Biological Process Design for Wastewater Treatment
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Lecture: 37
Sustainable Development and Environmental Impact Assessment

Welcome everyone in this NPTEL Online Certification Course on Biological Process Design for Wastewater Treatment. So, till now we have already studied the different aspects of biological wastewater treatment. We studied the characterization of wastewater, further we studied how to treat the wastewater. We also studied with respect to the sludge management, how we can manage the sludge in the previous few lectures.

Now, today we are coming to the end of this course. So, will be focusing on some case studies and also some important aspects like sustainable development and environmental impact assessment. So, today we are going to focus on understanding the sustainable development and EIA and how it is incorporated into the design as well as in the project planning itself of any industry. So, what is sustainable development?

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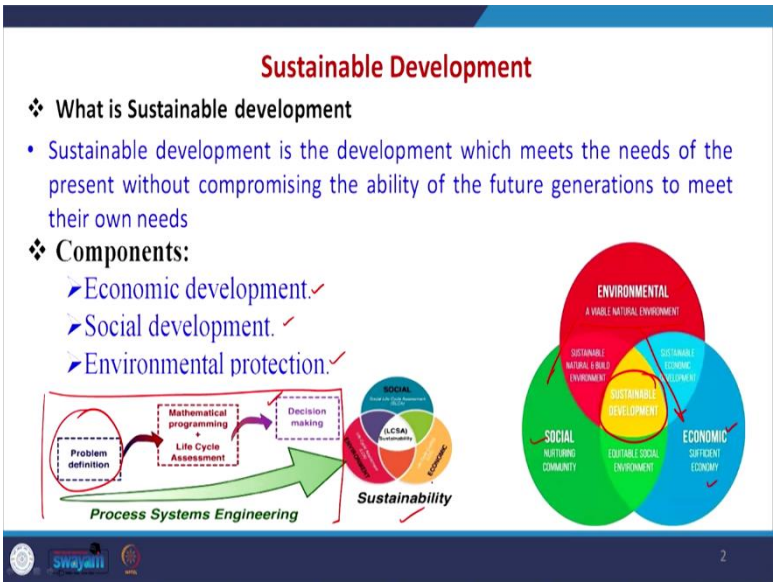

Most of us understand the definition, otherwise the sustainable development is the development which meets the needs of the present without compromising the ability of the future generation to meet their own needs. So, that means we have to utilize the resources in such a manner that we should be able to reuse the materials after those and the uses of resources should be minimized, so that the future generations can also use the same resource for their own needs.

Within sustainable development there are three components, the economic development, the social development, and sustainable development, the environmental protection, and these are highly interrelated between each other. So, we will try to see that we have a viable natural environment, whereas the economic development will try to see that we have sufficient economy, so that everybody has economic prosperity.

Similarly, the social development will require that we have the nurturing community. Now, when these two sections meet each other, then we have to see that like environmental and economics. So, we have sustainable economic development, similarly we have equitable social environment and then between environment and social we have sustainable, natural build environment.

Now, when all three meet together then we have the sustainable development. Now, to reach the sustainable development we have to go through a various process and in particular in chemical engineering, in process system engineering, we have some strategy through which we can achieve this. So, we have to identify the problem and define it and then do some aspects of programming life cycle assessment, etcetera.

And based upon that we have to make the decision. So, in the industries we have to incorporate this process and then we can achieve the sustainability.

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So, there are certain sustainable development goals which have been defined and engineering is for achieving these SDGs. So, we have 17 goals which have been defined and within these 17 goals there are few goals which are directly related to engineering aspects or other aspects.

So, like zero hunger is very important of for achieving this we have to conduct LCA of food. Also, we have to see that how food security, etc., is maintained.

Similarly good health and well-being, it ensures healthy lives and promote well-being for all. So, for doing this we will require chemicals and when will be requiring chemicals, so certainly pollution and contamination will also happen, so we will require treatment also. Similarly clean water and sanitation, it is one of the important sustainable goals and achieving in this goal the biological wastewater treatment or biological water treatment that we have studied will play very important role.

So, this goal requires ensuring the availability and sustainable management of water and sanitation for all. So, this goal has to be achieved by 20, 30. Similarly affordable and clean energy, again, ensure access to affordable, reliable, and sustainable clean energy for all. So, lot of work is being done for clean energy as well.

Similarly industry innovation and infrastructure sustainable cities and communities, responsible consumption and production and climatic action. So, all these actions which are related to SDGs, in fact, there are some of the SDGs goal and where the engineers are going to play a lot of role.

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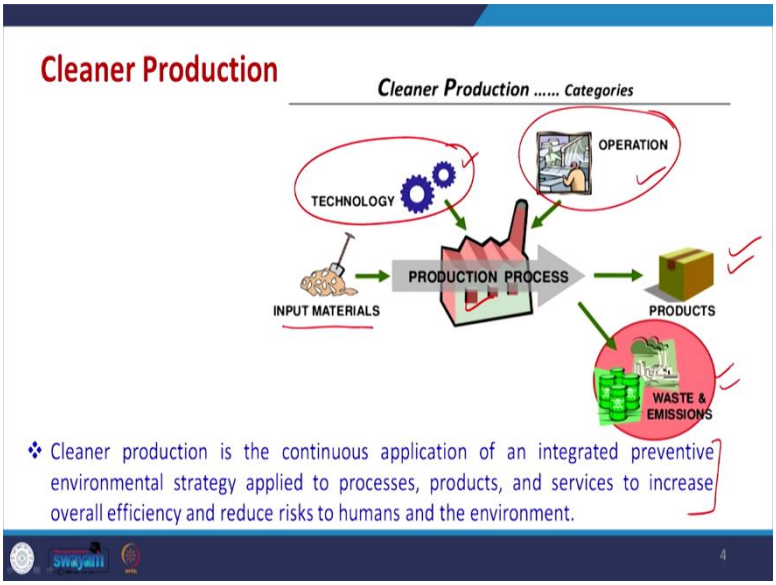

Now, within an industry the cleaner production aspects are very important and generally what will happen is that a cleaner production is the continuous application of integrated preventive environmental strategy which is applied to processes products and services to increase the overall efficiency and reduce the risk of humans and environment.

So, this strategy has to be planned in any industry. So, that the wastewater are the waste which are generated are minimal and the impact or environmental impacts on the society are also minimal. So, in any production process we have input materials. Now input material goes through certain production processes depending upon on the technology and operations which are performed, the products will come out, and also waste will come out.

Now, we have to choose a technology, which is cleaner technology and operations are also cleaner. So, if the technology is properly chosen, the products will be maximized, whereas the waste and emissions will be minimized. So, this is the strategy that has to be adopted in the cleaner production.

Now the essential elements of cleaner production are the production processes. Within the production processes we have to conserve the raw materials and energy. So, if we can conserve this actually the waste will be minimized.

