Introduction to Abrasive Machining and Finishing Processes

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Lecture- 05
Sustainable Grinding Process

In today's class we are going to study about Sustainable Grinding Process. Till now we have seen the cutting fluids and what are the additives that we have to add, what are the positive side of the additives, what is the positive side of the lubricant, what is the positive side of the coolant and all those things we have seen. At the same time we have also seen the negative effects of the cutting fluid and negative effects of the additives like biocides, emulsifiers and anti foaming agents anti rusting agents and all those things we have seen in the previous classes.

So, now how to overcome and as an engineer what is a solution that we are going to give to the society, that we are going to study in this particular class. And this particular class is mostly useful for the PG students who can take up the research area, in the area of sustainable manufacturing in particular sustainable cutting fluids, sustainable machining, sustainable grinding processes.

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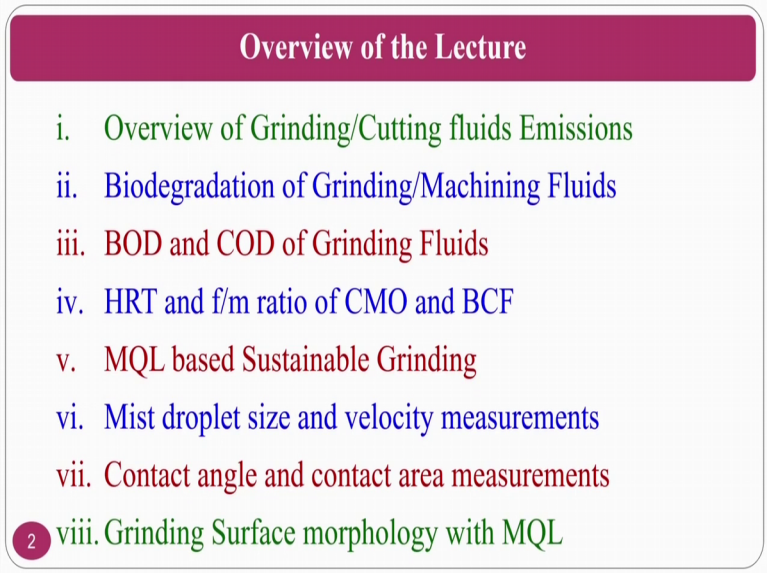

So, the overview it will goes like overview of the grinding and its emission of the cutting fluids, biodegradation of grinding fluids or the machining fluids BOD biological oxygen

demand chemical oxygen demand of the metal working fluids, HRT Hydraulic Retention Type and f by m ratio stands for food to microbes ratio of the commercial bio cutting fluids commercial mineral oils that are available in the market. And commercially there are bio cutting fluids also available at the same time you can also make your own bio cutting fluids by mixing the appropriate quantities of vegetable oils along with the some of the additives which do not have lot of emission problems.

So, then we come up to the minimum quantity lubrication or minimum quantity cutting fluid based sustainable grinding process, how the minimum quantity cutting fluid will develop, how the mist is developed and what is the particle size what is the velocity of that one, and all these things in a minimum quantity lubrication, contact angle measurement from there, how the area measurement we will see the grinding surface morphology, if you are using the MQL and other things. MQL and biodegradation of the cutting fluids, these are the two probable solutions that I am going to discuss in this one ok

The first sector up to 0.4 will deal with how the cutting fluid should be degraded before it is going to release into the water bodies or the soil bodies or any other environment. And thus, 5 to 8 will show the another solution sustainable solution how to use very little quantity of cutting fluid so, that the emissions will be minimized. These are the two sustainable solutions that I am going to deal with in this particular class. The cutting fluids in the grinding process just to overview the, what we have seen in the previous class.

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We have seen if you are not using cutting fluids the spark will come, if this is called a dry grinding and this is called wet grinding ok. If you use the cutting fluid, this will be like. If you do not use what will happen surface morphology surface metallurgical aspects of the work piece will go down. This is my work piece and which is held by the magnetic check of the grinding bet ok.

So, this if you see this much spark that is generated, what will happen the surface will be deteriorated which we do not want; for that purpose what we will do is instead of this we will go for wet type wet type what will happen? There also it will develop the spark like this, but it is nullified by the action of the cutting fluids that is why you do not see much spark there and whenever the spark false in that region it will try to evaporate or it will try to thermally crack that we have seen in the previous classes. So, that is the difference between dry and wet. From the performance point of view wet grinding will give you good surface roughness as well as good material removal and other things

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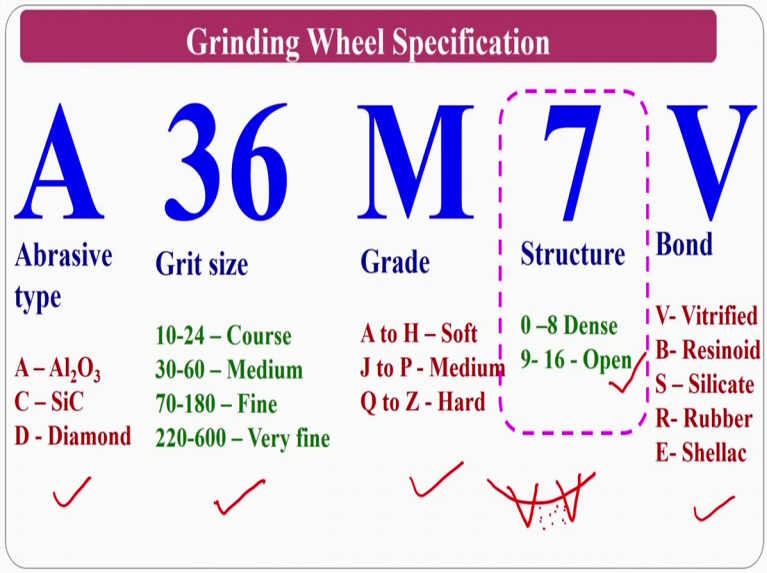

We have seen the specification of the grinding wheel, just to overview that we have seen abrasive type, abrasive size or the grit size, grade, structure and bonding. We have seen all this things, but whenever it comes to the cutting fluid; so, abrasive type do not have much say and grit size also do not have much say grade which is a part and parcel of the grinding wheel. So, it also do not have much play bonding it is also part, only thing is at how the particles are spaced in between is the only thing that strictly help for the cutting fluids, what will happen? In the, if the structure is open structure assume that my grinding wheel is like this, there will be a gap at the same time their porous structure also will be there.

So, the cutting fluid can come into this region and it tries to cool ok. For that normally you should opt for open type of structure; that means, you have a wide distance between two abrasive particles. So, that there have as a sufficient space for to have the work piece material to clog, at the same time this clog material can be removed by pressurized cutting fluid jet. So, only thing that we are worried in this particular section if at all is the structure of the grinding wheel ok.

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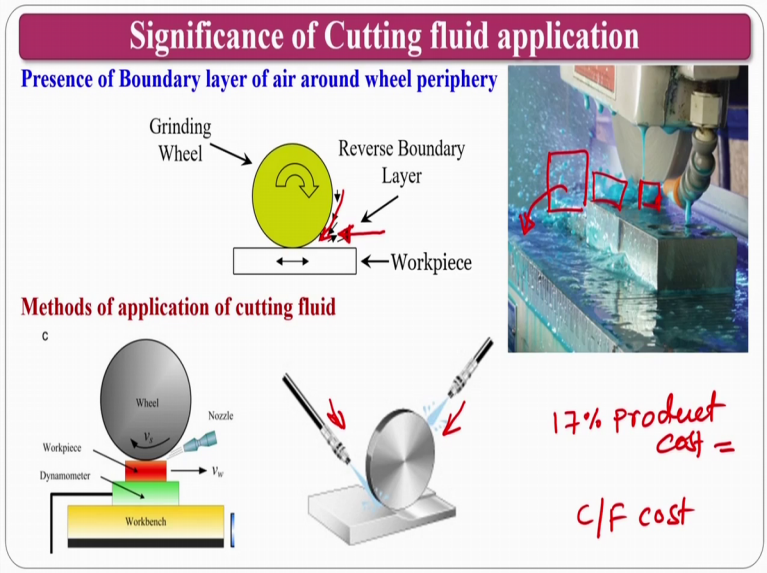

Significance of cutting fluid application, if you see the cutting fluid in the machining region or the grinding region the you can see the sky blue (Refer Time: 06:34) of cutting fluid is applied between the work piece as well as the grinding wheel. This has lot of impact you have a virgin cutting fluid if you see properly, this is the virgin cutting fluid which because which is coming from outside and the cutting fluid that is falling here in the machining region what will happen? This will be thermally degraded ok. And in the next go what will happen? Everything will mix here in this region and it will goes to the cutting fluid tank from where it is pumping ok.

So, you can supply the cutting fluid like this or you can also supply the cutting fluid like this you can also supply from zero degrees or you can also supply from varying angle. You cannot go for ninety degrees or something, but you can go, but it is not a feasible solution if the grinding wheel like that you can send like this or you can say up to 45 degrees it may be very good, and beyond which what will happen there may be a problem.

So, you should choose and some of the people who want to take up this as a research work, there are some papers, there are some thesis optimization of certain angle through which the cutting fluid should be sent ok. You can go through and the methods of application normally people as I said you can send with a high pressurized, you can send

the flood cooling and other things ok. You people also uses multiple jets one jet from this side another jet is from this side.

So, you can use multiple jet, but this will enhances the consumption of cutting fluid ok. As I already said the consumption of cutting fluid holds good for 17 percent of the product cost equal to cutting fluid cost. If you are going to use multiple jets and other things, the cost may slightly go up ok. Please make sure that you are going to use multiple jets until unless if you do not have necessity or if you are going to use for advance materials where the temperature generation is so, high in that circumstances normally you should use it ok.

