Physico-Chemical Processes for Wastewater Treatment
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Lecture 02
Environmental Acts and Standards

Good day everyone, and welcome to this second lecture of the course on Physico-chemical processes for wastewater treatment. And today we will be discussing regarding the, what are the various environmental protection agencies in India. What are the, which are the various environmental acts?

There are various standards, we will try to learn regarding the discharge standards, water treatment standards, and there are certain interesting things with respect to which is called as environmental impact assessment. So, we will be discussing only briefly regarding this, we will not be going into details, but to give an idea that we must know all these things, this is very important for environmental protection and in particular for wastewater treatment.

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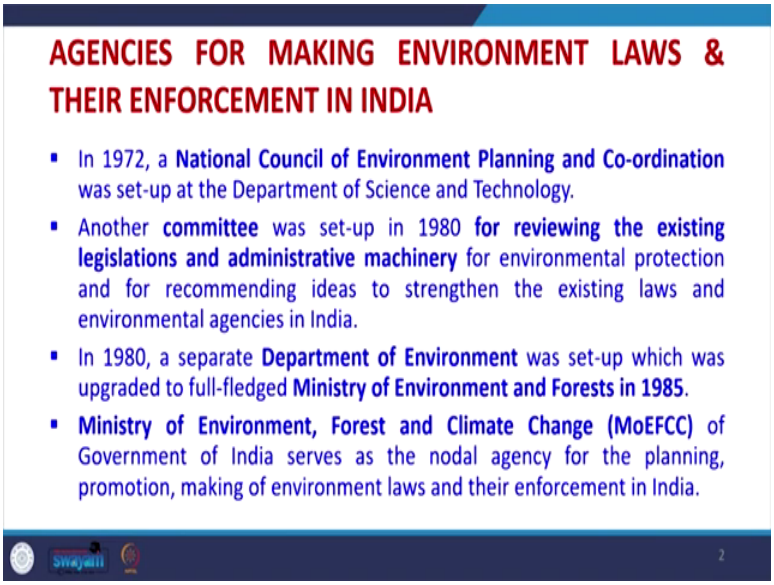

So, starting with there are many environmental laws and reinforcing agencies in India and which actually help in preventing the further environmental degradation and taking care of the environmental laws, which are made by these agencies and other agencies, which actually enforce these laws.

So, it all started earlier, there was in 1972, a National Council of Environmental Planning and Co-ordination was set up and under the Department of Science and Technology. And this council was set up so as to understand the needs of water, air and soil pollution, which will be there.

Now, after that another committee was set up in 1980 to review the existing legislations and administrative machinery, which actually build up little bit after the we got our independence and in particular, after 1972.

And these machinery, which were there for environmental protection and for recommending ideas to strengthen the existing laws and environmental agency is at this particular committee was highly helpful. And because of this committee, a separate department of environment was set up and which was further upgraded into full- fledged Ministry of Environment and Forest in 1985.

So, and in between the government of India passed some rules and regulations related to water pollution and control and similarly with respect to air pollution and control. So, these laws were made before actually this full- fledged ministry was made in 1985. Right now, this Ministry of environment forest was renamed as Ministry of Environment forests and climate change, because the climate change issues are now becoming more and more important.

So, this was also incorporated within this ministry. And this is the nodal agency for planning promotion, making environmental laws and enforcing the laws as well. Now, along with this particular ministry, there are other ministries, which are related to environment and water in particular. So, there is a ministry of Jal Shakti, or water and within that, there are two departments, one is called department of drinking water and sanitation.

So, this department in particular takes care of water drinking water availability and also sanitation all throughout the country. Similarly, there is a Department of Water Resources, river development and Ganga rejuvenation. So, since Ganga is one of the important rivers, so it tries to, along with the Ganga, for other river development and development of other water resources, this department takes care of all throughout the country and this is within the ministry of Jal Shakti.

Ministry of Rural Development, Ministry of road transport and highways, which includes the waterways also they have important role to play in the protection of environment and water related activities. Similarly, the ministry of Culture has a role to play in all such activities.

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Along with these ministries, there are many agencies, which are there, which are related to environment and its control and all the pollution aspects they are taking care of. So, two most important agencies are like CPCB. So, CPCB at the central level this is called Central pollution control board.

So, actually it mandates whenever there is a problem, it understand okay there is a new type of issues are evolving with respect to environment, or pollution. So, they always make a committee and depending upon the committee's new rules, regulations etc., may be made.

And then there are there are state pollution control boards, which are there in each and every state. Similarly, there are union territories environmental committees, which are there each and every environmental Union Territory. And they have to see that the whatever rules and regulations are made by the ministry, or center pollution control board, they have to be enforced.

So, enforcement lies with the state pollution control board and UT environmental committees. Sometimes these state pollution control board and UT environmental committees can also have a stricter, standard with respect to discharge up any water from any industry, or otherwise.

So, they can make little bit standards another thing, but generally they are in general enforcement agencies as compared to law making industries. In addition, there is a forest Survey of India, Wildlife Institute of India, the National afforestation and eco development board, the botanical and Geological Survey of India. They are highly engaged in environmental related activities.

Similarly, groundwater board and central groundwater authority are agencies which are related to groundwater. And they see that what is the amount of groundwater available beneath the ground in any reason and what is the, what is the level of composition of various, impurities, which are there in these groundwater where whether that groundwater is good enough for drinking, or it has to be treated further for drinking, or for irrigation also.

These groundwater boards continuously perform surveys and also testing for their uses of the groundwater for drinking, or any other uses.

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Now, there are many acts, rules and laws have been made in India with respect to environment. And these may be categorized into various categories like water pollution, the acts and rules related to water pollution, air pollution, environmental protection in general, public liability insurance act, then National Environment appellate authority was made under these rules and etc.

Then national environment tribunal, animal welfare, wildlife, forest conservation, biodiversity and IFS Indian Forest Service. So, there are different categories of Acts and rules. So, we are more interested in water pollution acts and rules. So, we will be discussing those.

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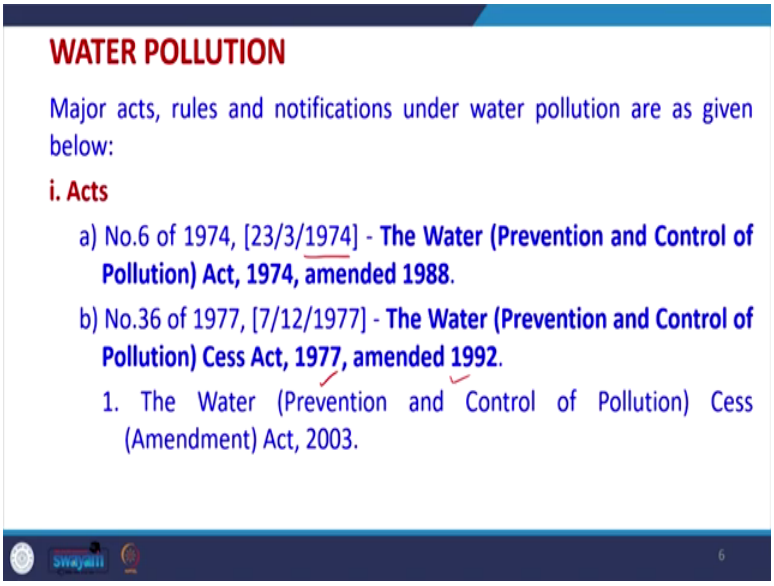

Now, one of the first water pollution related act was made in 1974 and it was called as Water Prevention and Control of Pollution Act 1974. And it was amended in 1988 also. Similarly, there was a Cess act related to water prevention and control Cess act. It was made in 1977 and it was amended in 1992. So, these were one of the first few acts related to water.

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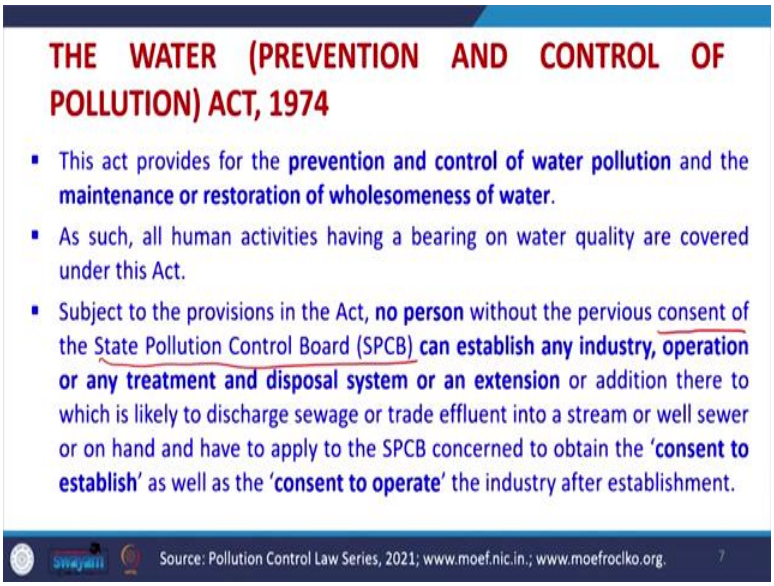

Now, regarding the Water Prevention and Control of Pollution Act 1974. So it provided for the prevention and control of water, water pollution, and the maintenance and restoration of wholesomeness of water in various aquatic bodies, including rivers, lakes, and reservoirs.