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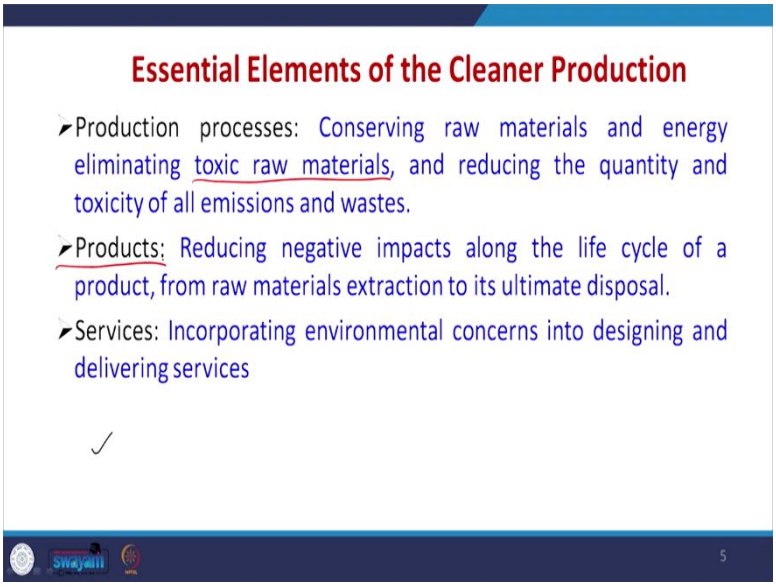

Also, we have to see that no toxic raw materials are emitted. We have to reduce the quantity and toxicity of all emissions and waste. So, for doing this we have to efficiently choose the technology which is the most important aspect. Now, products, reducing negative impacts along with the lifecycle of a product, from raw material extraction to ultimate disposal.

So, we have to see that the products which are getting formed they are such a manner that during their utilization after production also, they should not impact the environment. So, we have to perform the lifecycle of the product. Now services are also important. Incorporating

environmental concerns into the designing and delivering services will minimize the impact on the environment during any cleaner production process.

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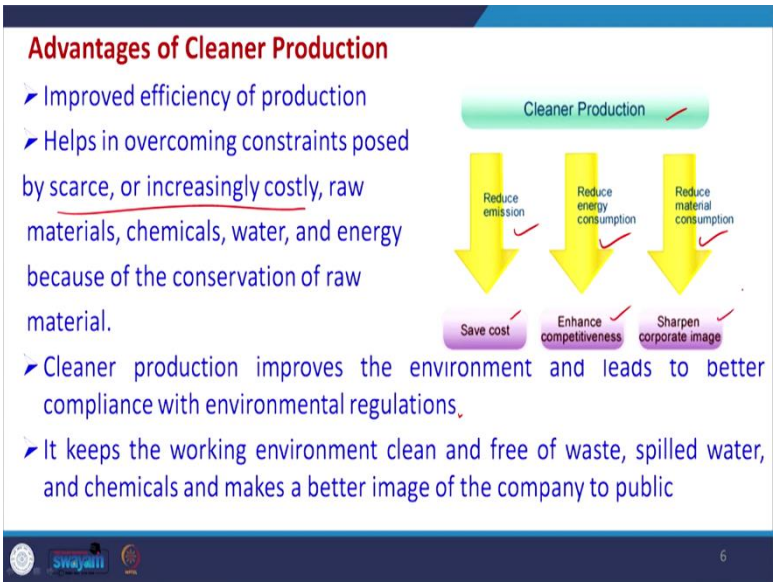

The advantages of cleaner production are that improved efficiency because we are trying to see that the raw material is going basically to the product side. So, we have more efficiency helps in overcoming constraints related posed by the scarce, or increasingly costly, raw materials. So, we try to obviously see that whether we can use a raw material which is cheaper in nature which is evidently available.

So, that we can have more amount of material, so that the cost will also be minimized. The chemicals water and energy are also minimized, because of the conservation of raw material. Cleaner production improves the environment and leads to better compliance with the environmental regulations.

When we are adopting such strategies, the treatment of water, air, etc., also gets minimized. So, it keeps the working environment clean, free of waste, spilled water and chemicals and makes a better image of the company to the public. So, overall, the cleaner production will reduce emissions, reduce energy consumption, reduce material consumption.

So, all these aspects when the emission will be minimized will, it will save cost, when energy usage will be minimized it will enhance the competitiveness, and also if the material consumption waste, etc., minimize, so it will sharpen the corporate image and overall, it will be highly beneficial.

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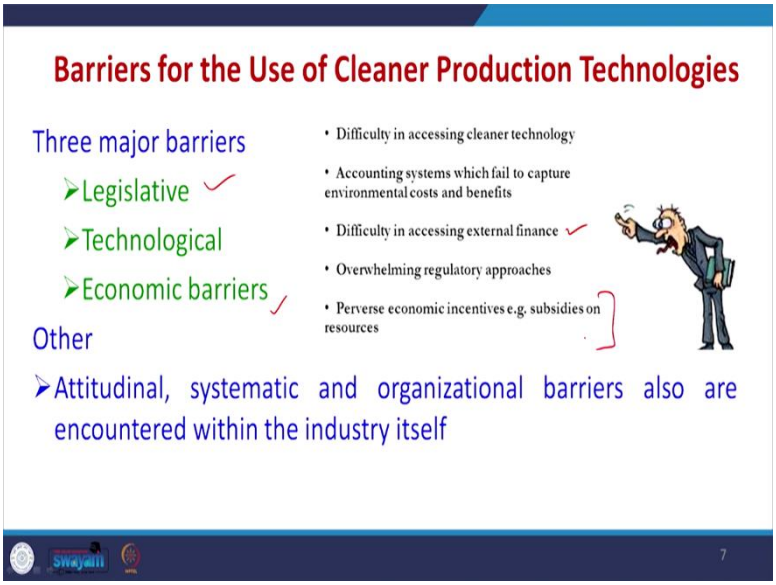

Barriers for the use of cleaner production technology. Certainly there are barriers, so they could be legislative barriers that you cannot use this particular process because of certain reasons. Similarly there can be technological barriers also. The technology itself is not that much good that we can use a cleaner production technology.

Similarly the economic barrier, the technology is available but it is highly costly, so we do not have the money that much to use there. So, these are some of the barriers in addition there may be other various difficulty in assessing the cleaner technology, can we assess the technology which is being given by some agency, whether it is correct or not.

Accounting systems which fail to capture the environmental cost and benefits. Similarly difficulty in accessing the external finances, also regulatory approaches will also be one of the barriers, then we have to check that what is the economics of our own plant that we are going to have. So, all these economic barriers may also be there.

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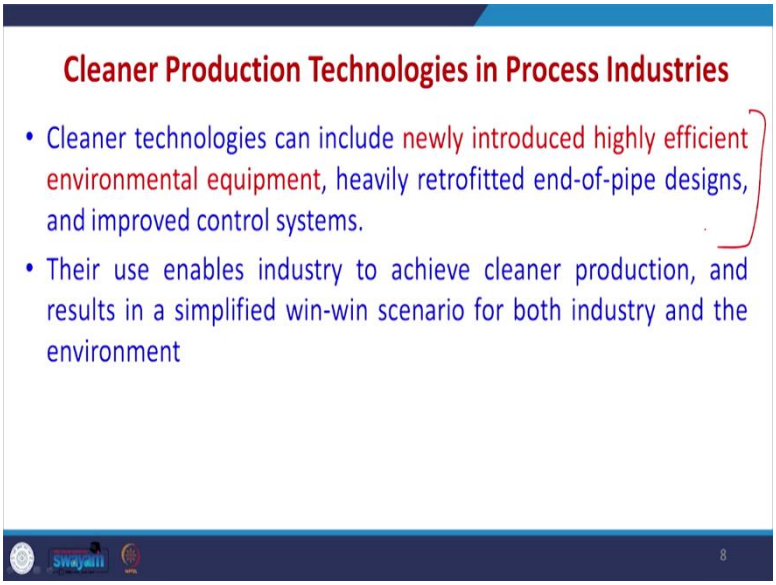

Now, the cleaner production technologies in process industries, because process industries will generate lot of different types of pollutant. So, if we can apply them in the process industry it will reduce lot of wastewater which is generated. So, the cleaner technologies include newly introduced highly efficient environmental equipment, heavily retrofitted end of pipe designs and improved control system.