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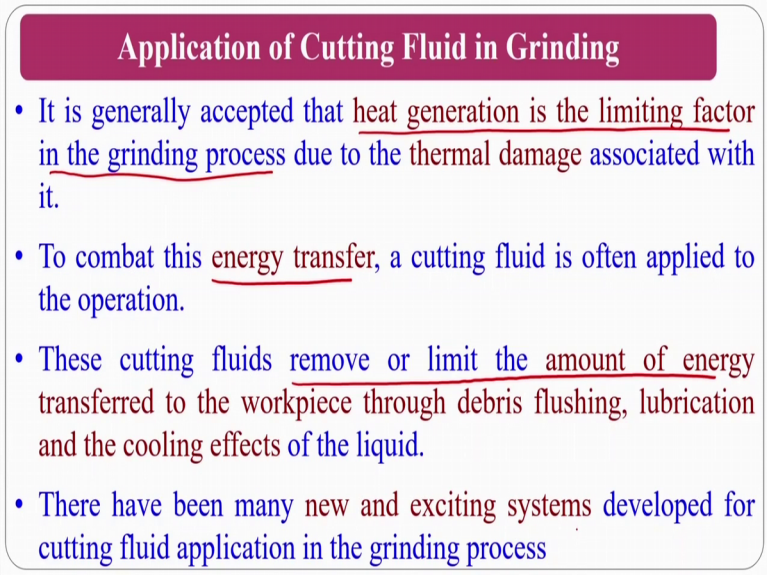

The application of cutting fluid it is generally accepted that the heat generation is the limiting factor in the grinding process, due to thermal damage associated with it that is why normally the cutting fluid use used to extract heat generation in the grinding region. The combat energy transfers because normally thermal energy transfers will be taking place the cutting fluid is often applied in this operation. And this cutting fluid remove or the limit the amount of energy transferred from the work piece through debris flushing lubrication and cooling effect ok.

So, the mainly three functions are used one is lubrication cooling and debris flushing. These are the three main functions of the cutting fluid that you are using in the grinding

process. There have been many new and exciting systems developed for the cutting fluid application in the grinding process.

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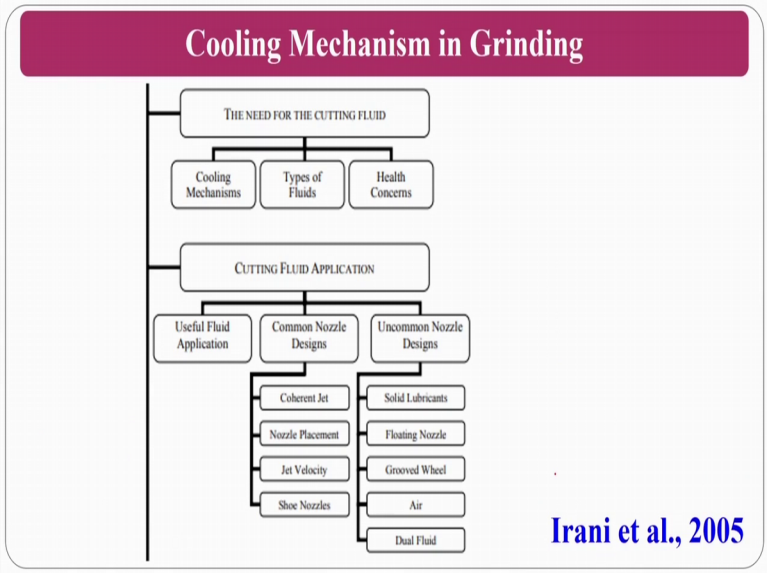

Many techniques are there like solid lubricant, MQL is there, texturing of the grinding wheel is there many things are there which we will see. The cooling mechanisms in the grinding if you see the need of cutting fluid normally cooling mechanism types of fluid and the health concerns is most important. The cutting fluid application and useful fluid application common nozzle application like coherent jet, nozzle placement, the jet velocity show nozzles some of the things we will see in the upcoming slides.

Uncommon nozzle designs like solid lubricants we will be use, floating nozzle, grooved wheel, air can also be used as a cutting fluid as that same time dual fluid techniques also can be used because from one side you can send water dominating on other send other side of the grinding wheel you can send only the lubricating type; that means, that where oil dominating cutting fluids you can send.

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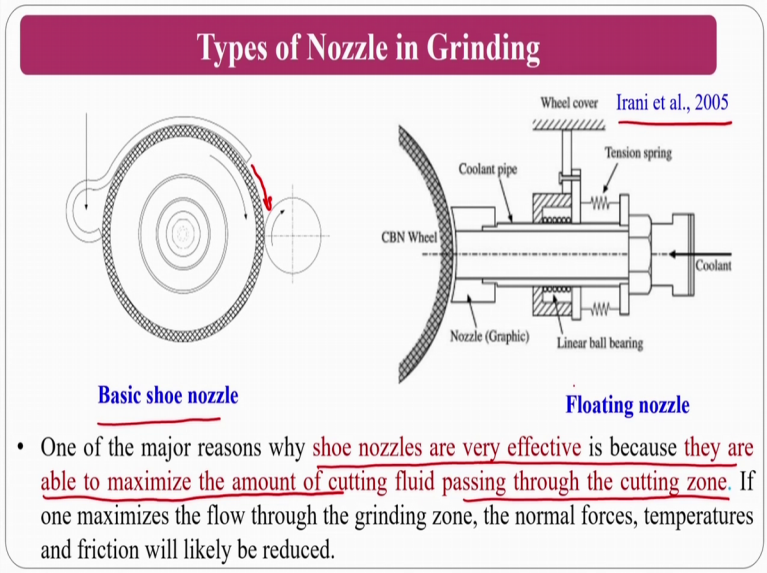

Types of nozzles normally as you have seen in the previous slide, basic shoe nozzle is there where the cutting fluid is fed and within the shoe and so that it will be. One of the major reason why the shoe nozzles are very effective is because they are able to maximize the amount of cutting fluid passing through the cutting zone ok. So, that if you want to occupy most of the machining region you can occupy in this one because, the cutting fluid will fall into the machining region perfectly because the alignment is like that.

Another one is a floating nozzle where the floating nozzle is also another one which people can (Refer Time: 11:35). Suppose if at all these are the common nozzles nowadays people are not using these type of things, if at all you want to undergo the some of the knowledge about this things you can see the papers and you can get some of the knowledge basically ok. So, the floating nozzle will be used again as a c b n grinding wheel or any other grinding wheel so, that it will slightly fluctuate and give wherever whatever the requirement you want.

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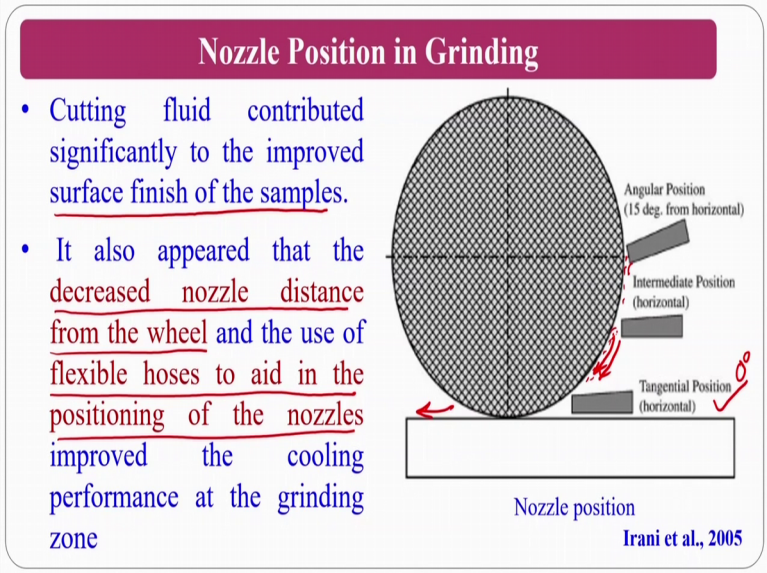

The nozzle position in the grinding if you see the nozzle position as I said people can be use tangential position that is 0 degrees and intermittent you can also use intermittent here so, that it will come like this it will come like that and we can also give certain angle so, that it will pass.

As we have seen in the previous slide, this also helps to flow along the rotation of the work piece and it will come out from this zone ok. See angle of declination will help the cutting fluid flow. For example, the people if you see on the roads people are just jumping out of the bus, they normally jump in the direction of bus moving, they never jump in the opposite direction because if you jump in a opposite direction you will fall. So, that is one of the thing that you have to note is here also. So, you have to align your nozzle in the declination mode so, that cutting fluid will come and along the direction of the abrasive wheel rotation it will go soft ok.

Cutting fluid is contributed significantly to improve the surface finish of the samples, because surface burning you can reduce at the same time friction you can reduce the heat generation you can reduce. These are all will help indirectly the surface generation and lower surface finish. It is also appeared that the decrease nozzle distance from the wheel and the use of flexible hose aid the positioning of the nozzle improves the cooling performance. Normally if you give certain angle at the same time you have to find certain optimum distance assume that my grinding wheel is like this, I cannot put far

away from this one I cannot put by touching this one or I cannot put here. You should find the optimum distance at the same time you should also find optimum angle at which I have to send. So, these are all two things that this paper will tell you ok. So, that distance at which the cutting fluid is exiting from the nozzle to the distance of the grinding wheel, at the same time at which angle it has to dispense in the form of jet is also to be taken care in this one.

So, people who are interested they can go for these type of things at the apart from it, the most important thing is that your cutting fluids may have different different viscosities. So, different viscosities will have different angles, even though you are sending at same pressure because of the viscosity effects there may be change in the force change, in the direction and all those some of the changes will come because of the viscosity. So, you should be careful. So, if you can use different viscosities with respect to different angles and different distances, you can come up with a good thesis in a master level or in a final year b tech level.