So, any human activity, which was having a bearing on the water quality of these aquatic bodies all such human activities were covered under this act of 1974. And under this act, no provision with no person without the previous consent of the state pollution control board can establish any industry, or operate any industry are can perform any treatment of disposable system.

In any such activity cannot be performed without the consent of the state pollution control board. So, it was one of the major points of this act. Also, it gave the consent to establish industry and after establishing the consent to operate the industry. So, this was provided by this act.

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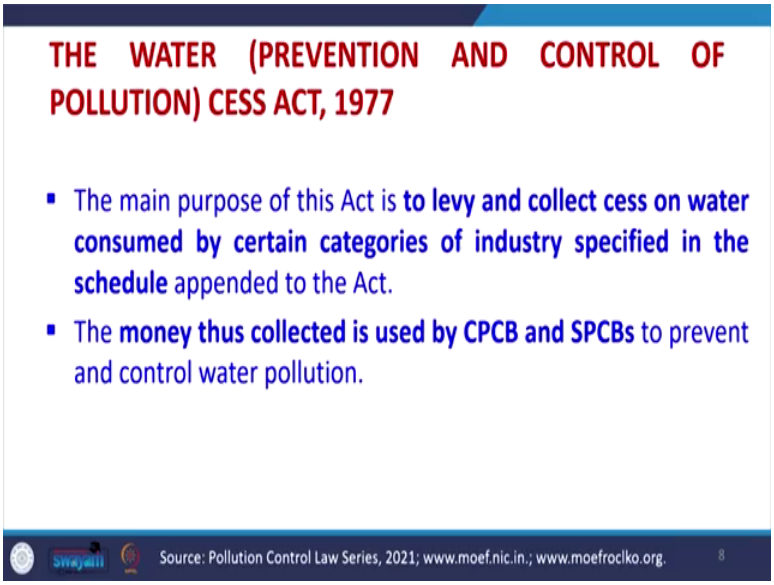

After that there was Cess Act 1977, And that was passed and it was done to levy and collect cess on water consumed by the certain categories of industry. So, this was done because if many industries take lot of groundwater. Now, if the water is after uses up that water in the industry, the water is being getting discharged in form of wastewater.

Now, if the wastewater pollution load is high, what they do is that they take out further water from the groundwater and dilute the water. So, it will come within the permissible limits. So, that is how they were actually taking more, they may take more groundwater from the ground, and thus, the groundwater levels were going down. So it this act actually levied Cess on the water consumed by these industries. The money thus collected was to be is used by CPCB and SPCB to prevent and control the water pollution. So, this is there.

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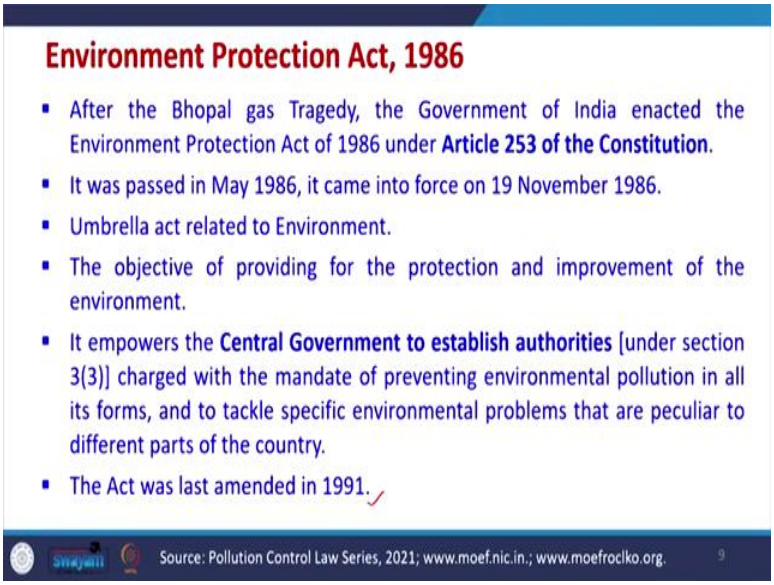

Then after in 1986. This is a umbrella Act was passed and this was foreseen after the Bhopal Gas Tragedy. After the Bhopal Gas Tragedy, the government of India felt that we should have a umbrella Environmental Protection Act and it was made in 1986. Under Article 253 of the Constitution. The act was passed in May 1986. And it came into existing in November 1986.

And this is considered Umbrella Act related to environment, because many other rules regulations et cetera have been passed under this Environment Protection Act. Now, the objective of this act was for the protection and improvement of the environment. And it actually gave a lot of power to central government to establish various authorities.

And these authorities were further given mandate for preventing the environmental pollution in all its form and also if any specific problem is arising and they see, so they can do studies and further make acts and rules. So, this was there. It was amended in 1991. And in 1994, there was a very important act rule related to environmental impact assessment was passed and that we will discuss later.

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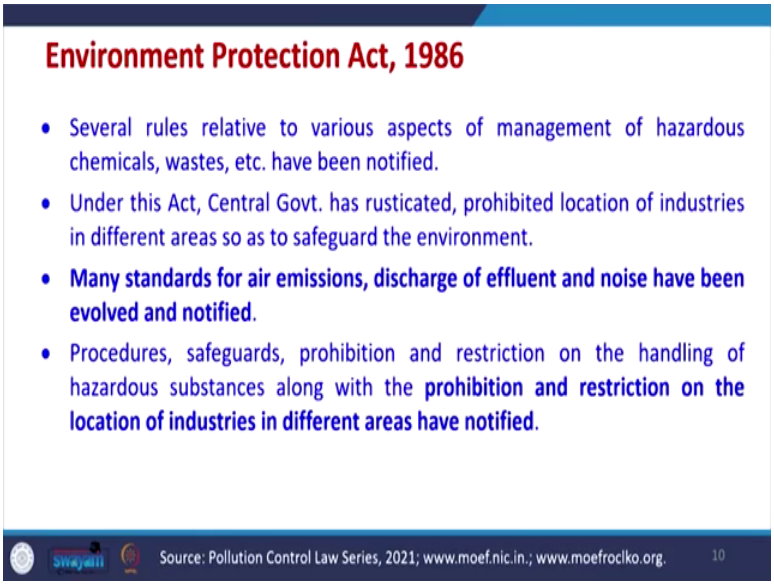

Now within this 1986 Act, several rules related to various aspects of management of hazardous chemical waste, etc., have been notified, also under this act central government has acted rusticated, prohibited a lot of industries in different areas to safeguard the environment.

Many standards, the standards with respect to what should be the quality of air, or water from in any reason, or for various uses, or for also for discharge of effluent from these industries, similarly with respect to noise have been evolved and notified under this Environmental Protection Act 1986.

So, this is considered an Umbrella Act. And under this, there are procedures safeguards provision and restrictions on the handling of hazardous waste. Similarly, a lot of new types of categories of waste are also being notified under this act including like E-waste, battery waste, hospital waste. So, everything is coming under this Environmental Protection Act 1986.

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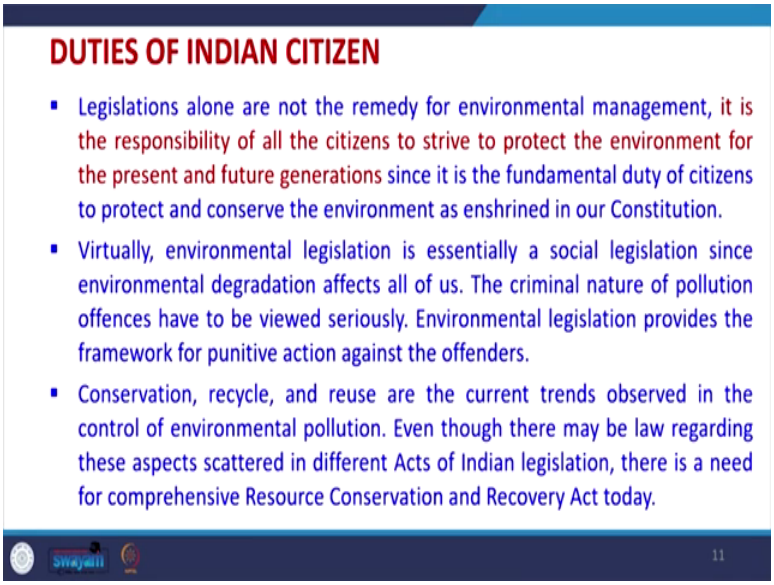

Now, these acts and rules, they also define certain duties of Indian citizen with respect to environment and legislations alone are not the remedy for the environmental management. So, it is our responsibility to strive to protect the environment for the present. And we should do all these things, so that we can the future generations must not be deprived of their resources and they must get all the resources that we are getting.

So, this is very importance of these duties were defined also under these acts and rules. Conservation, recycle, reuse, they are absorbed all around the environmental pollution acts and rules, but there are issues which are there with respect to enforcement of these acts and rules by the state pollution control board, or by central pollution control board, or UT environmental committees.

We must understand as citizen that there are only a limited number of persons working in these agencies. So, it is our duty to protect the environment, if any industry we foresee that we see that they are not following the rules and regulations, maybe we must convey this to the agencies. So, that those industries must start following all the acts and regulations and also do not degrade the environment.