So, all these three strategies are used in the process industries for better cleaner production. Now their usage enables industry to achieve cleaner production and results in a simplified win-win scenario for both industry and environment. Now, when any new project is being planned and any new industry is being planned, so what we do is that, we can assess the environmental impact of that project or process beforehand.

This process is called environmental impact assessment and that has to be studied or performed before actually the project is implemented.

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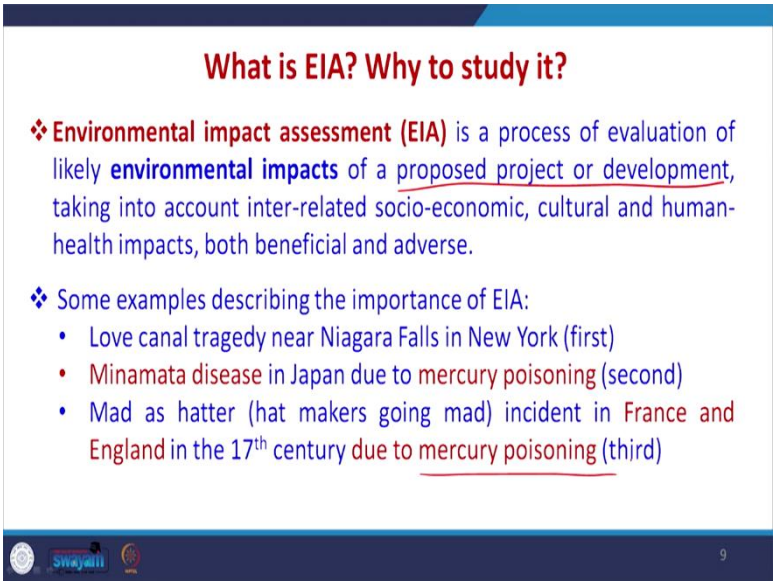

So, environmental impact assessment is a process of evaluation of likely environmental impacts of a proposed project or development taking into account the interrelated socioeconomic, cultural and human health impacts, both beneficial as well as the adverse. So, we have to check that if the project will actually be implemented.

What will be the effect on the socioeconomic, cultural and human health of the region? And also, we have to check whether there will be some adverse effect or there may be some beneficial effects also. So, both effects we have to take care. Now there are many examples in the world where the EIA process gave the importance of. So, there was a love canal tragedy near the Niagara Falls in New York.

So, this was the first instance. Similarly, Minamata disease in Japan due to mercury poisoning. So, then Mad as hatter, hat makers going mad incident in the France and England in 17th century due to mercury poisoning. So, there are many instances where the, we did not know the impact of any product or process or a project.

So, because of that a lot of environmental degradation happened later on and a lot of people were got affected. So people started doing the impact assessment beforehand before actually implementing the project. So, this is very important.

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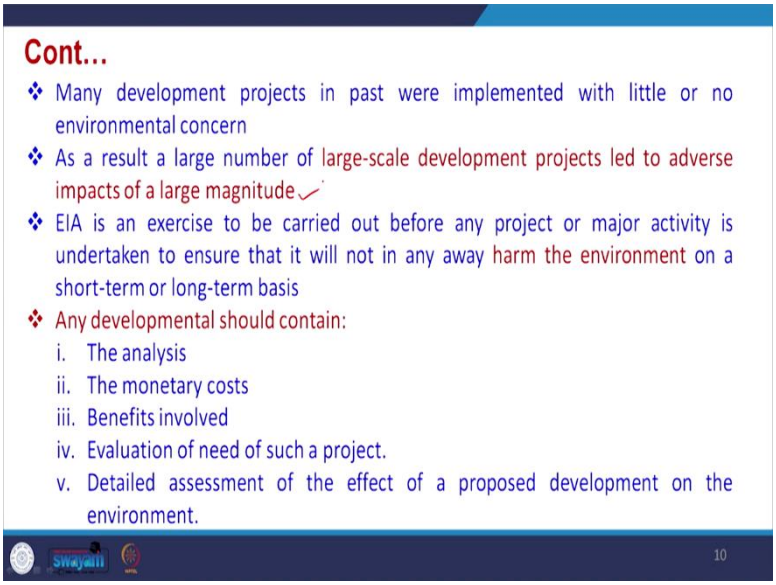

Now, many development projects in the past were implemented with little or no environmental concerns as a result, large scale development projects led to adverse impact of a larger magnitude. So, EIA is an exercise which has to be carried out before any project or major activities undertaking to ensure that it will not in any way harm the environment on a short term and long-term basis.

If any impact is there then we have to use technology so that we can minimize the impact. Like it is a wastewater is generated, we have to see that the wastewater should be treated, recycled back, used in the industry itself and the production process that should be able to use the recycled water.

Now, any developmental plan should contain the analysis, the monetary cost, the benefits involved, evaluation of the need of such a project and detailed assessment of the effect of the proposed development on the environments, all these aspects have to be incorporated into the study.

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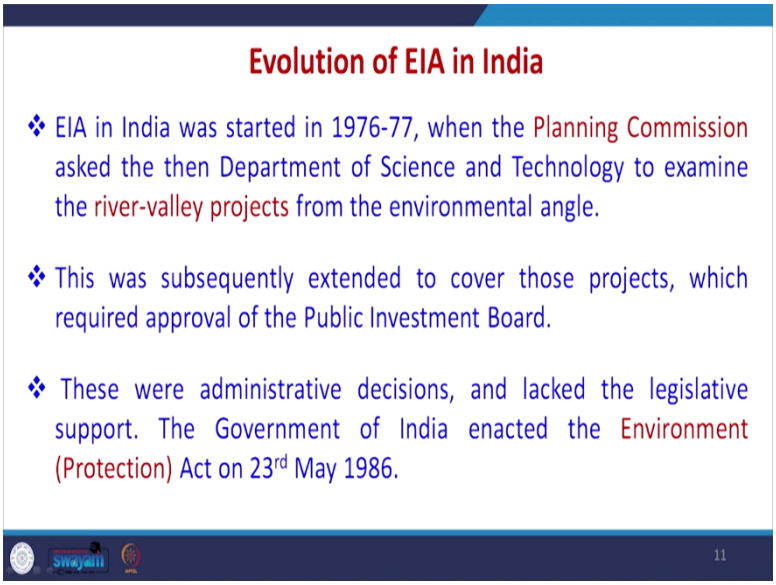

Evolution of EIA in India. So, EIA in India was started in 1976-77 when the Planning Commission asked that then Department of Science and Technology to examine the river valley projects from environmental angle. So, this was the first case where in India in a way EIA were started. This was subsequently extended to cover those projects which required approval of Public Investment Board.

So, further it was extended. Then there were administrative decisions, and lacked the legislative support. The formerly the Government of India enacted the Environmental Protection Act on 23rd May, 1986 and after that the environmental impact assessment was also made necessary.