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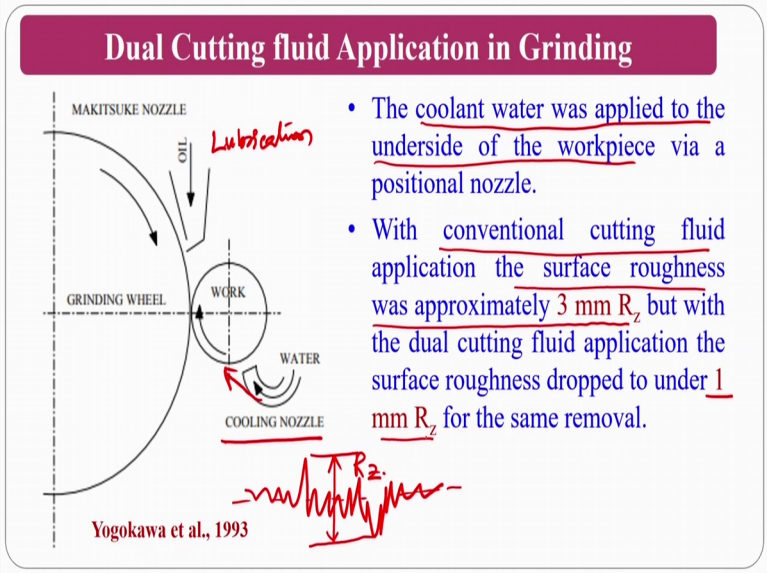

So, dual cutting fluid application as I said one side normally the people can apply water type of cutting fluid, because the temperature generation is very high. On another side you can use the oil oriented, because you need the lubrication. Whenever you are using the oil that is you are using for the lubrication and here you are using for the cooling

nozzle ok. So, you can use this multiple jets and you can get the maximum output or maximum better output from the experiment.

The coolant water was applied to the underside of the work piece via positional angle, at the same time the conventional cutting fluid that is mineral oil is applied for the surface roughness was approximately achieved 3 mm, normally these experiments, but then may be very old experiments that is why people are talking about R z. The surface roughness and other things I will explain if time comes normally R z refers to if I have a surface like this ok. Assume that centre line is like this, maximum peak to minimum valley this distance is nothing, but R z that maximum peak to minimum valley is nothing, but R z, normally it might be in the olden stages you will have coarser abrasive particles.

So, it may be like a 3 mm that might have achieved, but with the dual cutting fluid application technique, the people have achieved 1 mm maximum peak to minimum valley ok.

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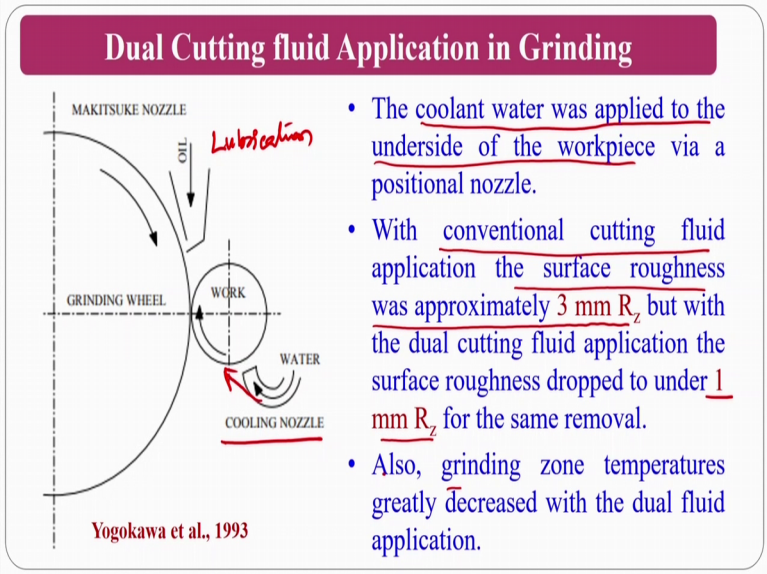

So, also grinding zone temperatures are greatly decreased with the dual cutting fluid; that means, that the author has used dual one oil another one is water, and the thing is that the temperatures also came down. So, if the temperatures are coming down what will happen you will get the good surface metallurgy.

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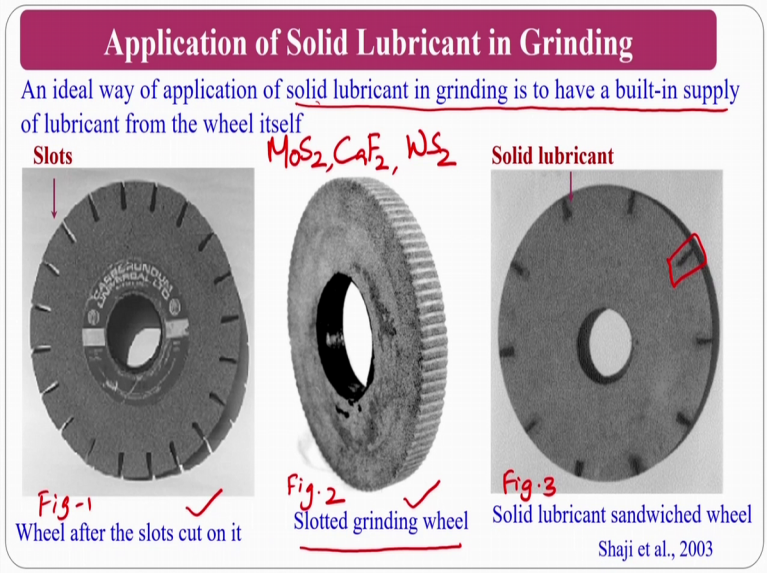

Application of solid lubricants people also uses solid lubricants, solid lubricants is nothing, but using the nano powders or micro powders of MoS 2 (Refer Time: 17:35) disulphide CaF 2 calcium difluoride and some people also uses tungsten disulphide WS 2 these are the three solid lubricants. So, ideal way of application of solid lubricant in the grinding is to have a built in supply, that is you just make the slots and you use the lubricants ok.

Slotted grinding wheel you can go for this type of grinding wheel or this type of grinding wheel and you can use the solid lubricant. I (Refer Time: 18:07) solid lubricants normal example is MoS 2 CaF calcium diflouride and tungsten disulphide also people will use. These are the particles commercially available from the market you can purchase it if at all you are interested and you can even send along with the high pressure air ok. So, need not to worry about that you have to provide the slots this may I mean to say this may decrease the structural strength of the grinding wheel may be ok. So, if at all you want to improve the structural strength as well as to improve the performance, you should go for having a pressurized jet air jet mixing with this particles and send to the normal grinding surface, but there may be a problem of environmental effect.

So, be careful if you can do this particular system in a closed chamber, that will be a best solution. So, use the solid lubricants coated in between the structures, you can see here the structures are made like figure 1 this is the figure 1 figure 2 and figure 3. Similar to

figure 1 the slots are fabricated, but the solid lubricant is coated there itself. So, it we can call it as self lubricating grinding wheels also.

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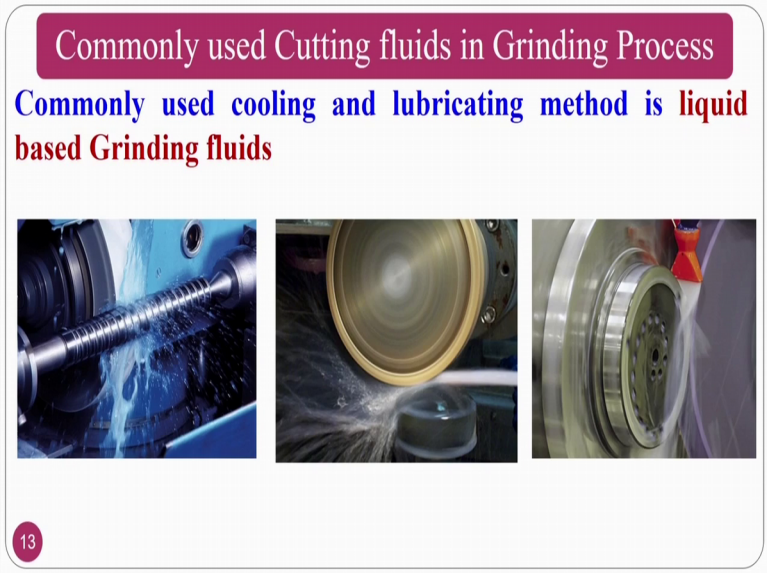

So, commonly used cutting fluids this solid lubricants other things are exceptional cases, but normal cases is nothing, but using the cutting fluids liquid based cutting fluids. As we have seen in the previous cases most of the applications they will go for the liquid based because solid cannot penetrate into the machining region, but liquid has slightly flexibility can penetrate in to the regions where the machining is taking place, but not 100 percent. So, from the point of accessibility by the cutting fluid, people go for liquid based cutting fluids ok. Now, these liquid cutting fluids what is happening is they will use it then after sometime they will dump into the water bodies which is not a good solution.

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So, one should not dump the grinding fluids like this it will causes the water pollution and it is also causes the land pollution ok. So, what will be the solution? This is the question. So, as an engineer's it is our primary responsibility to give a good solution for the industries, for the human kind and at last we should think what good we have done for the humans; who are our neighbours, who are our brothers, who are our sisters across this globe for that purpose what solution is a tentative solution that are as per the current trend is, this is a one of the tentative solution.

So, what we have to do is, before throwing or before pumping of these cutting fluids into the river bodies we should treat them biologically treat them so, that it would not create any harm to the living organisms in the water body, at the same time the people who are depending on that water body. So, this is the one of the probable solution. The pollution by the machining and grinding fluids pollution is a introduction of the contaminants in to the natural environment.