The problem of environmental degradation is a very, very complex and it requires a multi-dimensional approach. So, it is also the duty of the citizens to take care of all these aspects.

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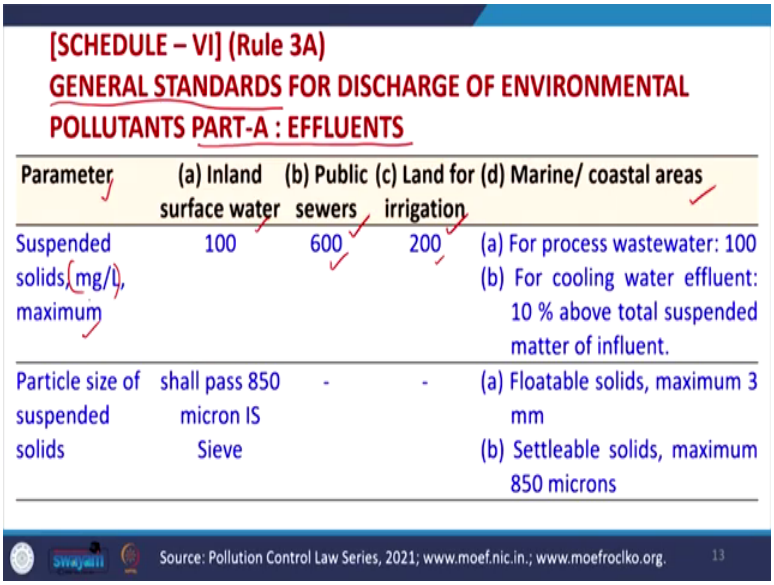

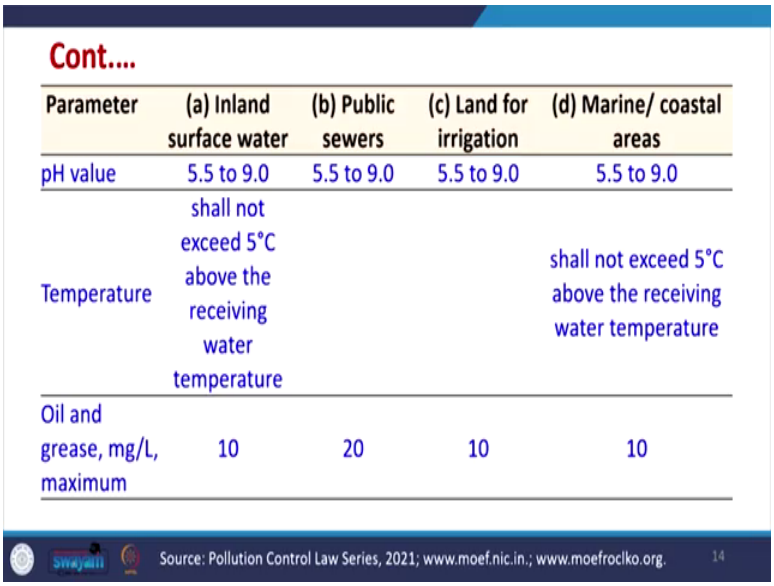

Now, there are many standards have been made for protecting the environment. So, there is a one standard which is not I am not listed here, there is standards with respect to air emission also, there is standards with respect to noise, but in this course, we will be since we are concentrating only on wastewater treatment. So, we have mentioned only the standard which are there with respect to water.

So, one of the first standard, which is there with respect to general standards for discharge of environmental pollutants. And in particular for effluents, which are discharged from industries for those cases, there are certain maximum allowed concentration. So, that means, this is for

suspended solid in this particular unit milligram per liter. This is the maximum allowed concentration.

Now, in India, I had told that any water discharged from industry may have different uses, we may have to discharge the effluent to the surface water to the public sewer, for irrigation in the agricultural fields, and it is possible that we may have to discharge effluent to in the marine, or coastal areas.

So, for in India there are different sets of maximum allowed concentration limits for all these four categories. And these four categories are like inland surface water, public sewers, because public sewers are further been treated. So, here there is a relaxation if any industry discharges any of its effluent to the public sewer.

Now, if that industry water can be used for irrigation, then certainly the limits are a little bit relaxed, because for irrigation we can use the treated water. Now, similarly for marine and coastal areas standards are there. So, we can see there are four different standard limits, many times they are same, many times all four have different values, depending upon the parameter for which standard is being set. So, these are called general standards.

Now, there is another industry specific standards also, which have been made in India. So, we will be discussing that later on. So, we can see here there are different sets of parameters like suspended solids, particle size of suspended solids. A pH value worksheet with a pH value.

So, we can see the general limit is from 5.5 to 9, but it may be it may be much lower range may also be there, it may be 6 to 7 also depending upon the industry. Similarly, for temperature there is also a rule and then oil and grease.

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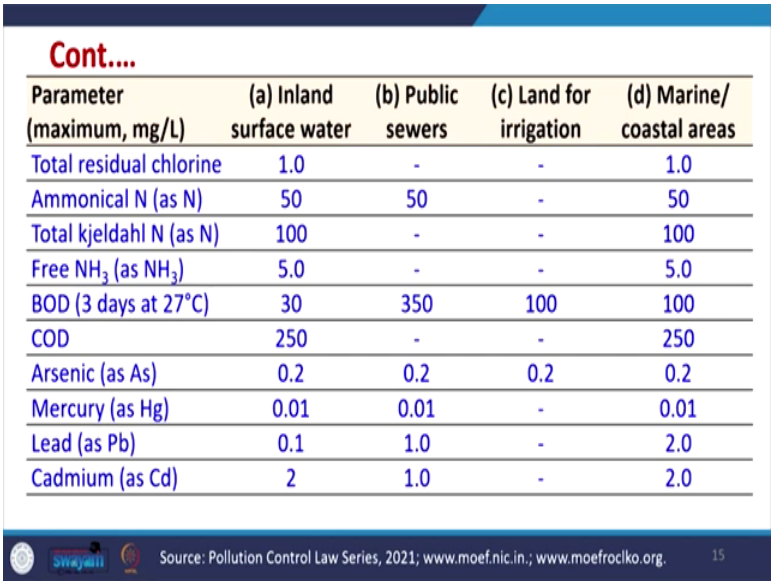