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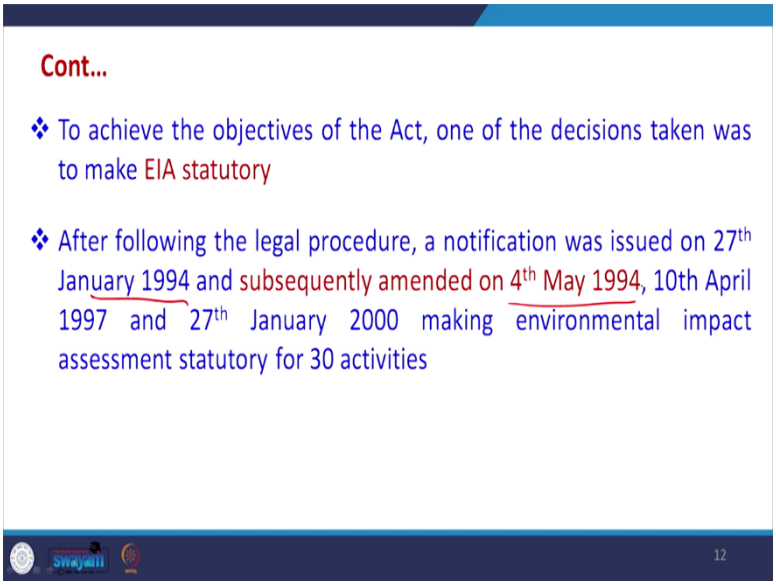

To achieve the objectives of EIA one of the decisions that was taken was to make the EIA statutory. After following the legal procedure a notification was issued on 27th January, 1994 and subsequently it was amended in on 4th May, 1994. So, again it was further amended on 10th April 1997, again on 27th January 2000. So, environmental impact assessment has been made mandatory for many activities, there are 30 plus activities for which EIA is mandatory and it was notified in 1994.

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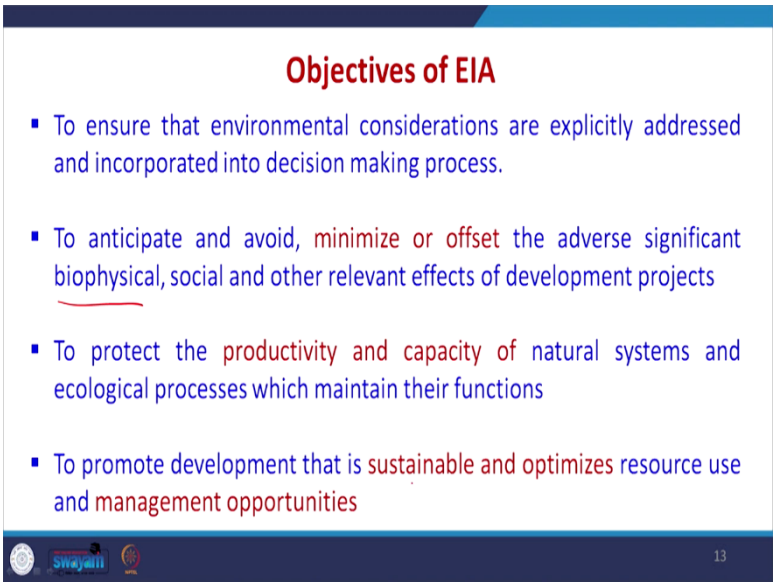

Now the objectives of EIA. It is done to ensure the environmental considerations are explicitly addressed and incorporated into decision making process. To anticipate and avoid,

minimize or offset the adverse significant biophysical, social and other relevant effects of the development projects.

And to protect the productivity capacity of natural systems and ecological process which maintain their functions. To promote the development that is sustainable and optimizes resources use and management opportunities. So, these are the basic objectives of the EIA under which the EIA is carried out of any project.

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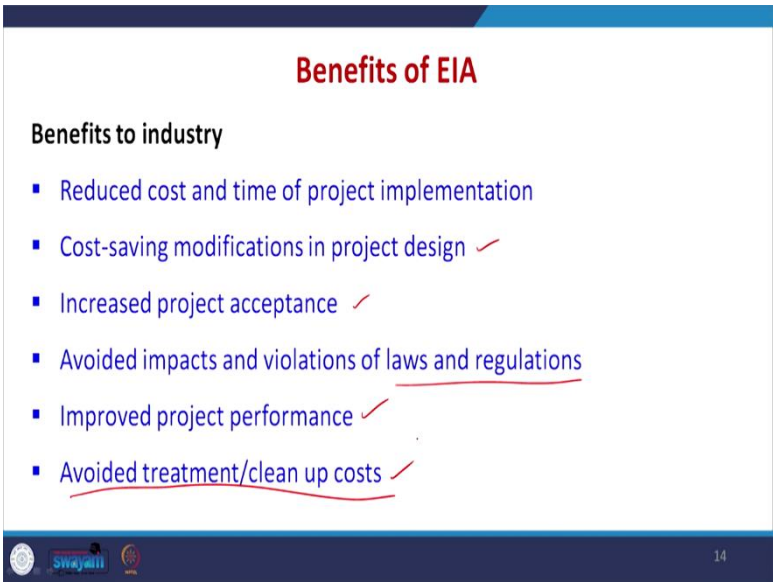

Now, what are the benefits to the industry if EIA is carried out? So, it will actually reduce cost and time of project implementation because you are trying to foresee what are the different steps of, what will be the cost occurrence, etcetera, beforehand? So, cost saving modifications in the project design can be implemented beforehand.

So, like I was telling that we can recycle back the water. So, actual water that has to be taken from any other source will be minimized. So, we can do the, similarly energy intensification and integration can be done. So, that we can do lot of energy saving. So, cost saving modifications in the project design.

Increased project acceptance, when we are not releasing any waste etcetera to the environment, so certainly the project will be accepted by the people nearby. Avoid impacts and violation of laws and regulations. So, we will know beforehand that what are the laws and regulations related to the projects and we have to comply for the law and for complying to the law and regulations we have to use technologies, methods, which are able to fulfil those regulations.

Now improve project performance and avoid treatment and clean-up costs later on if the anything bad goes. So, these are the benefits that are there to the industry if the EIA is carried out beforehand.

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Now, benefits to the local community because for project EIA is beforehand carried out. So, certainly, the environment will not be harmed. So, we are having a healthier environment. Improved human health because they can help in the plantation of trees, many other things. So, the human health can improve also based upon the project.

The maintenance of biodiversity by properly planning, we can still maintain the biodiversity and also many times increase the biodiversity if we plan it very well. Decreased resource use, so if EIA is carried out the resource uses in the industry or the project will be minimized because there will be more recycling of resources and so the decreased resource use will be there if EIA is carried out otherwise the resource usage may be larger.

