**Advanced Green Manufacturing Systems**
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**Lecture - 30**
**Design for Environment (Part 2 of 4)**

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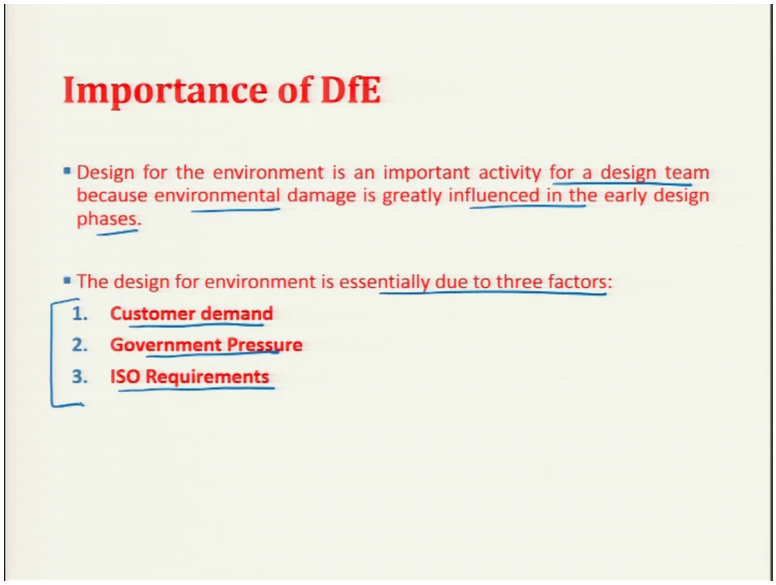


Good morning. Welcome back to the lecture on Design for Environment. We were discussing this importance of design for environment. The design for environment is an important activity for a design team. Because environmental damage is greatly influenced in the early design phrases the design for environment is essentially due to these 3 factors. Number 1 is customer demand, number 2 is government pressure, number 3 is ISO requirements; the customer motivation is due to the reasons which professor Albertlett just explained.

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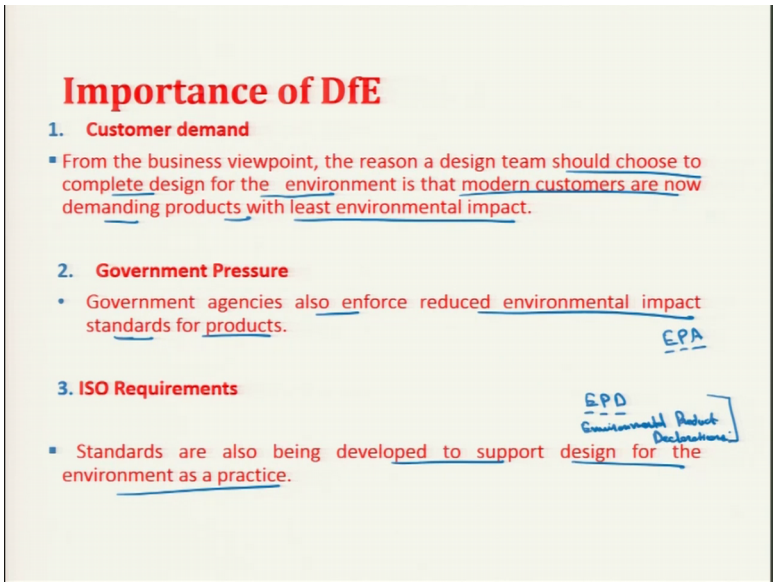


And what are these? The customer demand from the business viewpoint the reason a design team should choose to complete design for the environment is that the modern customers are, now demanding products with least environmental impact.

So, this is the because the customers are demanding the world population is now becoming much aware of the influence or impact of the products those are not green. So, creating a product that impacts the environment less becomes a market advantage because customer would like to purchase. That the government agencies also enforce reduce environmental impact standards for the products. So, such regulatory pressure will also grow with time many countries, now have the products such as packaging computers and transportation vehicles complete with required recycling of the components. These things are there in the market and one needs to get this certification EPA Environmental Protection Agency.