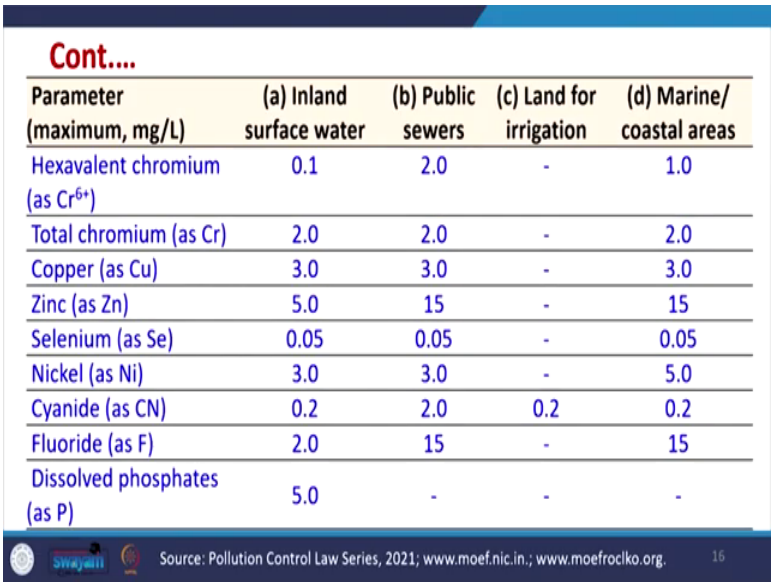

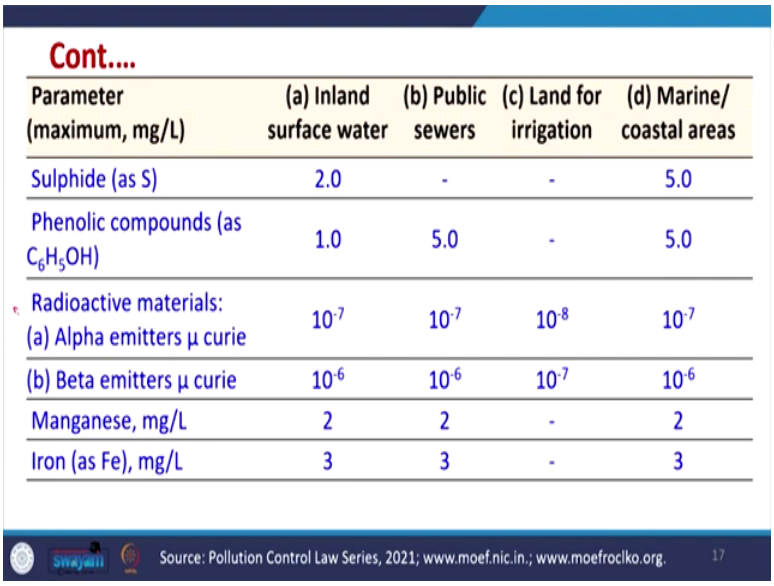

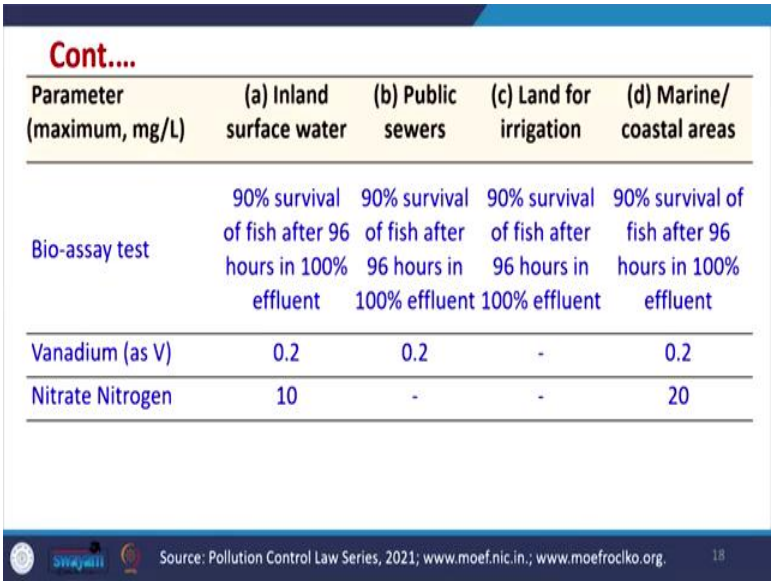

So, there we can see total residual chlorine, Ammonical nitrogen, total kjeldahl nitrogen, free ammonia, BOD, 3 days at 27 degrees centigrade, COD, Arsenic, Mercury, Lead, Cadmium, hexavalent, chromium, total chromium.

So, we can see a large number of parameters are listed sulfide, phenolic compounds, radioactive materials are also listed if they are likely to be present. Then some bio assay tests, etc., can be performed, Vanadium, Nitrate Nitrogen etc. So, all these limits have been set.

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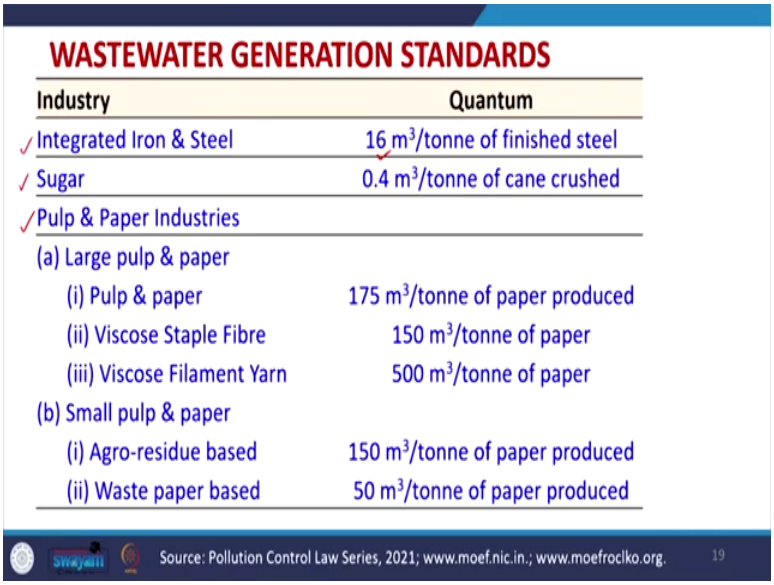

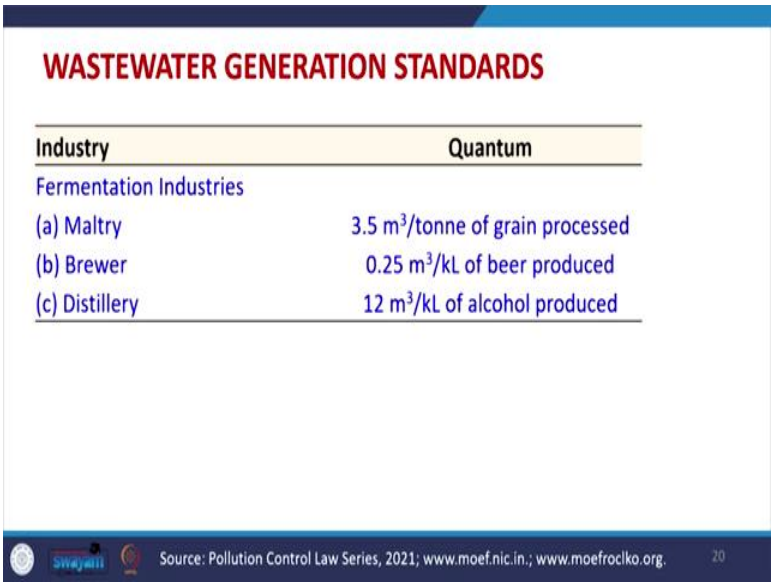

Now, what happens that earlier I have told, so these are limits have to be followed by industry. In addition there are industry specific limits also, where for some key parameters the limits will be much lower than what is mentioned in the general standard.

Now, there is a possibility as mentioned earlier that these industries may start using more amount of water and dilute these effluent. So, that the standard limits may become less. So, there is after studying the technology, which is there in any industry some wastewater general generation Standards have been also device.

So, what are these that how much amount of water can be used per tonne of any finished product. So, like for integrated iron steel it is 16 meter cube per tonne of finished steel. Similarly, for suger 0.4 meter cube. So, there are a large number of standards which are like how much wastewater can be generated, it is not that we can generate any amount of water and it is related to how much amount of any finished product is being produced.

So, there are standards are pulp and paper industry, sugar industry, iron and steel. Then fermentation industries. So, these all those industries, which use very large amount of water these wastewater generation standards have been set.

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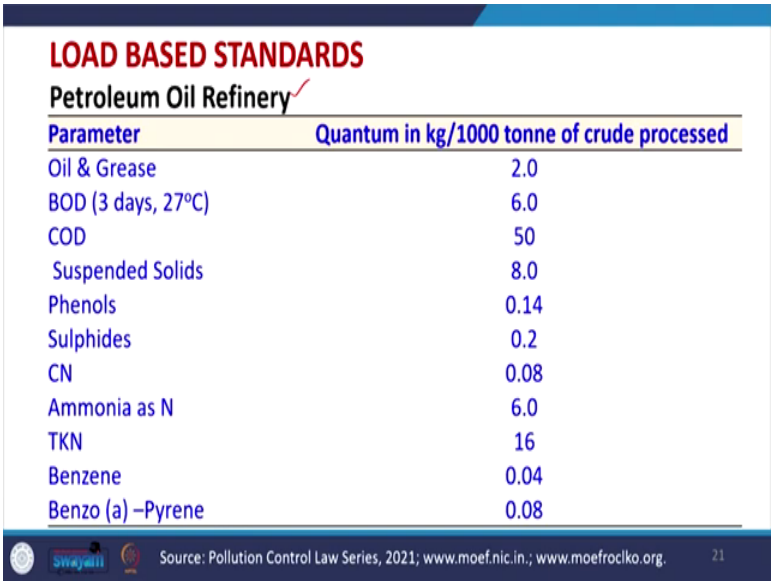

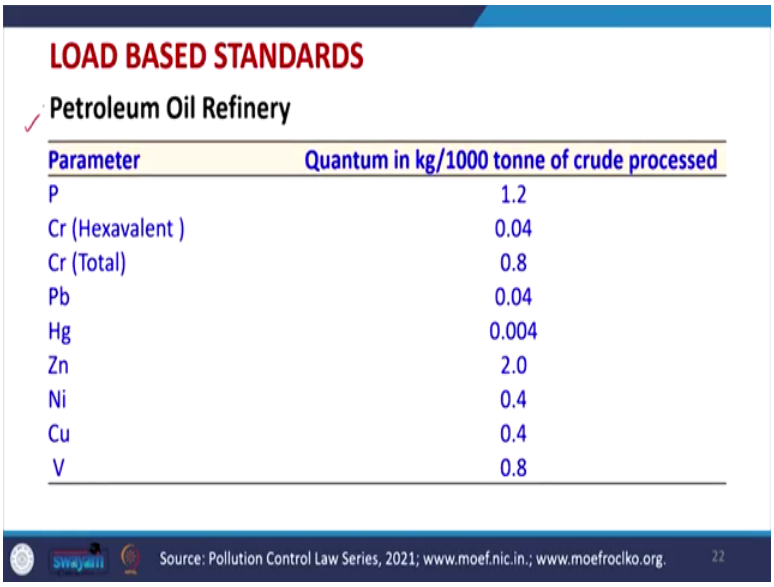

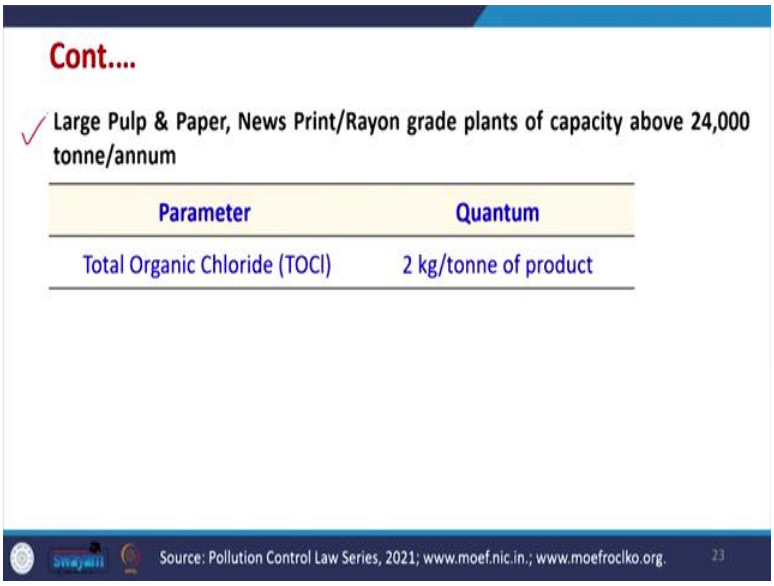

Similarly, load based standards have been set, that how much oil and grease you can generate per tonne of any finished product, or raw material process. So, if you process this much amount of raw material, how much amount of any particular pollutant you can generate, or any particular parameter what should be the maximum value.