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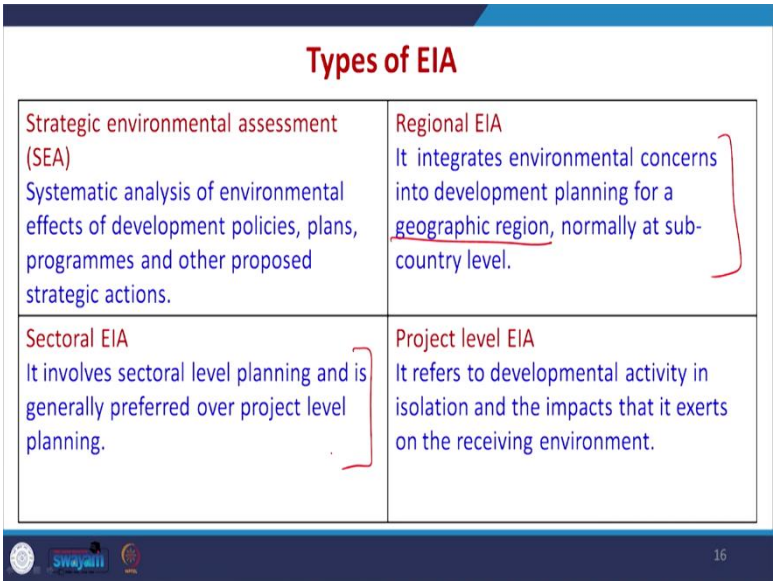

Now, there are different types of EIA that are carried out. So, these include the strategic environmental assessment, SEA. So, systematic analysis of environmental effects of development policies, plans, programs and other project strategic actions for, if these are carried out this will fall into the category of strategic environmental assessment.

Then we have regional EIA. It integrates environmental concerns into development planning for a geographic reason, normally at sub-country level. So, we can carry out EIA at a regional level. Similarly, the sectoral level, it involves sectoral level planning and generally preferred over project level planning.

So, if suppose area is there, some particular area where lot of industries are going to come for a particular type of industry then or otherwise also, we can carry out the sectoral EIA, then project level EIA, it refers to the development activity in isolation and the impacts of it, which are exerted on the receiving environment. So, this is the usual project level EIA for any industry, for individual industries for individual projects, these EIA have to be carried out.

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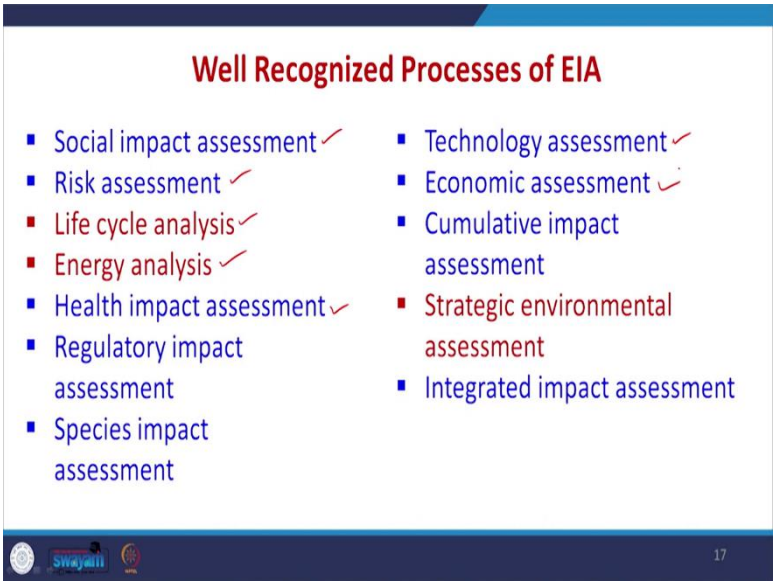

Now, what are well recognized processes of EIA? Certainly each EIA have various processes. So, there are many common processes, well recognized processes which are carried out in any EIA. So, these are listed here. So, we always carry out social impact assessment. What will be the impact on the society because of the project?

Then risk assessment, life cycle assessment of the project, energy analysis, what will be the energy consumption, health impact assessment of the project, then regulatory impact assessment, species impact assessment, if any species are getting impacted or not, then the technology assessment whether what type of technologies we are going to use and then decide based upon the technology available, which will be better?

Certainly, it will also include the economic assessment also, one technology may be better but its cost is very high. So, we may go for little inferior technology where the cost is much cheaper. So, that still minimizing the impact on the environment. Then we have cumulative impact assessment, strategic environmental assessment and integrated impact assessment. So, these are the some of the well-recognized processes of EIA.

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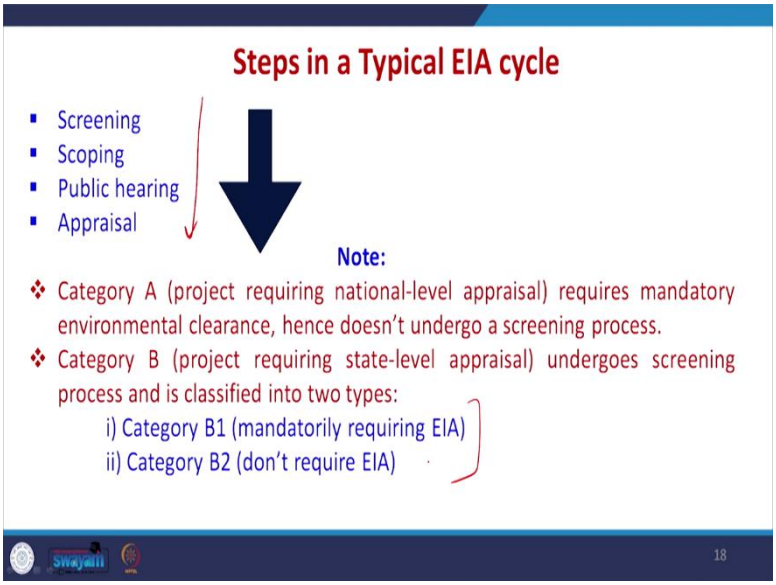

The steps which are involved in a typical EIA cycle. These steps include four processes, the screening of the process, then scoping steady, what is the scope of the process, certainly based upon this, a public hearing is carried out and ultimately, appraisal is also done. So there are few types of EIA in India. So, category A involves project requiring national level appraisal, which requires mandatory environmental clearance hence does not undergo the screening process.

Now category B, project requiring state level appraisal which undergoes screening process and is classified into two types. So, B1 and B2. So, B1 will require EIA and B2 does not require EIA. So, if the initial a project falls into category B, then we have to check whether EIA is compulsory or not. Now, environmental clearance process for category A activities or category B which require EIA.

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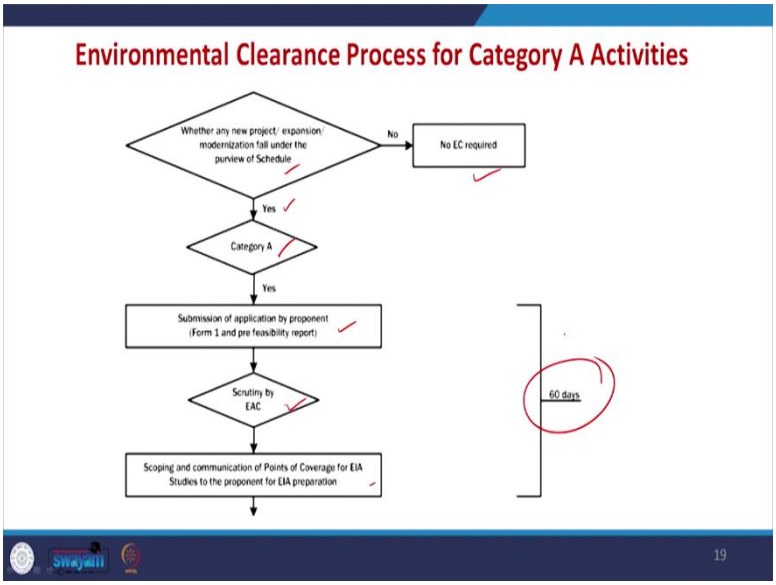

So, first whether we check whether any new project expansion or modernization will fall under the purview of the schedule of the EIA. So, if no, it does not fall, so no environmental clearance is required. If yes, we check whether it is category A, or any category which will require EIA, so category assessment is done. Then if yes, this is category A, submission of the application by proponent.