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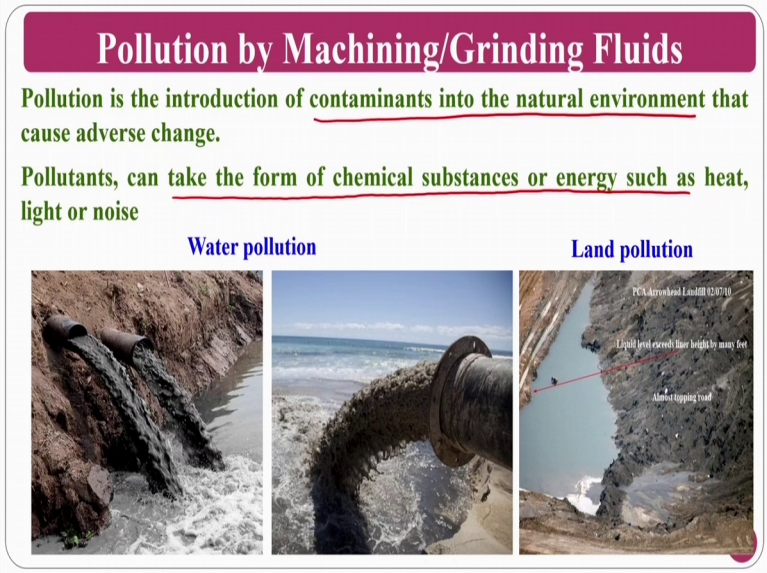

So, any commonly the pollution means you are using or you are throwing out or you are contaminating the contaminants into the natural environment. Pollution can take from the chemical substances or energy such as heat and light and noise. So, these are the water pollution that we have seen this is the land pollution and other things, which recently we have seen in the previous slides. So, what is a problem is a these contaminants you are throwing. So, you are causing the pollution. So, you should not cause this pollution, even though you want to release you should do some pre treatment then you have to send.

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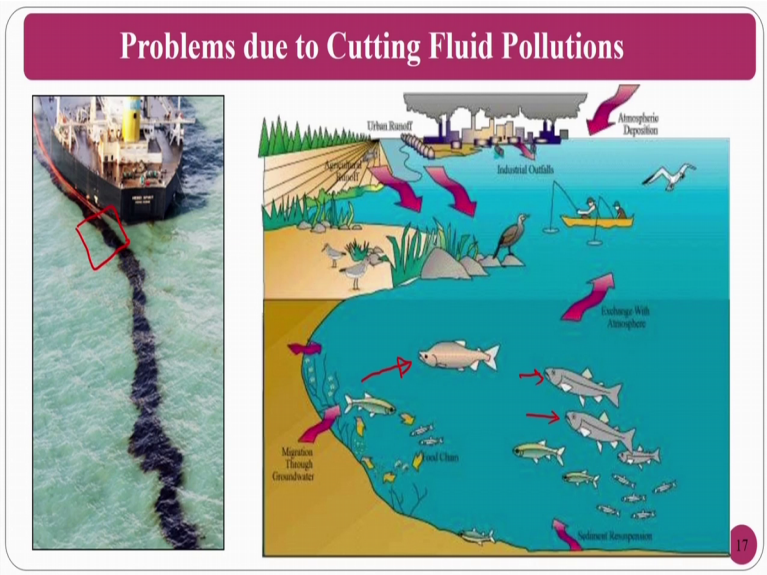

So, problems due to cutting fluids what here the people are leaking the contaminants into the ocean or into the river ok. So, what will happen? These or the things that will come into the water bodies and whenever it comes into the water bodies, the organisms living organisms like the fishes and other things will take and they will die or you the people who are surrounding to that lakes or rivers or something they will regularly consume for making the food for making drinking the water and other things. So, it is a big problem because the particular person who is dumping is destroying the ecological system ok.

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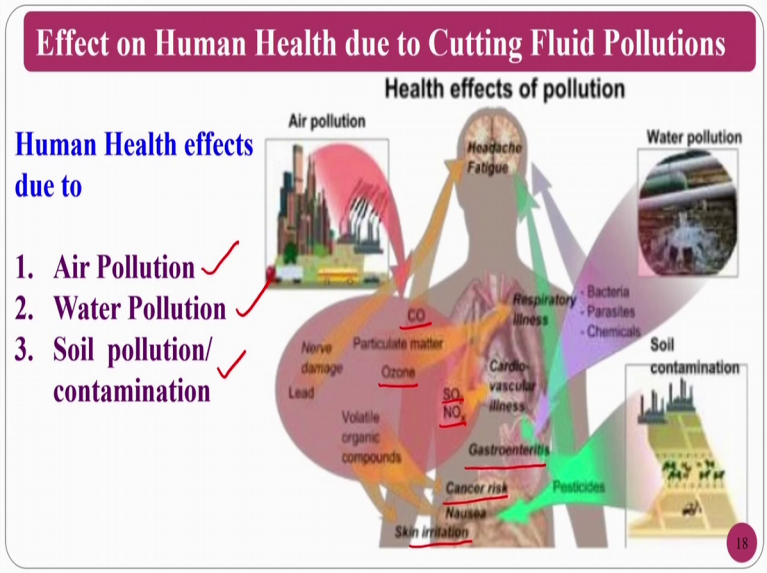

Human health due to cutting fluid normally human health effects due to air pollution, water pollution or soil contamination or soil pollution you can see here air pollution. Air pollution refers to the carbon monoxide, socks, nocks and you are also damaging ozone layer at the other things. If you see the water pollution the biggest problem with the water pollution is gastroenteritis problem that is a stomach problems, cancer problems and skin irritation and other things soil contaminants also causes like cardiovascular and other things because your soil pollution already oil can go in and it also mixes with the water that normally people pumps.

So, people what they will do assume that the contamination is taking place from 100 meters from here, the people are pumping water from here from the bore well what will happen this contaminants; will contaminate water again. So, you are indirectly damaging

the water bodies of the nearby people and other things for that purpose you should be taken care about all this things before you dump.

Degradation as I said before you are going to dump this cutting fluid, you have to degrade it to a good level. That good level is it should not cause any problem to the water bodies or the humans ok.

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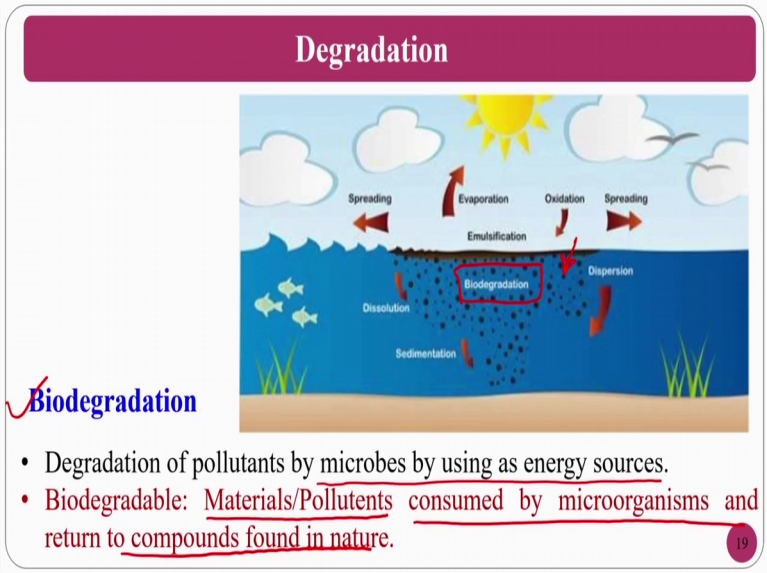

So, we are talking about biodegradation because why biodegradation you are dumping into the water body and water body contain lot of living organisms. So, if it can degrade by those micro organisms, that is well and good; so, that the humans who are there or who are depending on it will be safe ok. Degradation of pollutants by the microbes using as a energy source what is biodegradation? Whenever you are throwing certain pollutants or certain materials into the water body or anybody, the microbes which are there they are using this materials as energy sources and consumes without any problem to them that is called degradation by microbes, that is called is biodegradation.

Biodegradation where the materials or the pollutants consumed by a microorganisms and return to the compounds to the nature ok so, this is what the biodegradation is concerned. Whenever if you see here the biodegradation the dispersion the people have or something is came into picture sedimentation will take dissolution and what is happening here is it is dumped and the microorganisms or consuming it as their energy source like what we

eat as a food ok. So, consume and releases the compounds which are biodegradable that is about the biodegradation.

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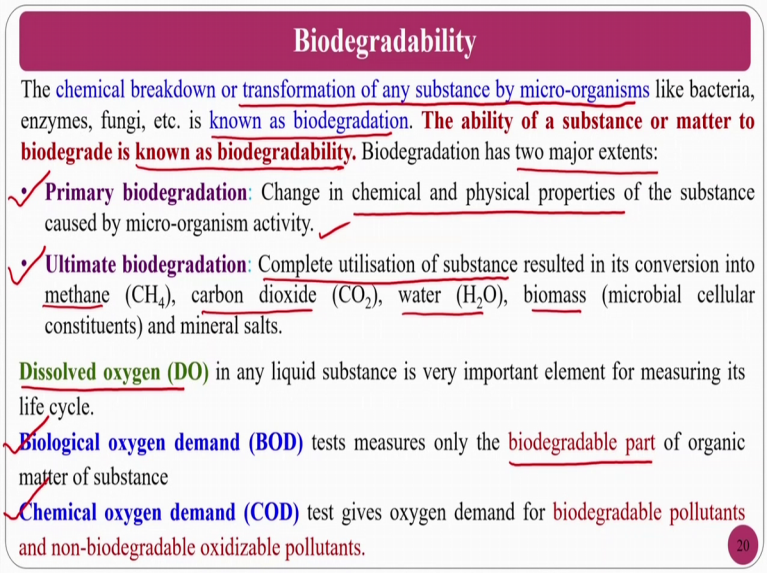

Biodegradability is nothing, but the chemical breakdown or the transformation of any substance by microorganisms like bacteria, enzyme, fungi known as a biodegradation. The ability of substance or the matter to degrade is known as biodegradability of that processes material ok. Biodegradability has two major extents one is primary biodegradation another one is ultimate biodegradation.