So, for petroleum oil refinery you can see here, oil and grease can be maximum 2 kg per 1000 tonne of crude process. So, there are a number of other standards you can parameters you can see here. They are listed BOD, COD, suspended solids, phenols, Sulphides, cyanides, ammonia and many others. Similarly, for petroleum oil refinery, these parameters have been set. For large scale pulp and paper mill etc. These standards are set.

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So, in addition to various standards, which are generally standards. Minimal national standards have been specified by CPCB, for various types of industries. And these MINAS standards vary from industry to industry. So, CPCB actually laid down a specific standard for effluent discharge from these industries and the standards a clear made taking care of the techno economic feasibility of the processes which are being followed in that industry.

So, that means, we were trying to see that the economic aspects are still met while following these minimal national standards. And under these standard these MINAS standards can never be relaxed. So, and SPCB, the state pollution control board has to see that always these minimal national standards are being followed.

Now, the MINAS standards can further be made stricter by the state pollution control boards, if they find that okay, there is a requirement of making these standards stricter in that particular reason of that the state, or in the overall all the parts of the state. So, this is SPCB, the state pollution control board is empowered to make these standards restricted, but can never be relaxed under any condition.

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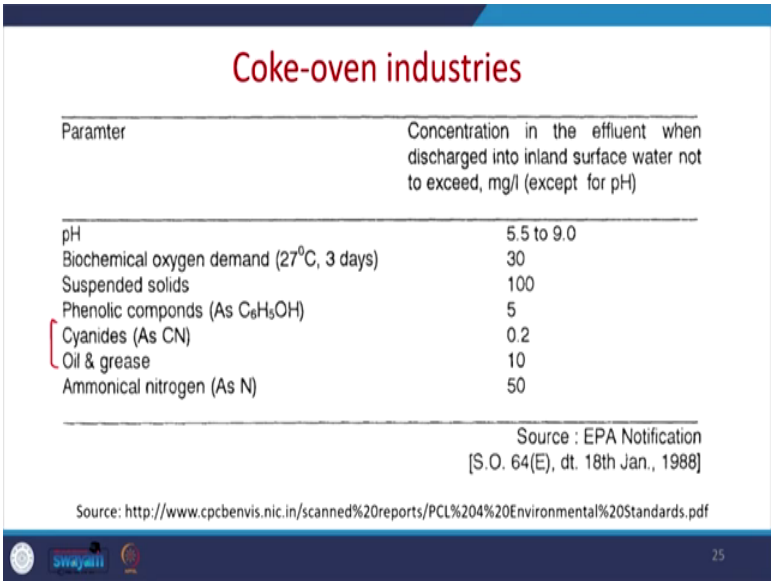

So, this is the one example is given for here coke-oven industries. We can see these are the standards which have been laid down under the EPA notification 1988. And we can see one of the key parameters like cyanide is mentioned here. So, cyanide is one of the important parameters, it is for coke-oven industry.

So, they have made it a specific maximum concentration limit with respect to cyanide, oil and grease as well as ammonical nitrogen from these industries so along with the phenolic compounds. So, similarly MINAS standards have been made for a large number of industries. And there have different sets of parameters, which may be industry specific like for tannery there is a parameter for chromium.

Similarly, for another industries depending upon the raw material being used, and the product being produced, other parameters may be different, but they are likely to be stricter with respect to general standards which have been made.

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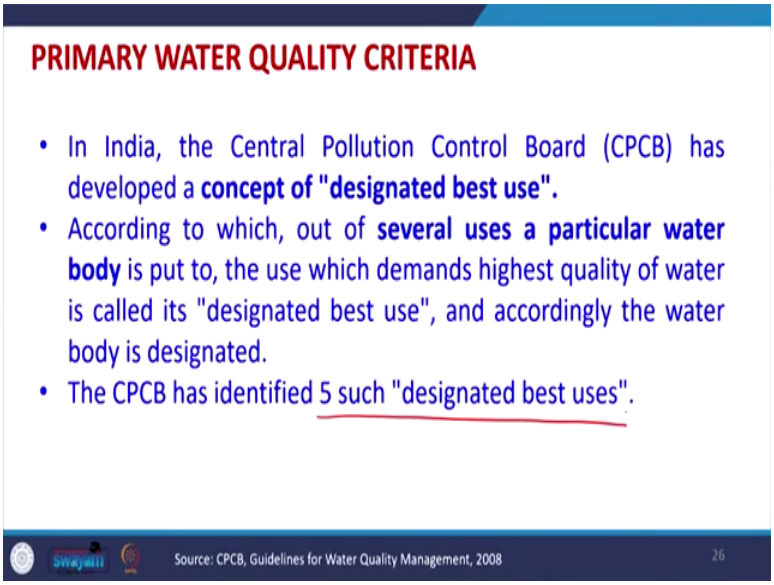

Now, in addition to this minimal national standard, the CPCB also has developed a concept of designated best use of any water body, depending upon the water quality, which is present in that aquatic body and this is called as primary water quality criteria. And this depends upon the characteristics of water, which is there in that aquatic body. So, there are five such designated best uses, which have been prescribed by CPCB.

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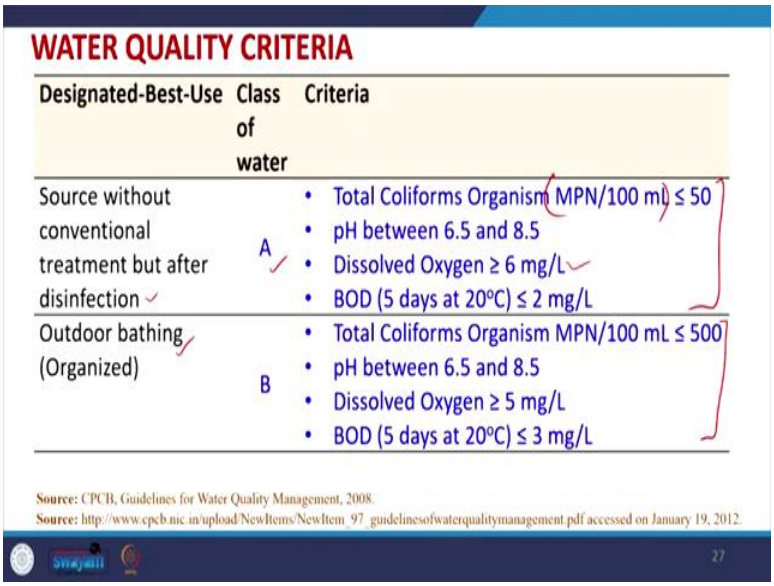

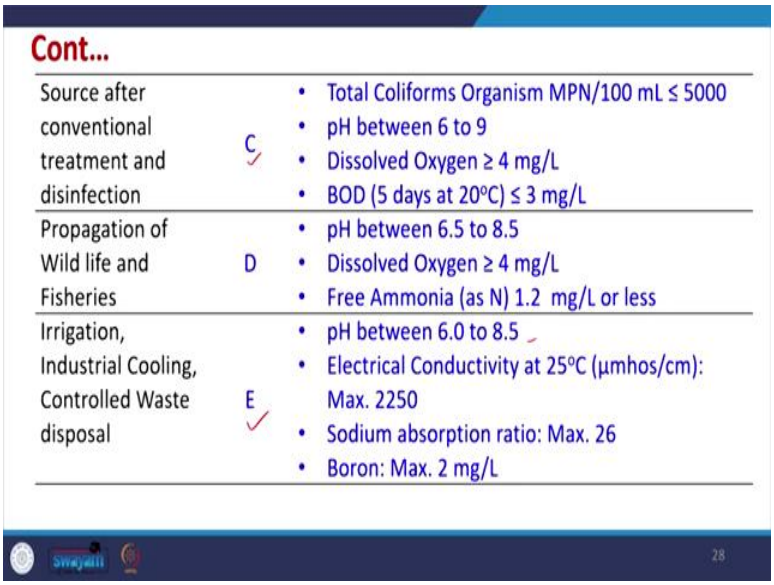

And they are listed in this particular slide. So, that if the source without conventional treatment, but after disinfection has these sets of it is meeting these sets of criteria, that total coliform organism in terms of MPN per 100 ML is less than 50, if pH is between 6.5 and 8.5, DO is above 6 milligram per liter and BOD5, or BOD3 depending. So, it is within the standard, then it is classified as the water quality criteria A.

