temperature from which to which it is applicable I have mentioned in the next column. Then environment, as I have told you the vehicle construction whether inside and outdoor which environment we are using I have mentioned in this. This will give you the quick glance how the various applications call the different types of fluids operating at different pressures and a temperature.

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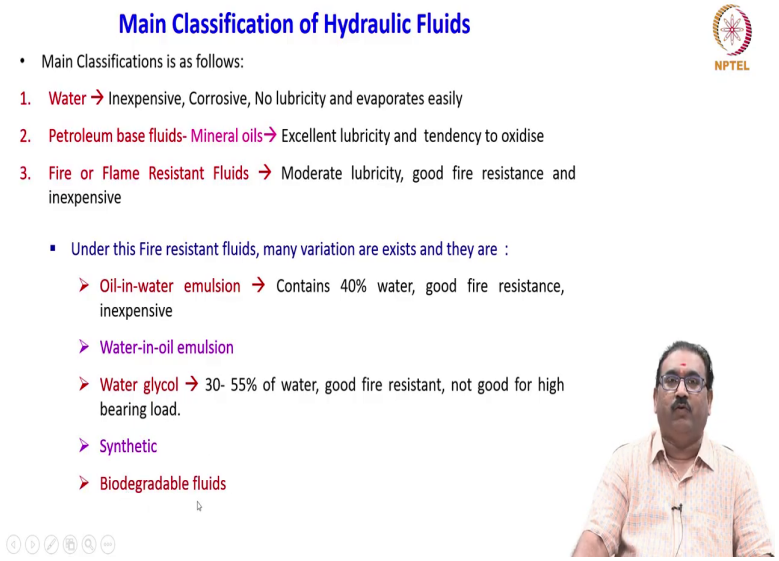

Now we will see the main classifications of hydraulic fluids main classification is as follows. First and foremost thing from the olden days water is used as hydraulic fluid because inexpensive, but it is a corrosive, no lubricity and evaporates easily. Next petroleum base fluids also known as a mineral oils, excellent lubricity and tendency to oxidize.

3rd one fire and a frame resistant fluid moderate lubricity, good fire resistance and inexpensive as compared to petroleum based fluids. Under this fire resistant fluids many variations are exists and they are oil in water emulsion you will see here contains 40 percent of water good fire resistance and inexpensive.

Next you will see water in oil emulsions, then water glycols here 30, 50 percent water good fire resistance not good for high baring loads. Synthetic fluids, then biodegradable fluids we will see one by one these hydraulic fluids.

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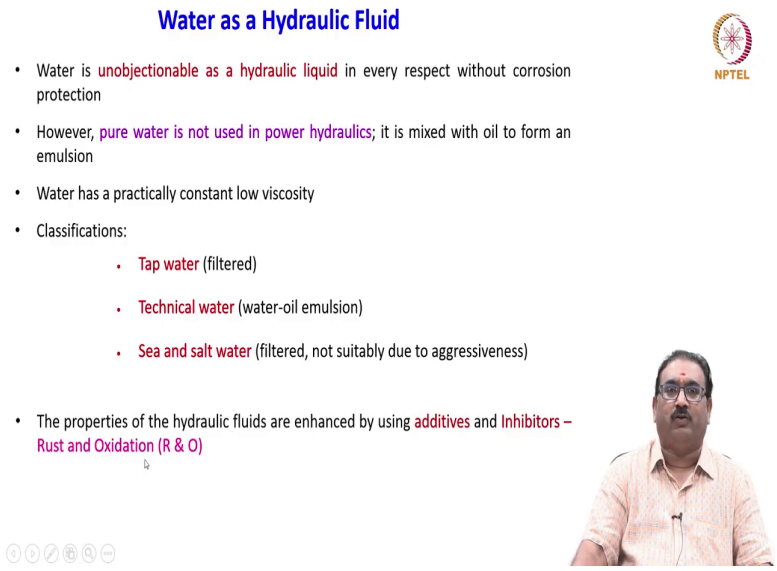

First one is water as a hydraulic fluids. Water is unobjectionable as a hydraulic liquid in every respect without corrosion protection. However, pure water is not used in power hydraulics it is mixed with oil to form an emulsion, water has practically constant low viscosity. Classification here the tap water filtered one, technical water, water oil emulsions, sea and salt water filtered not suitable due to aggressiveness.

The properties of the hydraulic fluids are enhanced by using the various additives and inhibitors, inhibitors rust oxidation inhibitors.

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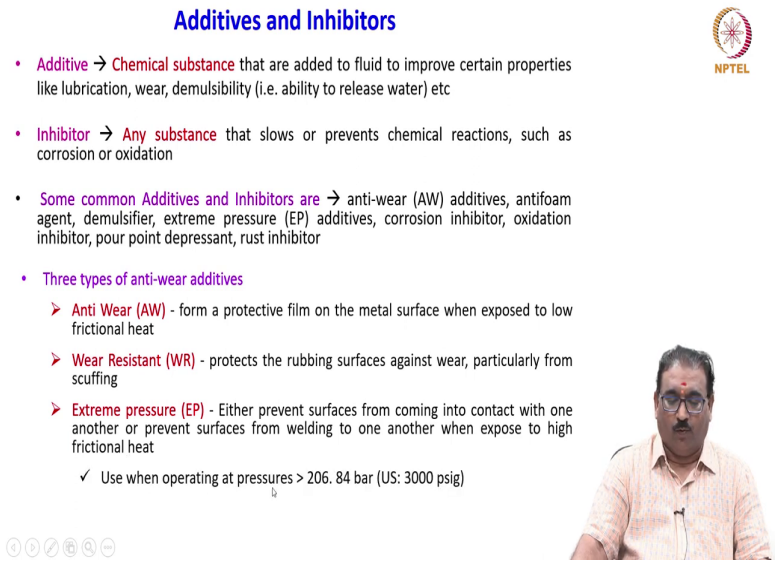

What are these additives and inhibitors to enhance the fluid properties? Additives or a chemical substance that are added to fluid to improve certain properties like lubrication, wear, demulsibility meaning ability to release a water. Inhibitors any substance that slows or prevents chemical reactions such as corrosion or oxidation, some common additives and inhibitors are anti-wear additives also known as AW additives.

Antifoam agent demulsifier extreme pressure additives or EP additives, corrosion inhibitors, oxidation inhibitor, pour point depressant, rust inhibitor. Three types of anti-wear additives are also used Anti Wear AW form a protective film on the metal surface when exposed to low frictional heat.

Wear Resistant WR protects the rubbing surfaces against the wear particularly form scuffing. Extreme pressure EP either prevent surface from coming into contact with one another or

prevent surfaces from welding to one another when exposed to high frictional heat. Use when operating at a pressure 206.84 bar.