The primary biodegradation means it is a chemical or physical properties change of the substance by microorganism activity and ultimate biodegradation means complete change; that means, that complete utilization of the substance result in conversion into methane, carbon dioxide, water biomass and other salts this is nothing, but biodegradation which is nothing, but ultimate biodegradation there are two things one is primary and ultimate.

How do check both these dissolved oxygen is another effect in this one you have two things one is biological oxygen demand and chemical oxygen demand. Biological oxygen demand measures the oxygen required for degrading the biological part and chemical oxygen demand means the oxygen required for degrading the biological; that means, the biodegradable and non-biodegradable. How the non biodegradable? Here in

the chemical oxygen demand in the reactor in the laboratory scale what we do is, we also add some chemicals to degrade the non-biodegradable things.

But we have to supply the oxygen continuously; that means, how much oxygen is required for degrading these biodegradable and non-biodegradable things using this chemical oxygen demand that oxygen requirement is nothing, but chemical oxygen demand ok.

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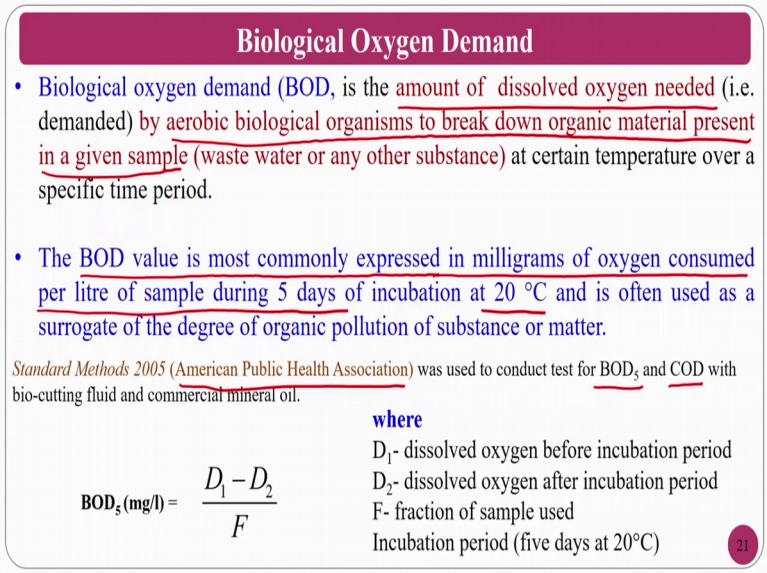

Biological oxygen demand is the amount of dissolved oxygen needed by the aerobic biological organisms to break down the organic material present in a given sample. So, normally BOD values are most commonly expressed in milligrams of oxygen consumed per litre of the sample in 5 days. Normally BOD is measured in terms of number of days like 5 days this is called primary degradation test normally people will be done at 20 degrees, normally this test will be done to understand preliminarily like IAS examination and other examination there is a preliminary tests as well as a main test. So, you can consider this as a preliminary examination and ultimate biodegradability is nothing, but our main slide ok.

Standard method of American public health association was used here normally BOD 5 stands for biological oxygen demand test that you are doing for 5 days and COD is nothing, but chemical oxygen demand that is ultimate one ok. So, it is BOD 5 that is milligram per litre and D 1 minus D 2 by F; that means, that where D 1 is dissolved

oxygen before incubation period, I said there will be a reactor you should put the microbes you should the put the pollutants and you have to continuously send the oxygen.

So, what is thing? First you have to measure what is the dissolved oxygen in the reactor that is called D 1. Now, D 2 is dissolved oxygen after incubation period and F is nothing, but the fraction of sample used in the normally the incubation period is 5 days as I said earlier at 20 degrees ok.

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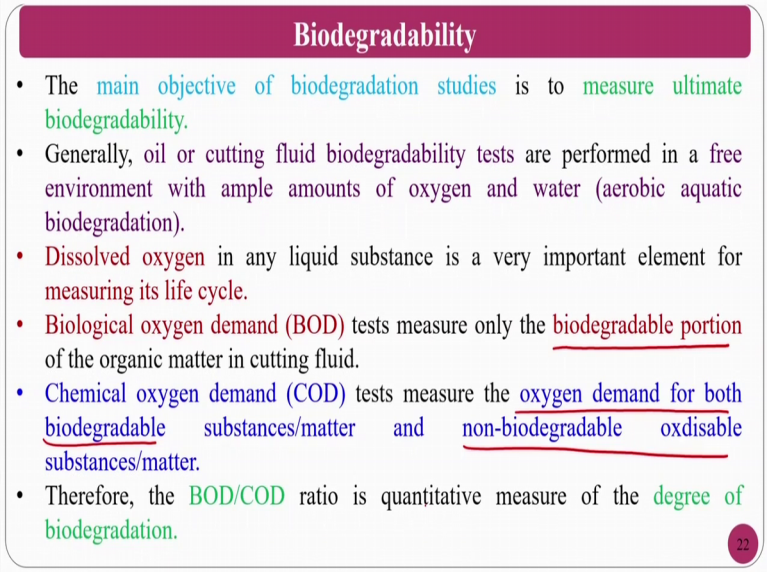

So, the main objective of biodegradable study is to measure the ultimate biodegradability generally oil or cutting fluid biodegradability test were performed in a free environment and dissolved oxygen in liquid substance is very important for measuring the life cycle, and biological oxygen demand measures only you should be careful about this it can only degrade biologic biodegradable portion and a chemical oxygen demand measure oxygen for both biodegradable substances and non-biodegradable as I said earlier.

Therefore, BOD by COD I mean to say BOD by COD means biological oxygen demand to chemical oxygen demand ratio gives the degree of degradation. That means, that how much biological degradable material is there, how much you can do by the COD; that means, bio biodegradable plus non biodegradable this gives the percentage or the degree of degradation.

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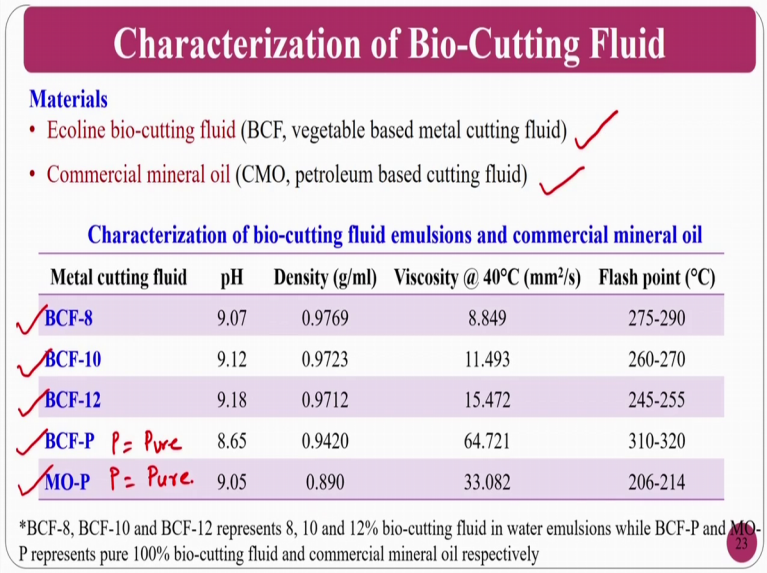

In the current test for your better understanding, we have used echo line bio cutting fluid which is commercially available in the market, and the commercial mineral oils also we have used ok. So, I want to say here this is normally BCF 8 means biological cutting fluid we have used with respect to 8 litres of water 10 litres of water 12 litres of water and this is bio cutting fluid pure one P refers to pure and MO refers P refers to pure ok.

So, this is what we have measured the pH values, density values viscosity what is the flash point other things. This is not that much relevant, but whenever you are going to do the biodegradability test and other test you can also look at the viscosity levels what is the flash point what is a pH levels because you have to maintain the pH during the experiment that is why you have to always measure your pH of your system ok.

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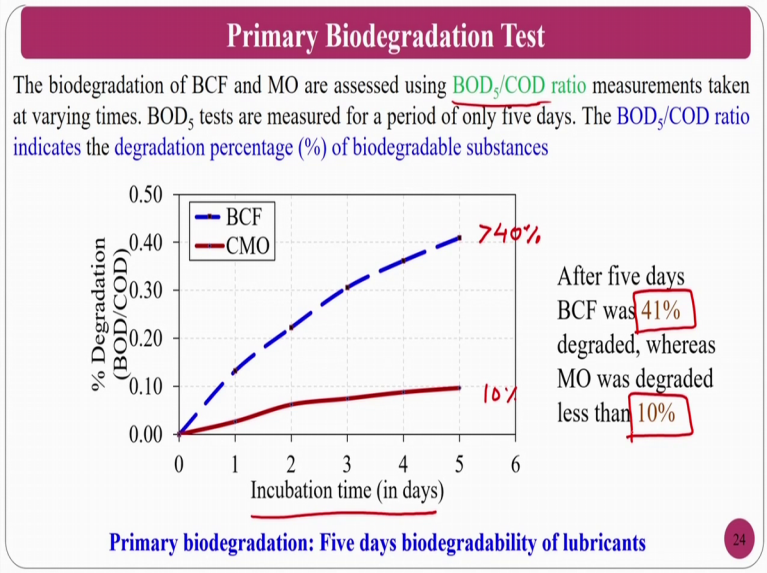

Primary degradation test, if you see the primary degradation test it is BOD 5 by COD ratio that is nothing, but biological oxygen demand that you are doing for 5 days to the chemical oxygen demand with respect to incubation time. As you can see here it is degradation is approximately above 40 percent, here it is less than 10 percent ok. So, after 5 days biological cutting fluid is 41 percent and it is a maximum is 10 percent.