So, there are certain pre-feasibility reports and the form is submitted and it is scrutinized by the Environmental Act assessment committee. Then scoping and communication of points of coverage of EIA studies to proponent for EIA Preparation. So, this is done and it will take approximately like 45-60 days this process.

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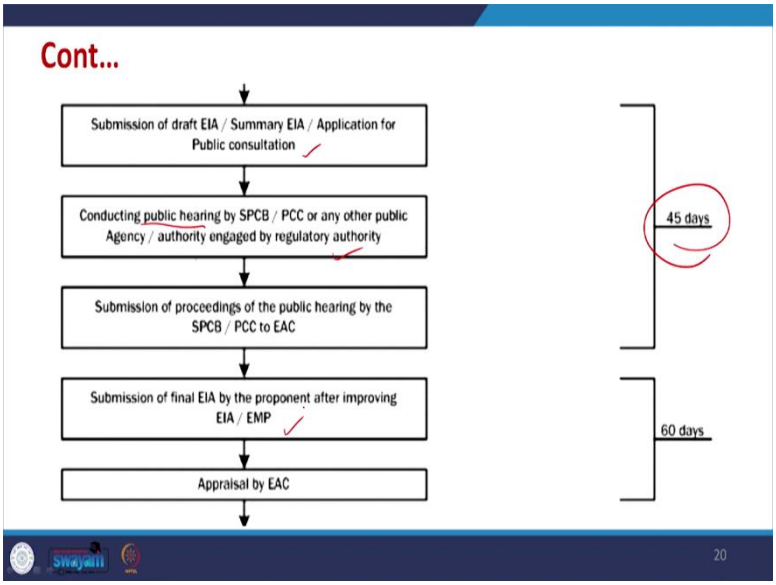

Then submission of draft EIA, summary EIA or application of public consultation. Further, the conducting the public hearing by state pollution control board or PCC to any other public agency authorizing engaged by regulatory Authority. So, this public hearing will be carried out and ultimately submission of the proceedings of the public hearing.

So, all this process again will take 45 days submission of final EIA by the proponent, after improving the EIA or Environmental Management plan and which will be further be apprised by the environmental assessment committee. So, this will take 60 days. So, this is the process.

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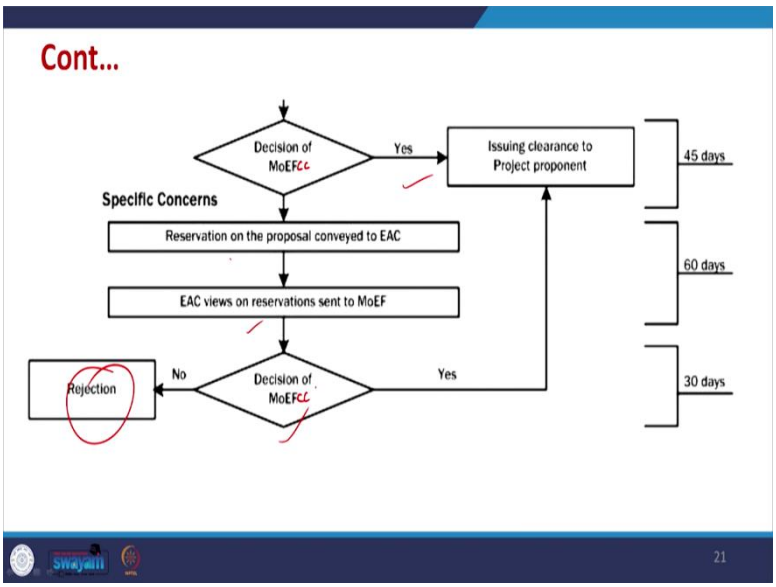

Ultimately, the ministry will take decision. So, if there are any concerns it will be the reservation and the proposal conveyed to the EAC and EAC views the reservation and the

decision is taken. So, if everything is okay, the issuing of clearance to the project proponent. So, this is the possibility also if the ministry is still not very clear it can reject the proposal.

So, now, this minister of environment forest and climate change. So, this is this is how the EIA clearance takes place.

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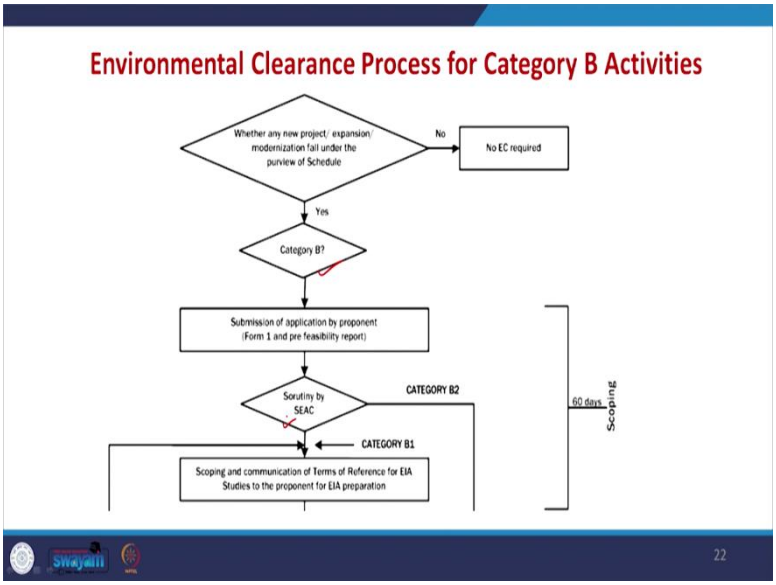

Now, environmental clearance is also similar for category B activity. So, you can only see that this is category B and whether it requires a submission or not and also in this case we have state level environmental impact assessment. So, the procedure is very same only thing that the committee changes, okay.

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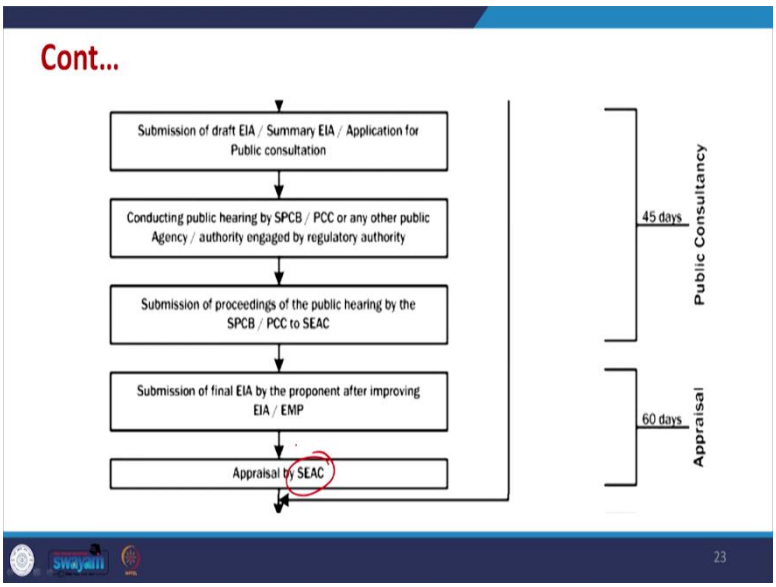