Similarly, for outdoor bathing, these are the standards. So, any water body, which meets this criteria can be used for bathing. Otherwise, we have to see that there should be no bathing done in that water body. Similarly, for there is C, D, and E class. And these are the designated best uses and how like for irrigation, industrial cooling and controlled waste disposal, the pH should be between 6 and 8.5.

Electrical conductivity at 25 degrees centigrade should be maximum 2250 micro moles per centimeter. Then similarly sodium absorption ratio for irrigation should be maximum 26 and boron should be maximum 2 milligram per liter. So, these are the different standards with respect to water quality criteria that have been set.

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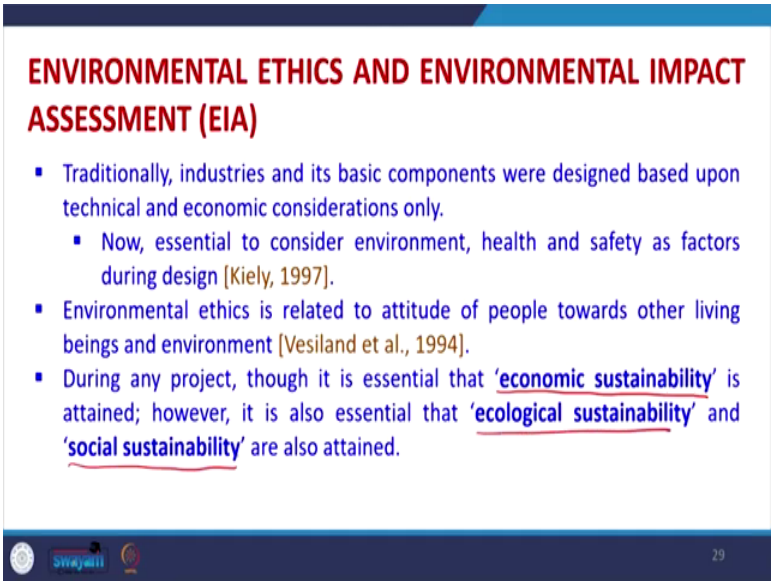

In addition, there are there are few things that we should follow and under that there is environmental ethics for the industries and there is a term which is called as environmental impact assessment and this is very, very important. So, environmental ethics actually, the industries by themselves should develop a practice by themselves so, as not to degrade the environment or pollute the environment by any means.

And during this environmental ethics, it also includes that all these industries and the society as large should use the resources and other things in such a manner that economic sustainability is attained. However, it is also seen that ecological sustainability and social sustainability is also attained. So, this everything, all the three aspects economic, ecological and social sustainability, they fall within the category of environmental ethics.

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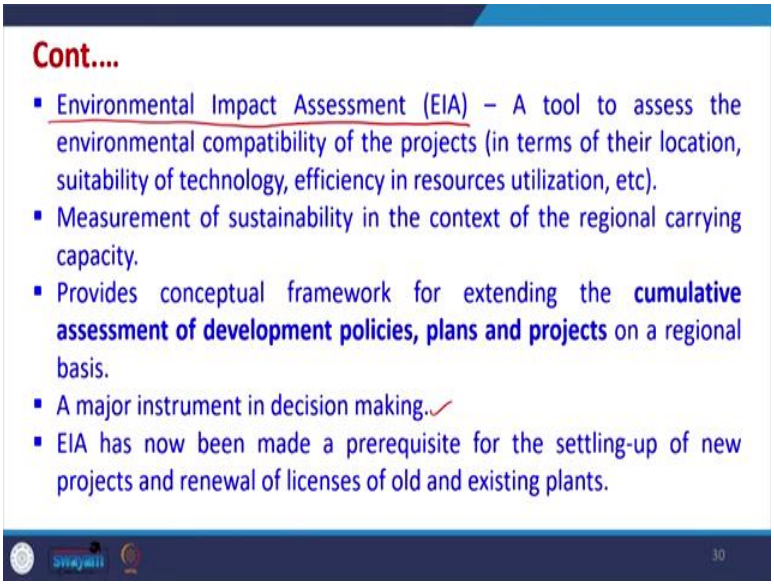

In addition, there is a term which is called as environmental impact assessment this is very, very important term and this was, this is under the rules of the Government of India. And this has to be this tool, or this impact assessment study has to be performed by each and every industry and many projects before actually the project is implemented at the ground level.

And this tool actually gives us the decision making capability. So, what does it do that in this EIA study, we have to perform a lot of studies with respect to air, soil, groundwater, ecology, and many other things that what will be the damage that will happen if that project is implemented.

So, for assessing this damage, what we have to do is that, we have to assess the present environmental conditions, which are there in that particular region, when there is, when that project is not implemented, and once the project is implemented, what will be the condition that will be there.

So, there are certain sets of rules, guidelines and other things are there and methodologies are there under EIA, and which help in performing this environmental impact assessment beforehand and via this we can decide whether that project has to be implemented or not. If there is a possibility of implementation of that project, what are the various technologies and other things that we can follow said that the impact on the environment is minimal.

If there is any impact on the environment, how we will take care of that impact, so, that it is further minimized, so, that there is virtually no impact on the environment. So, this EIA has been made a prerequisite for setting up any new project or renewal of license of old and existing plants. So, if the license has to be renewed, then we have to perform this EIA study.

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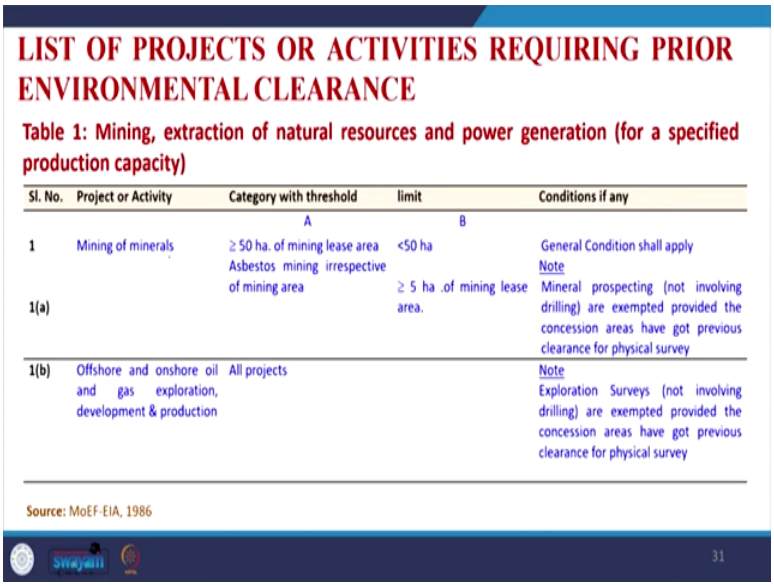

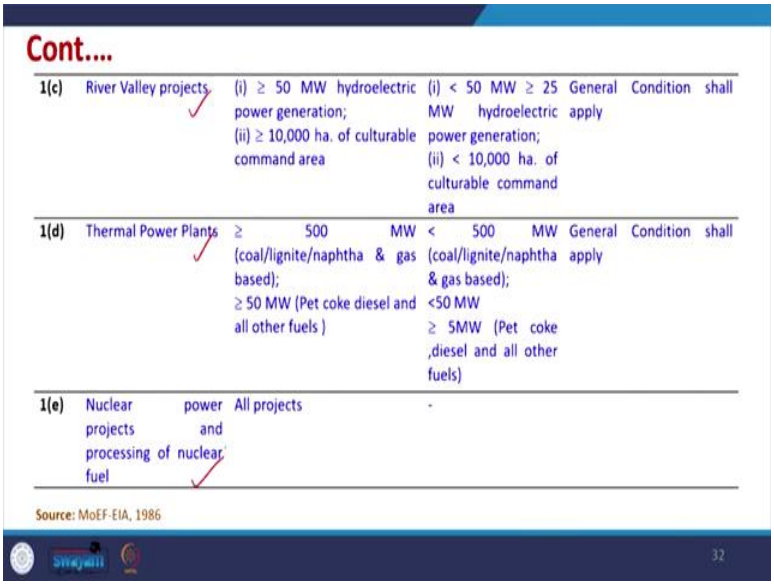

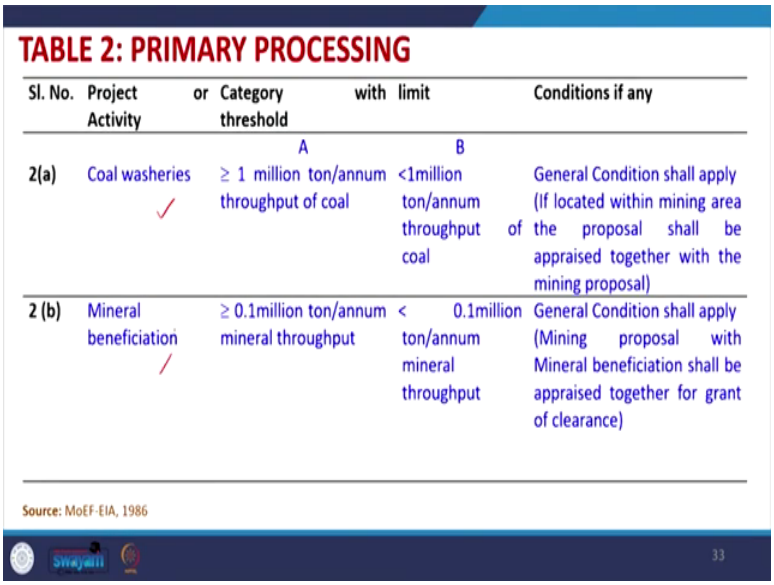

So, there are many projects and activities which require environmental clearances and they are listed here just for knowledge, we will not be discussing much in detail, but this is just for knowledge, like in the, like for mining, extraction of natural resources and power generation, we can see the various activities which are listed like mining of minerals, we can see thermal power plants, river valley projects, nuclear power projects, so, all these depending upon the various.