There is a analysis I think it will come in the next slides in a 5 day test, that is primary preliminary degradation test if the degradation is above 40 percent; that means, that your cutting fluid is completely biodegradable majorly it is biodegradable if it is less than 20 percent means it is non-biodegradable.

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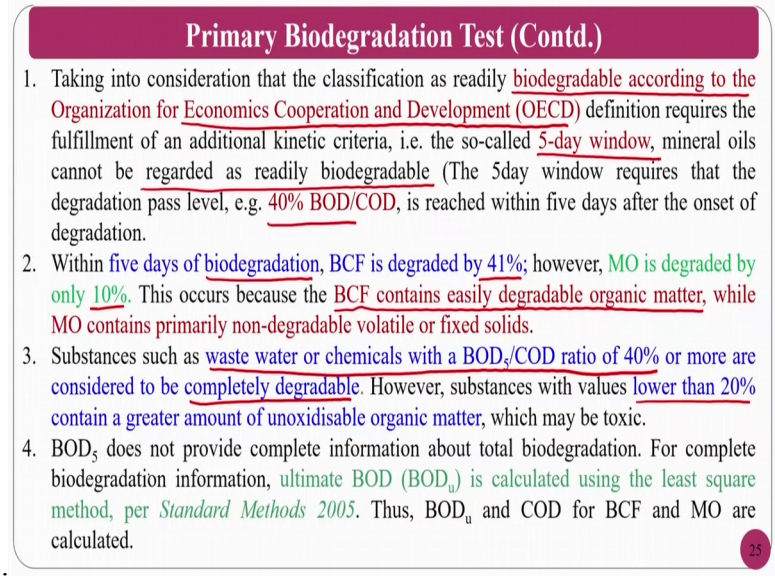

Taking into consideration of the classification of biodegradable according to the organisation for economics and corporation development definition is so, called 5 days window, mineral oil cannot be regarded as readily biodegradable because it is less than 20 percent which is 10 percent in fact, in the previous slide, but our cutting fluid that is biological cutting fluid BCF bio cutting fluid is above 40 percent. So, it will degrade; that means, that it is biodegradable.

With 5 days test of biodegradation BCF degraded by 41 percent and this is degrade by 10 percent; that means, that BCF contains easily biodegradable organic matter, but the other commercially mineral oils that is nothing, but you whatever the petroleum based cutting fluids normally the companies most of the companies are using most of the workshops are using these are non-biodegradable ok. So, people who are listening to the class should think about it, because people are going against plastic single use plastics similarly there is machines like swatch bharat. These are all things are used in polythene and polythene is also a polymer and which is coming from petroleum products and this also coming from petroleum products.

So, you should people who are working in a manufacturing arena. So, you should think about this also to make swatch bharat for the manufacturing staff ok. Substances such as waste water or chemicals with BOD 5 ratio above 40 percent are more considered to be completely degradable ok. As I said if it is lower than 20 percent it is non oxidizable or

non-biodegradable. BOD 5 does not provide you complete information there is a preliminary experimentation

Assume that it is giving 41 percent in ultimate biodegradability we cannot confirm whether it is 100 percent degradable because it would not give 100 percent clear idea, but you have to go for that test also. So, the doubt is that 100 percent degradable are not is a concern. So, it may be 95 percent degradable or 97 percent degradable or 92 percent degradable or 91 percent degradability ultimately we have to check.

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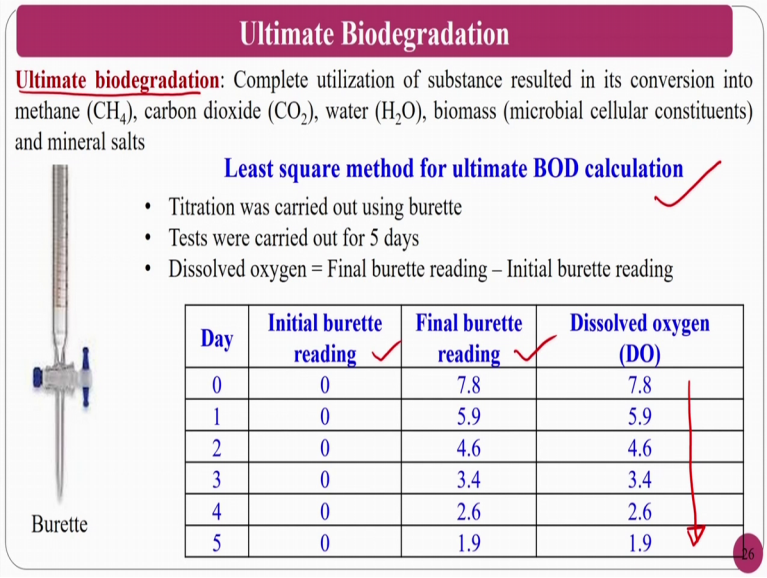

For that purpose we have to go for ultimate biodegradation test that is called ultimate biodegradation test, where we will use the least square method which is using the burette, final burette, reading initial burette, reading and dissolved oxygen and all those things we will see, and this is used by least square method which are standard papers are there you can go through those standard papers, to calculate this ultimate biodegradability and other things ok.

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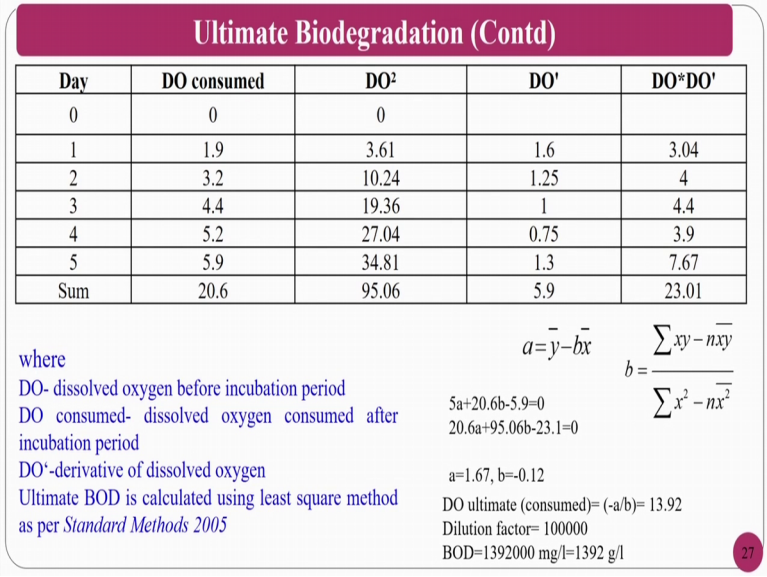

So, as I said ultimate biodegradability dissolved oxygen consumed dissolved oxygen square and the derivative, then all this things will give you the ultimate biodegradation. So, primary degradation you have done from there, you can calculate using least square method and you can come up with ultimate biodegradation ok.

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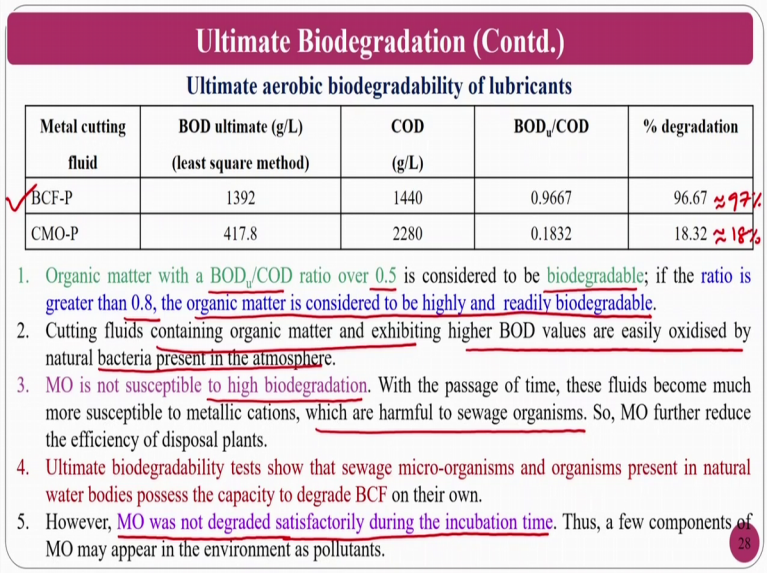

So, ultimate biodegradation if you see in this particular thing it is BCF pure; that is pure biological cutting fluid degrades by 97 percent approximately and it is approximately18 percent; that means, as I said it is going to dump into the river if you are going to dump

into the river, you should take care that even the product cast is slightly high I request the companies to look into this factor from the point of environment and try to use the bio cutting fluids or if not, there are abundant amount of vegetable oils available at economic prizes in India. So, people can go for those type of oils like coconut oil, jatropha oil many other palm oil these are the oils are available. So, people can use by blending as per the requirement ok.

So, organic matter that is BOD ultimate by COD ratio is 0.5 is considered to be the biodegradable if the ratio is greater than 0.8; that means, organic matter is considered to be highly and readily degradable; that means, that if my ratio value is came around 97 percent; that means, that if it is above 80 percent it is ready to degrade; that means, that my bio cutting fluid which I have I am using in my experiments; that means, that I can directly dump into the water body and the water body, the organisms algae fungi fishes whatever the things are there they will readily degrade there is no problem to the organ.

But if you are using the petroleum based cutting fluids, it has a danger. Cutting fluid containing organic matter exhibiting higher BOD values are easily oxidizable by natural bacteria present in atmosphere, at the same time mineral oil is not susceptible for high biodegradation because this value is approximately 20 percent maximum. So, in that circumstances this is very harmful for sewage organisms and it is also very dangerous for the water bodies. The ultimate biodegradability test shows that the sewage of microorganisms and organisms present in the natural bodies possess the capacity to degrade BCF on their own; that means, that the micro organisms that are there in a sewage or in a pure water bodies or the river bodies or the lake bodies are capable enough to degrade the bio cutting fluid, but not the mineral oil.