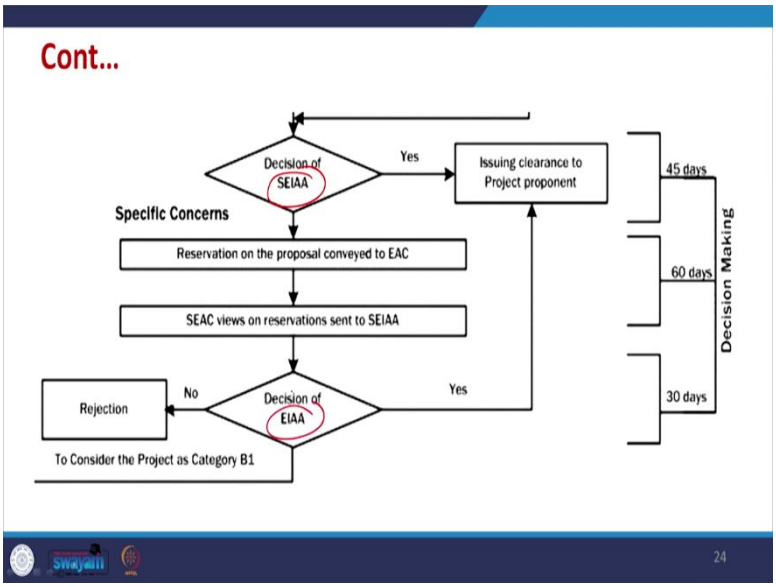

And we have the same process, we can see here, only thing is that appraisal by the state level environmental like assessment committee is there, which will take care of all these processes and further the decision is at the, by the state level committee. So, state level agencies take decision for project B category, overall the process remains the same for both the processes.

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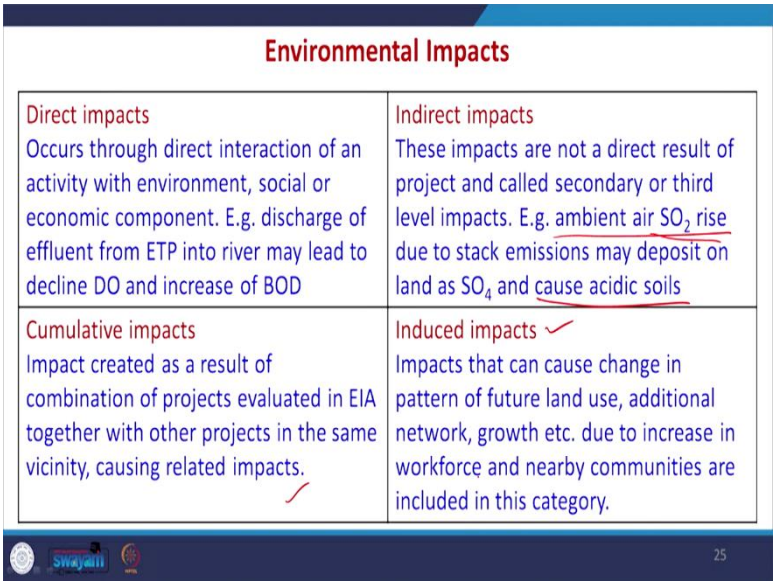

Now, there may be different types of environmental impacts, which may be, like direct impacts occurs through direct interaction of an activity with environment social or economic component. Example discharge of effluent from ETP into river may lead to decline DO and increase of BOD. So, this is direct impact which is happening because of some activity in the project.

Now, indirect impacts, these impacts are not a direct result of the project and called as secondary or third level impacts. Example ambient air SO_2 rise due to stack emissions may deposit on land as SO_4 and cause acidic soils. So, this is indirect effect the actual impact was SO_2 instant but the impact overall impact is acidic soils.

Similarly, cumulative impacts the impacts created as a result of combination of projects evaluated in EIA together with other projects in the same vicinity causing related impacts. So, there may be lot of cumulative impacts which are occurring together.

Then we have induced effects, impacts that cause change in the pattern of a future land use, additional networks growth, etc., due to increase in the workforce and nearby communities are induced in this category. So, there may be four types of impacts direct, indirect, cumulative, and induced impacts.

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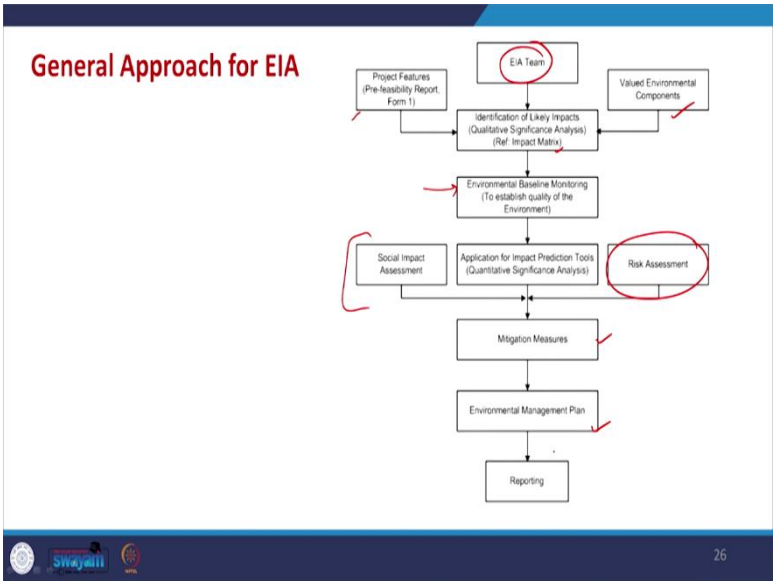

We learned that how the EIA clearance take place. Now, how the EIA is carried out is given here. So, there will be certain EIA team will be there and we have to check that the project features are already given back to us. So, pre-feasibility report form 1, etc., are given. Now, the valued environmental components, the major environmental components are already valued. Now the identification of likely impacts.

So, we try to find out the qualitative significance analysis using different approaches of EIA that includes impact matrix, they are the different methods of EIA. So, we can use them. Then we try to find out the environmental baseline monitoring to establish the quality of environment at present. After that, we try to check with respect to social impact assessment and risk assessment that what will be the application of impact prediction tools.

So, we use impact prediction tools to find out what will be the actual impact. Then once this is done, so we will perform the social impact assessment, risk assessment everything and, then finally when we are able to analyse what will be the potential impact, we report that what will be the mitigation measures that have will be taken. So, that these impacts are minimized.

So, we have mitigation measures and this mitigation measures are incorporated into the environmental management plan and this plan will include everything, so that the impact and the environment is minimal and then overall the EIA report is generated.

So, all the steps these are the step and approach towards carrying out the EIA. EIA report should contain the potential impact of the project and also the mitigation measures and what

is the environmental management plan, so that those impacts which are likely will be minimized are overall mitigated. Now, there are certain projects which have been made mandatory for environmental clearance.