Now, these activity have a threshold limit that how much amount of activity is going to be performed. So, what is the area of that project? So, there are other conditions also possible. So, all these are listed here and similarly, coal washeries, mineral beneficiation, all these are listed within this.

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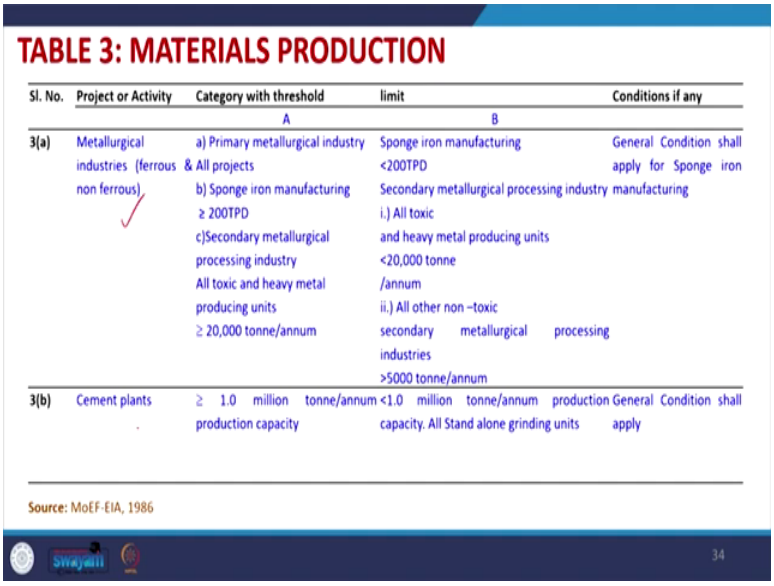

Now, materials if any materials have to be produced, these activities are also there metallurgical industries, cement plants because they are producing new type of things.

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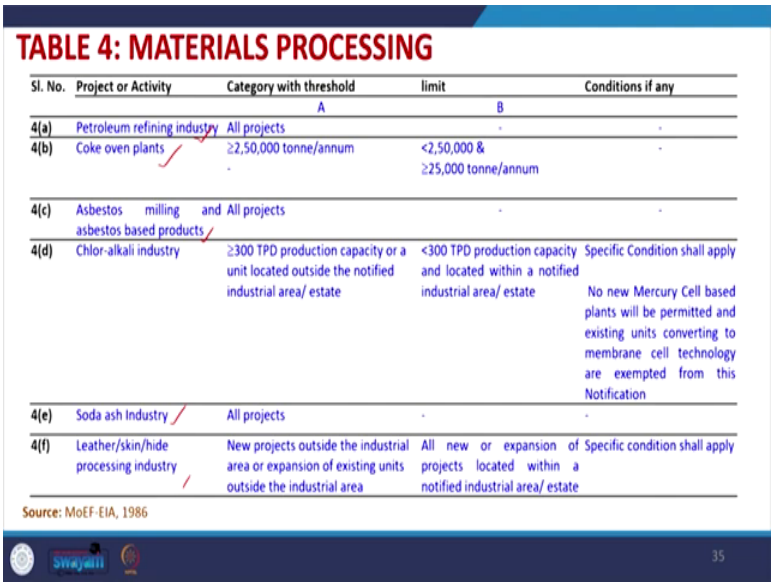

Similarly, materials processing like petroleum refining, coke oven plants, asbestos milling, chlor-alkali industries, soda ash industry, leather, skin, hide processing industry. So, all these industry actually process some of the raw material and convert into some product. So, all these industries are listed.

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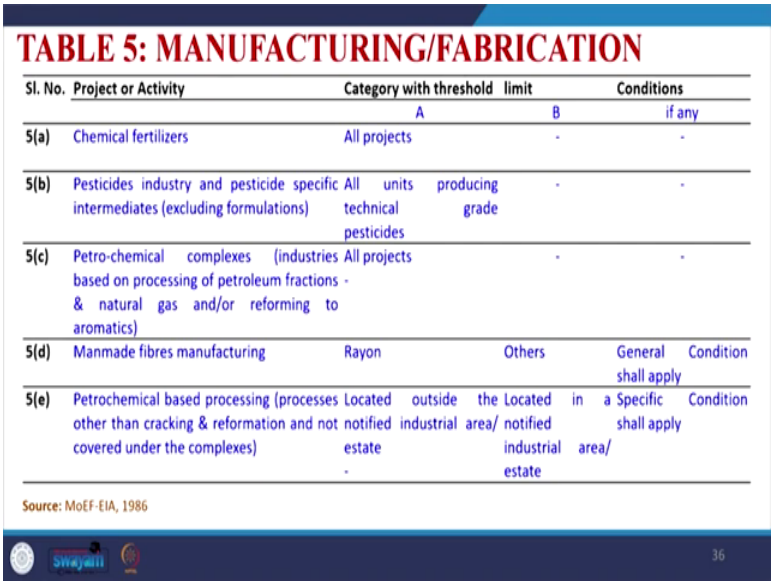
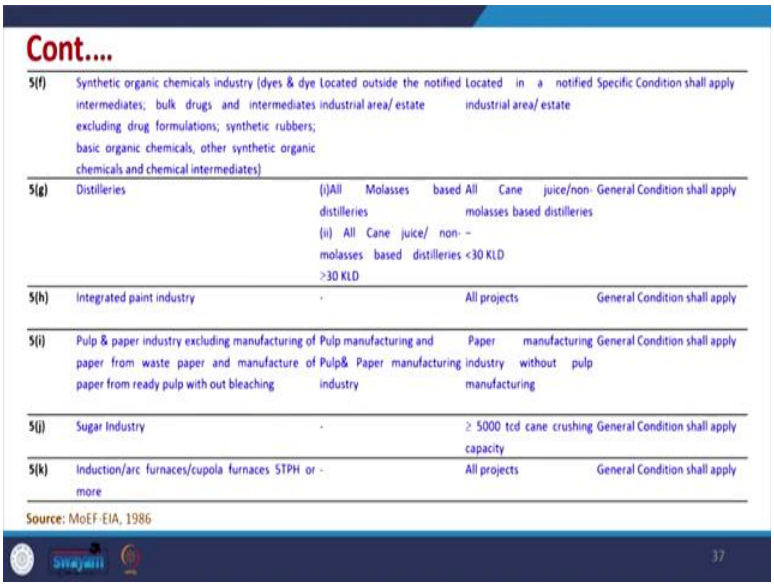


TABLE 5: MANUFACTURING/FABRICATION

Sl. No.	Project or Activity	Category with threshold limit		Conditions
		A	B	if any
5(a)	Chemical fertilizers	All projects	-	-
5(b)	Pesticides industry and pesticide specific intermediates (excluding formulations)	All units producing technical grade pesticides	-	-
5(c)	Petro-chemical complexes (industries based on processing of petroleum fractions & natural gas and/or reforming to aromatics)	All projects -	-	-
5(d)	Manmade fibres manufacturing	Rayon	Others	General Condition shall apply
5(e)	Petrochemical based processing (processes other than cracking & reformation and not covered under the complexes)	Located outside the notified industrial area/ estate -	Located in a notified industrial area/ estate	Specific Condition shall apply

Source: MoEF-EIA, 1986



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5(f)	Synthetic organic chemicals industry (dyes & dye intermediates; bulk drugs and intermediates excluding drug formulations; synthetic rubbers; basic organic chemicals, other synthetic organic chemicals and chemical intermediates)	Located outside the notified industrial area/ estate	Located in a notified industrial area/ estate	Specific Condition shall apply
5(g)	Distilleries	(i)All Molasses based distilleries (ii) All Cane juice/ non-molasses based distilleries >30 KLD	All Cane juice/non-molasses based distilleries – <30 KLD	General Condition shall apply
5(h)	Integrated paint industry	-	All projects	General Condition shall apply
5(i)	Pulp & paper industry excluding manufacturing of paper from waste paper and manufacture of paper from ready pulp with out bleaching	Pulp manufacturing and Pulp& Paper manufacturing industry	Paper manufacturing industry without pulp manufacturing	General Condition shall apply
5(j)	Sugar Industry	-	≥ 5000 tcd cane crushing capacity	General Condition shall apply
5(k)	Induction/arc furnaces/cupola furnaces 5TPH or more	-	All projects	General Condition shall apply