However, mineral oil is not degradable satisfactory during the incubation time this is what; that means, ultimate or the bottom line of the story is that, if you are going to use biodegradable cutting fluids what you are going to achieve is, you need not to do anything you directly dump into the river body. And, the organisms bacteria fungi whatever the things are there in the water body, can readily degrade it, but not the commercial mineral oil, my so, my request is to use the biodegradable cutting fluid.

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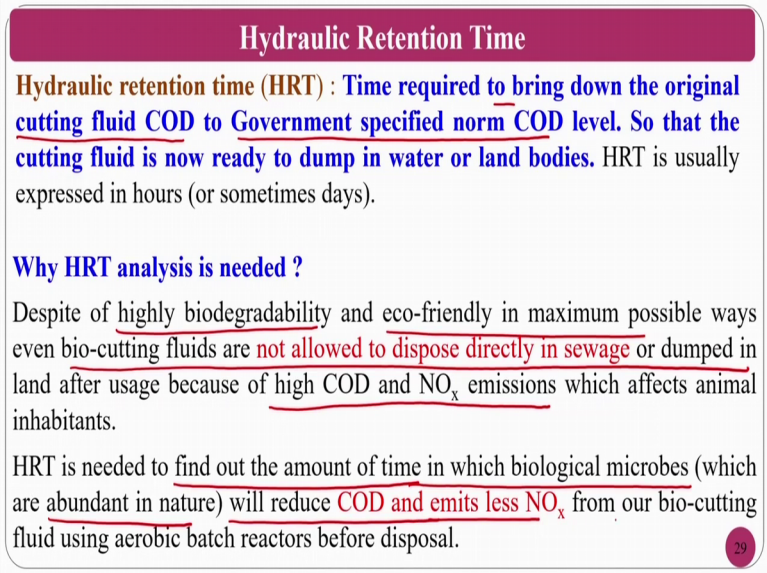

Hydraulic retention time this is the time required to bring from the original COD level to required COD level; that means, it is a time taking normally in terms of many or in terms of hours in terms of, the days it is the time required to bring down the original cutting fluid COD to the government specified COD assume, that the original COD is 2000 and the government specified is 200. If your COD levels are 200 then only you have to release into the water that is the rule, then the time in a reactor to degrade or to make the COD from 2000 to reduce the COD from 2000 to 200 the time required is nothing, but hydraulic retention time ok.

What is HRT analysis despite of high biodegradability and eco-friendly in the maximum possible ways, bio cutting fluids are not allowed to dispose directly to sewage because of high COD NO x emissions as I said, you cannot dump even though it is biodegradable if it is a COD level is slightly high, you have to reduce it to 200 if the original is assume that even though it is biodegradable and your limit 500 in a bio cutting fluid also, you have to reduce as per the government norms 200 how to reduce it then only you have to dump.

That time in the reactor in the factor you have to have a separate reactor in the factory and you have to do it then you dump it there is no problem ok. HRT is needed to find out the time in which the biological microbes which are abundant in nature will reduce the

COD and emits NO x from our bio cutting fluid using the aerobic batch reactors. So, this microbes will do the COD and releases NO x and other things ok.

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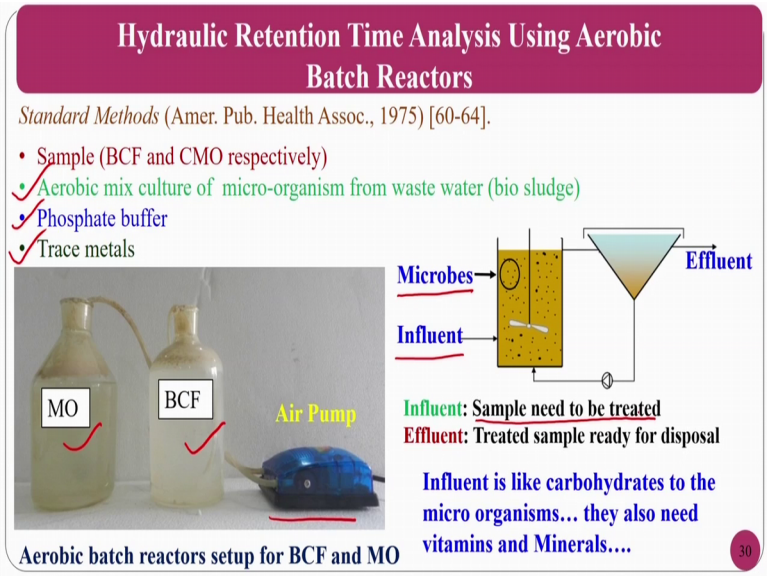

Batch reactors normally you can see here there is air pump what will happen sample aerobic mix culture is there phosphate buffer is there and trace metals are there, and other things are there influent what is a influent is that the sample needed to be treated; that means, that the cutting fluid that I am going to use or the cutting fluid that is after the machining operation or the grinding operation that I am going to use you use and effluent is a treated sample ready for disposal ok. There is a different between influent and effluent influent is my used cutting fluid I am putting, then I am putting a microbes then I am extracting after HRT time the effluent now effluent I can dispose it ok.

So, influent I cannot dispose effluent I can dispose. Influent is like a carbon carbohydrates to the micro-organisms they can need you gives the vitamins and minerals; that means, that microbes are there who are giving the cutting fluid or other things what will happen you are giving indirectly that is one type of food to them. So, that they will eat and they will gain energy and other things ok.

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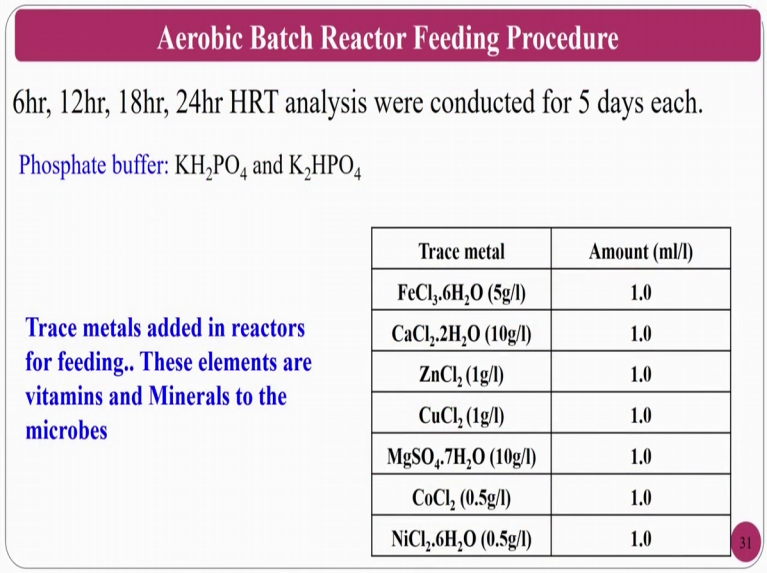

So, normally buffer solution and other things if you see 6 hours, 12 hours, 18 hours 24 hour HRT analysis who conducted normally these are the phosphate buffer solutions, you can use the trace metal and amount how much amount trace metals are added in the reactors for feeding these metals are vitamins and minerals for the you have used the used grinding fluid. Now, you have to add the minerals and vitamin because assume that a particular person is there you need lot of minerals and vitamins. If you daily take rice, rice, rice you are not going to lead healthy life. So, you need to take the vitamins minerals and other things like that the people also give these trace elements to the reactor or to the organisms that are there in the microbial reactor ok.

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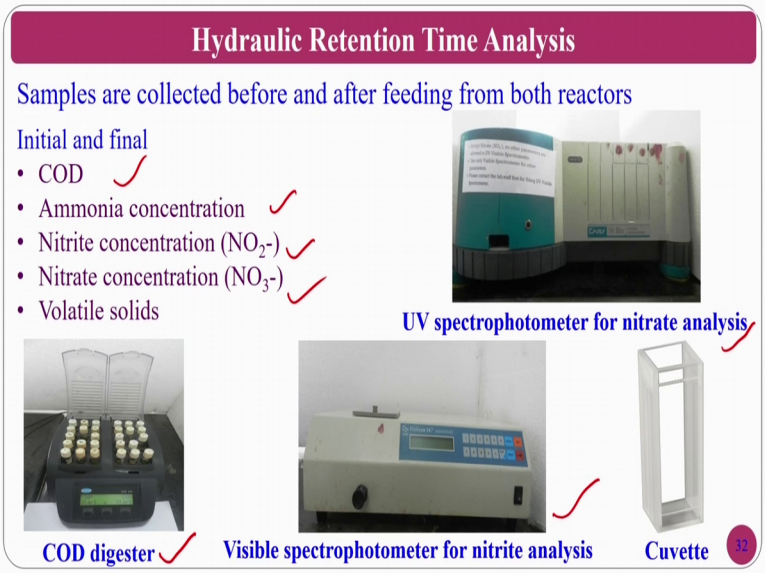

So, samples normally ammonia concentration COD these are all will be tested by using the COD digester UV spectrophotometer, for nitrate analysis cuvette where you keep the sample visible spectrometer for the nitrate analysis all these things are the some of the equipments that you required at laboratory scale to test the COD BOD analysis and other things.