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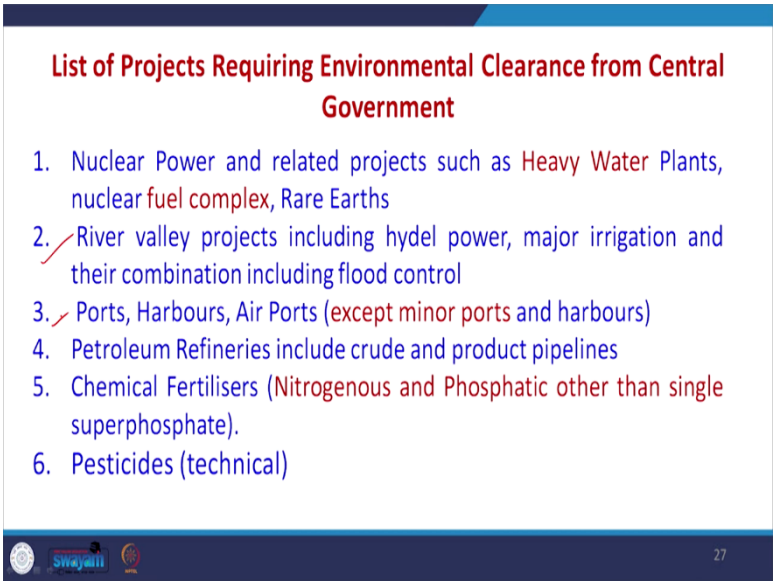

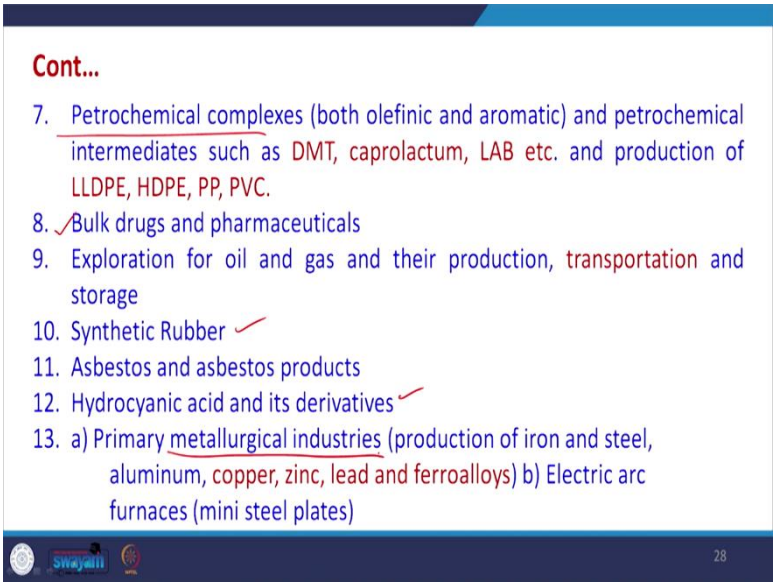

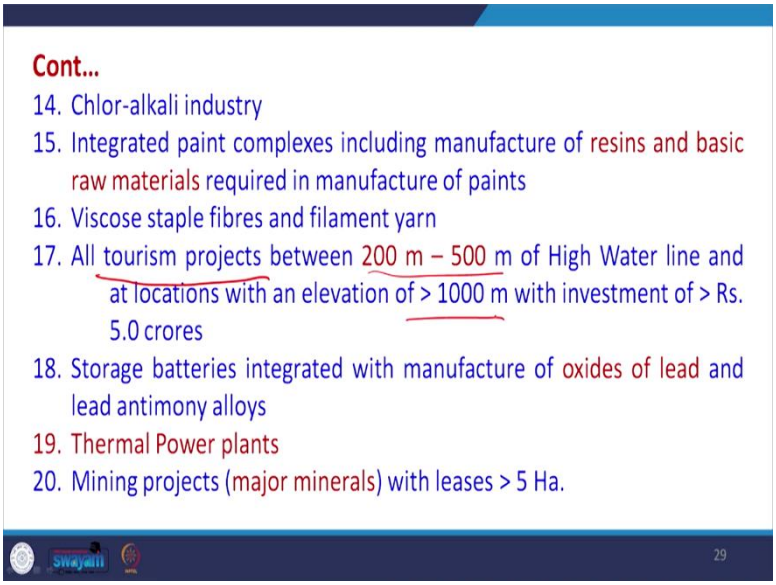

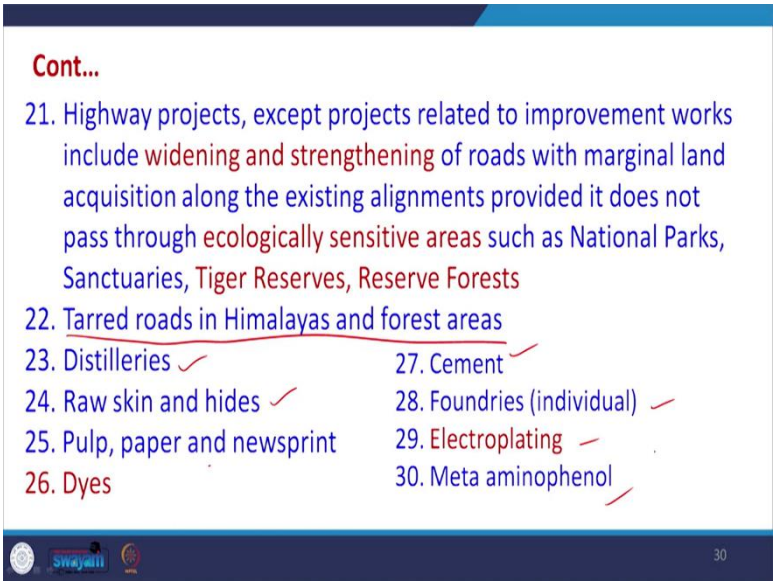

And these include like nuclear power plant and related projects like heavy water plants, nuclear fuel complexes, rare earth's, similarly, river valley projects, ports harbours, and airports, except very minor ports. Then petroleum refineries, chemical fertilizer industries pesticides industries, similarly, petrochemical complexes including all different types of plastics are petrochemical manufacturing processes.

Bulk drug and pharmaceutical industries, exploration of oil and gas and their production, transportation and storage, synthetic rubber production, asbestos, and asbestos products, similarly, hydrocyanic acids and its derivatives then all metallurgical industries and the subsequent refining processes all are made mandatory

Chlor-alkali industry integrated paint complexes, viscose staple fibres industries and yarn industries. All tourism projects between 200 meter and 500 meters of high-water line and at

location with an elevation of 1000 meter. So, and with an investment of rupees 5 crore or higher are mandatory to be carried out EIA.

Now, storage batteries, thermal power plants, mining projects, highway projects all highway projects, then tarred roads in Himalayan forest areas, distilleries, raw skin and hides, then pulp and paper, newsprint, dyes, cement, foundries, electroplating, then aminophenol industries.

So, many industries which have been put under the categories that they have to perform the EIA. And once EIA is done then we can go for the protective measures. We can identify how much wastewater will be generated, what will be the emissions, how we will take care of the wastewater via a plant design whether it will biological, physicochemical, all those things will be incorporated.

So, all these industries, EIA is mandatory EIA and these projects overall assessment helps in the social sustainable development of the society and which is the most important thing. So, today we will end with this lecture. Now next lecture onwards will be trying to take some case studies where the biological wastewater is more done in some industries.

So, we will be taking example of dairy industry, some slaughter industries also will try to understand the common effluent treatment plant in the next lectures. Thank you very much.