Source: MoEF-EIA, 1986

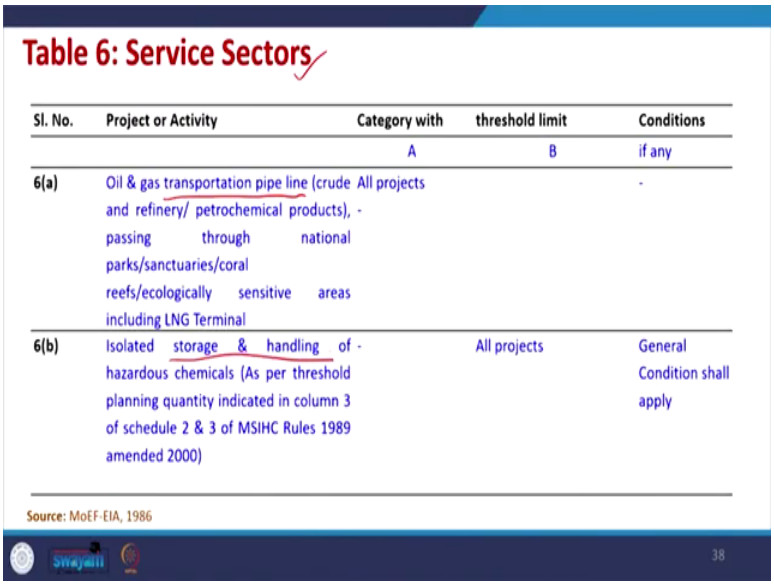

Table 6: Service Sectors

Sl. No.	Project or Activity	Category with threshold limit		Conditions
		A	B	if any
6(a)	Oil & gas transportation pipe line (crude and refinery/ petrochemical products), passing through national parks/sanctuaries/coral reefs/ecologically sensitive areas including LNG Terminal	All projects	-	-
6(b)	Isolated storage & handling of hazardous chemicals (As per threshold planning quantity indicated in column 3 of schedule 2 & 3 of MSIHC Rules 1989 amended 2000)	-	All projects	General Condition shall apply

Source: MoEF-EIA, 1986

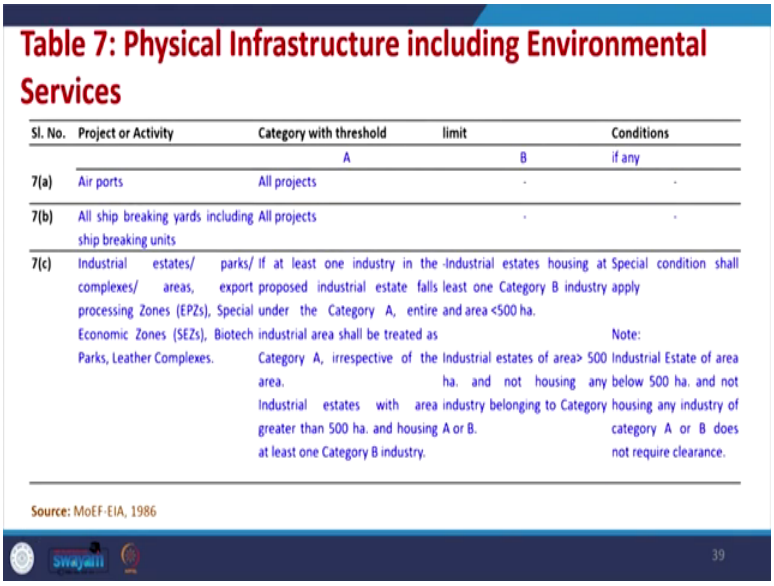

Table 7: Physical Infrastructure including Environmental Services

Sl. No.	Project or Activity	Category with threshold limit		Conditions
		A	B	if any
7(a)	Air ports	All projects	-	-
7(b)	All ship breaking yards including ship breaking units	All projects	-	-
7(c)	Industrial estates/ parks/ complexes/ areas, export processing Zones (EPZs), Special Economic Zones (SEZs), Biotech Parks, Leather Complexes.	If at least one industry in the proposed industrial estate falls under the Category A, entire industrial area shall be treated as Category A, irrespective of the area. Industrial estates with area greater than 500 ha. and housing at least one Category B industry.	-Industrial estates housing at least one Category B industry and area <500 ha. Industrial estates of area> 500 ha. and not housing any industry belonging to Category A or B.	Special condition shall apply Note: Industrial Estate of area below 500 ha. and not housing any industry of category A or B does not require clearance.

Source: MoEF-EIA, 1986

Similarly, manufacturing and fabrication, chemical fertilizer, pesticide industry, petrochemical. So, we can see here a large number of industries are listed and all these industries need to take environmental clearances. And these industries and projects include the service sectors also. Suppose any transportation gas pipeline has to be made, then isolated storage of, a storage depot of hazardous chemicals have to be made.

So, all these services, sectors and various other physical infrastructure all these activities require environmental clearance and also EIA studies have to be performed. And within these EIA studies, wastewater treatment or water treatment is very important aspect of all these studies, it is

one of the most important parameter after air which is taken into consideration in performing these studies.

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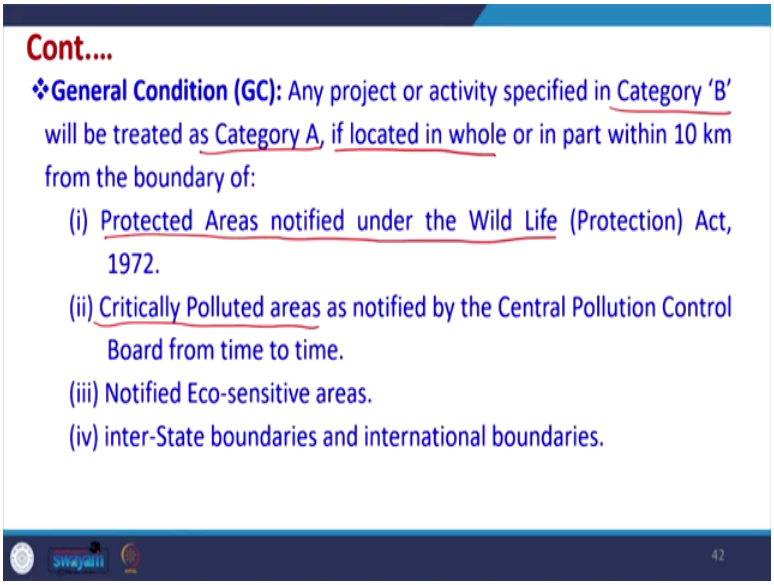

Now, there are some general conditions also with respect to implementation of these projects or activities and generally all A category projects, they are considered as A category projects. For them EIA is mandatory. For Category B projects which generally fall, which are similar to category A but their capacity or amount of production is much lower.

So, for them there is some relaxation. But if that category B project, if it is located in such a place that it is within 10 kilometers from the boundary of protected areas notified by wildlife, then it will fall into category A and EIA will be mandatory.

Similarly, all those category B projects, which are in critically polluted areas also they have to be, they fall, they are considered as category A projects. Similarly, if they are present in the Eco sensitive area or interstate boundaries near to interstate boundaries or international boundaries, then also EIA is made mandatory.

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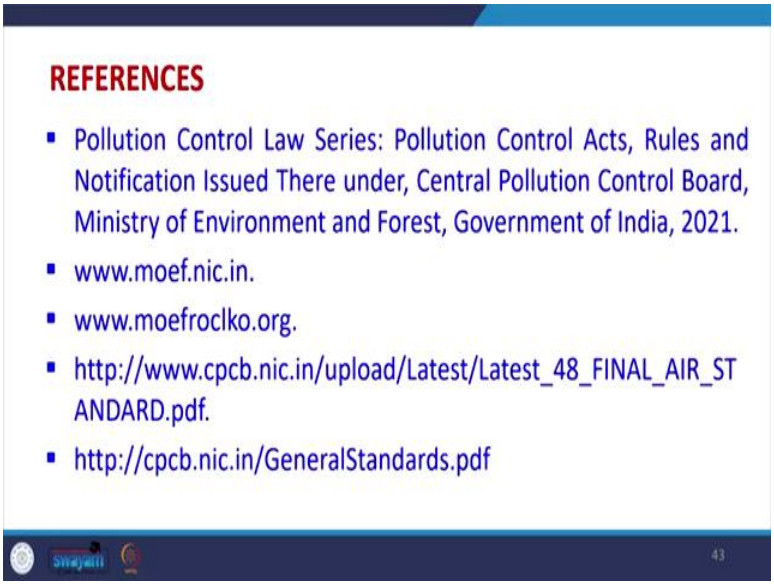

From all these things we understand that that EIA, environment, pollution and we have to see that how the environment conditions are maintained, we are polluting the environment in minimal. So, all these things are very important and within that water pollution and wastewater treatment, water treatment and wastewater treatment is very important and that we are going to start learning in the next few lectures.

Before that from today's lecture, we understand few other things also. Now, in each of the standards, we have seen, there are a large number of parameters that are listed. Now, if these parameters are there, we must understand the physical significance of these parameters until unless we know the physical significance of these parameters, water quality parameters, which were there like BOD, COD, total cyanide, total chromium, all these parameters.

So, if we do not understand the basic, and we do not have the basic understanding of these parameters, we can never perform the treatment or we can never understand that how to use any technology or which technology has to be used for which purposes. So, we will start with understanding the water quality parameters in the next lecture. So, this is there, with this we end today's lecture. Thank you.