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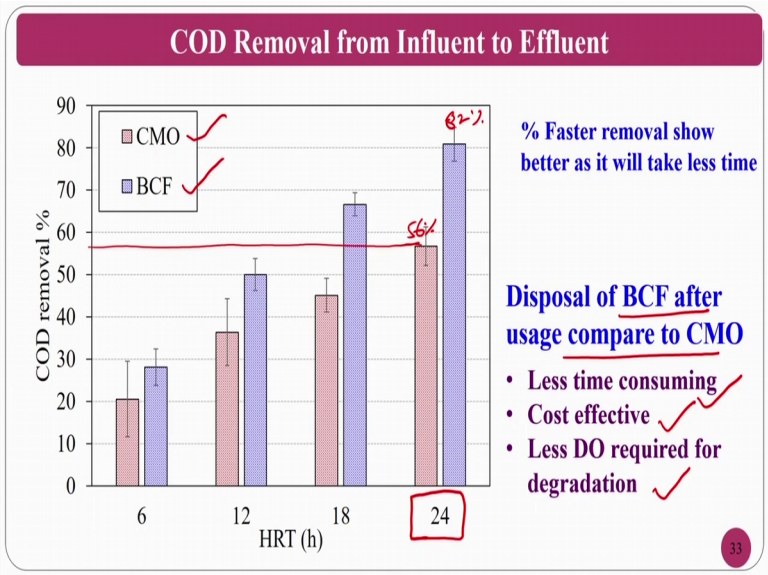

If you see here COD removal in the commercial mineral oil and BCF that is biological cutting fluid, in all the cases the COD removal for the same time assume that I am going

to take for 1 day 24 hours what is going to takes place? Here it is like 56 percent or something, here it you can see it is 82 percent or something ok; that means, that faster removal show better and other things then you can (Refer Time: 46:29) what I mean to say is here is BCF will degrade at faster rate. That means, you require less time to degrade BCF compare to your mineral oil. Disposal of BCF after the usage compare to mineral oil it is less time consuming cost effective and less dissolved oxygen is required it has beneficial to compare to the mineral oil ok. It requires less oxygen, its required less time its required many many things in a lesser compared to mineral oil ok.

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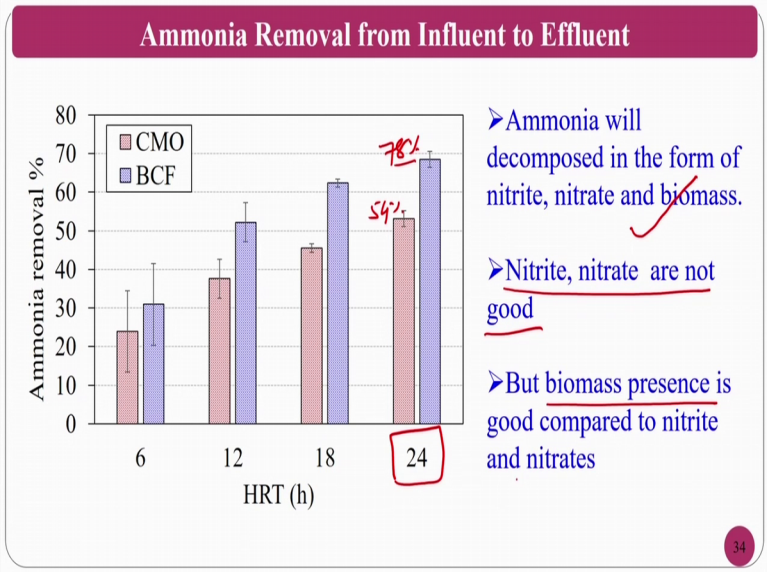

Ammonium removal also if you see here it is also in the biological cutting fluid for one day if you take in this condition also it is 56 and it is like 78 percent or something it is like 54 percent or something ok. So, ammonia will decompose in the form of nitrite, nitrate and biomass nitrites and nitrates are good and, but the biomass presence is good compared to nitrite. This normally these are the world tile solids that remain so, that will also help the system.

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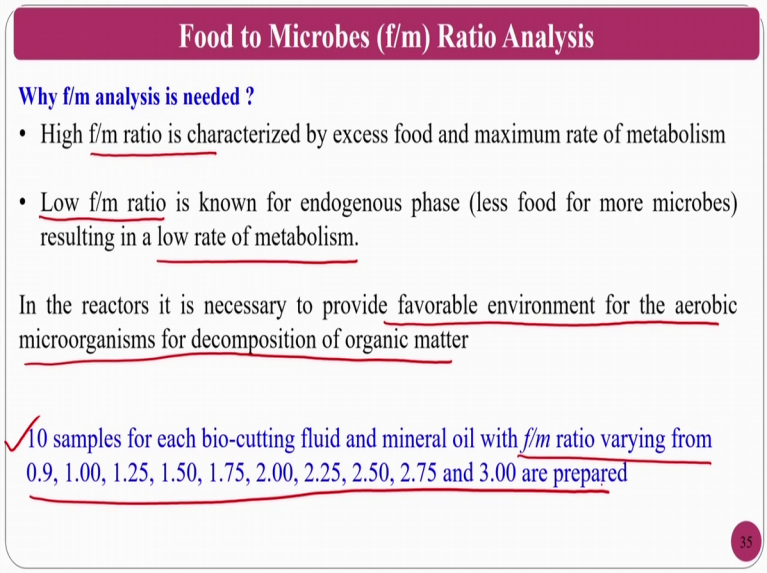

So, next comes the food to microbes ratio what is food to microbes ratio? The food to microbes ratio is high; that means, that excess food you are giving if the food low food to microbes ratio is nothing, but it is result in low rate of metabolism, in that circumstances you have to give optimum food to microbes ratio ok. Anyhow, if you are not understanding you may understand in the next slide, in the reactor it is necessary to provide favourable conditions to the aerobic microorganisms for decomposition of organic matter. This is 10 samples for bio cutting fluid and mineral oil with food to microbes ratio varying these are all the things were prepared.

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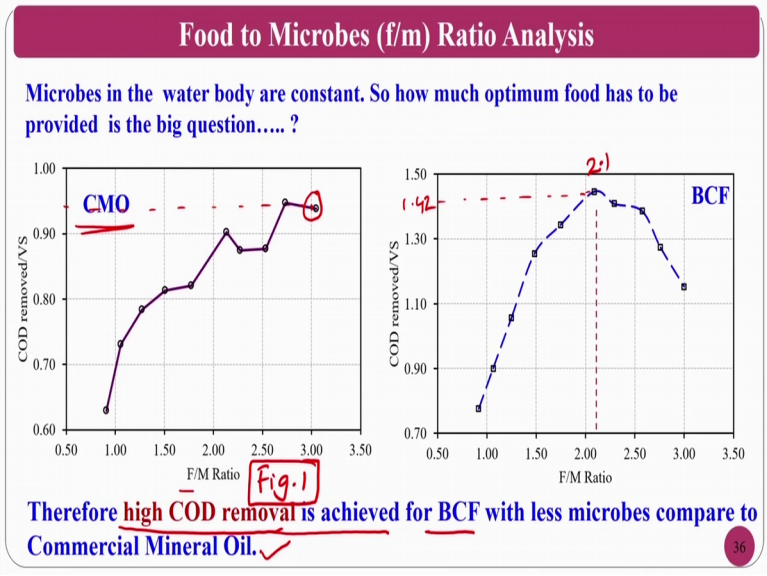

And you can see here just who have that understood what is food to microbe ratio and other things, you take figure one where you are talking about commercial mineral oil ok. So, I am using the food to microbes ratio; that means, that I am giving food; that means, a minerals vitamins and other food I am giving food to microbes ratio even though I am giving up to three my COD is approximately less than 1 ok. But however, at two point something that is 2.1 around, my COD level if you see for the bio cutting fluid it is approximately 1.4 or 1.41 or something like ok; that means, that even though I am supplying food to microbes ratio less I can degrade the bio cutting fluid.

This is the thing at the laboratory level what is the inner meaning of this one what is the inner meaning of this one is assume that I am going to dump this cutting fluid into the river or I am going to dump this in to the water body. If microbes are less and food also to them is insufficient, still these micro-organisms can degrade the bio cutting fluid, but not the commercial mineral oil hope you understand. I will repeat again if you are going to dump this cutting fluid into both cutting fluid into the water body in that circumstances what you are going to even though your food is less even though your micro-organisms are less still you can degrade by your cutting fluid rather than commercial mineral oil.

Therefore, high COD removal is achieved for BCF with less microbes compare to the mineral oil ok; that means, that it is good you can dump readily and it easily without any problem because you are within the loss of government. Summary of this class what all we have done? We have two solutions one is biodegradation of the cutting fluid this is we have studied in this particular class and overview of grinding.

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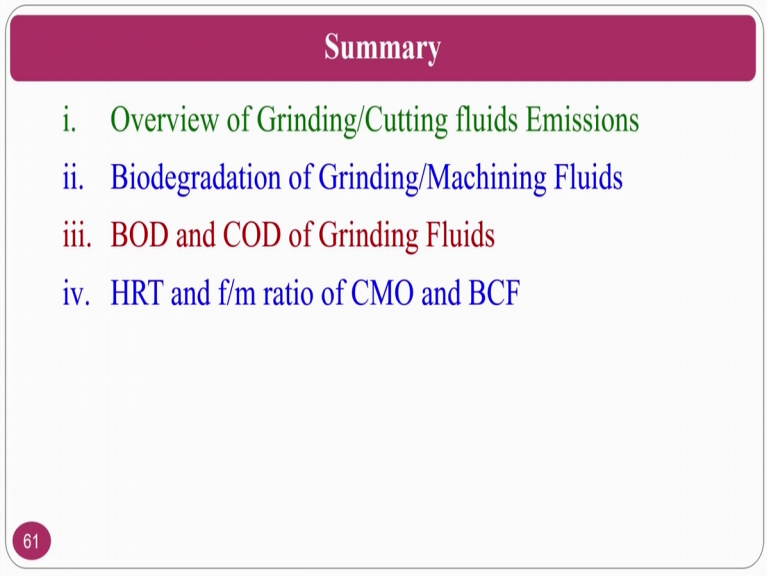

And cutting fluid emissions, biodegradation of grinding fluids, BOD, COD, HRT and f by m ratio.

Thank you for your kind attention and I will see you in the next class.