Then comes the ISO requirements this is something EPD those are Environmental Product Declaration. I will put it environmental product declarations. So, this is a verified document that communicates the transparent and comparable information about the life cycle assessment of the product. These are also required these days. The standards are also being developed to support design for the environment as a practice. So, this is the importance of DFE that customer would now like to purchase, the product

government pressure is there, ISO requirements are to be maintained. So, all these factors contribute to have a product that is eco friendly.

So, environmental product declaration these documents which is externally verified and in a uniform international documents format. So, they provide an ideal format and verification structure to deliver unbiased information transparently. This helps in many ways not only are these EPDs themselves within a marketing and communication, but the demonstrative companies responsibility and for sustainability as well.

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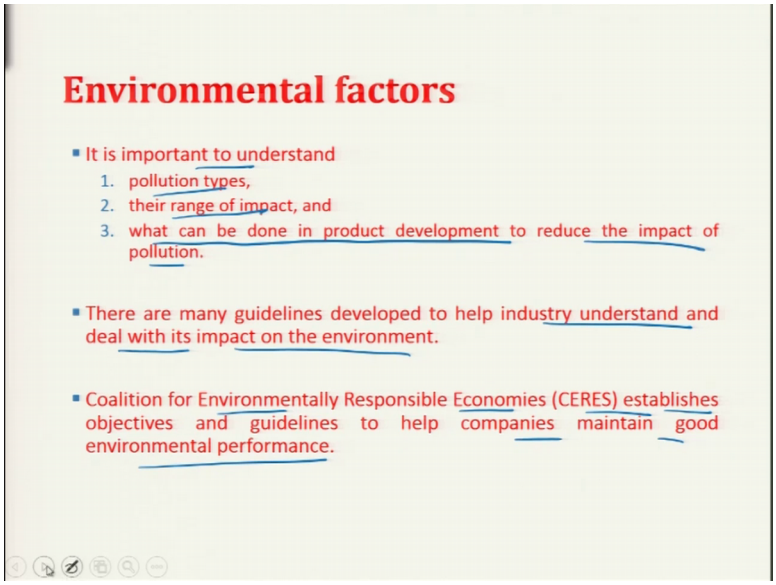


Next is environmental factors those one need to understand it is important to understand pollution types their range of impact what can be done in product development to reduce the impact of pollution. So, these are the factors which are important in design for environment. Then there are many guidelines that developed to help the industry to understand and deal with its impact on the environment. Coalition for environmental responsible economies series establishes objectives and guidelines to help companies maintain good environmental performance. This is a this has come up with these outline of objectives.

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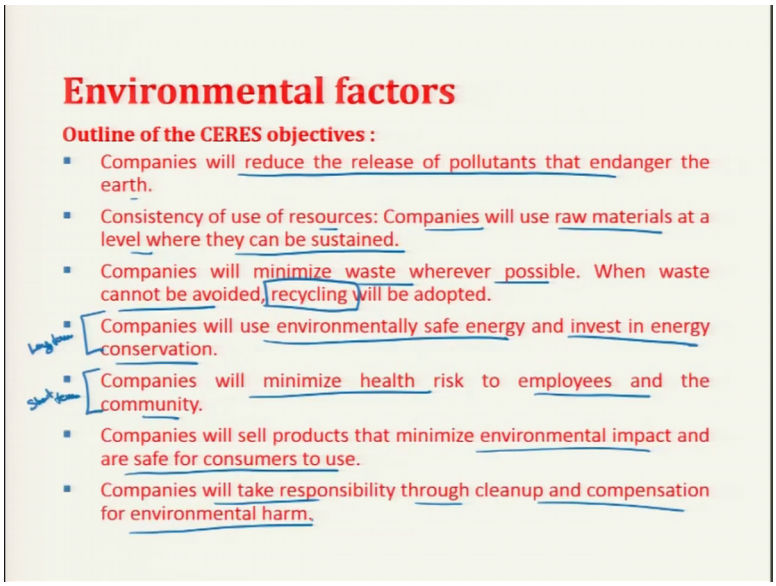


The outline objectives are companies will reduce the release of pollutants that endanger the earth. Consistency of the use of resources companies will use raw materials at a level where they can be sustained. The companies will minimise waste wherever possible when waste cannot be avoided, recycling will be adopted. So, these are the guidelines which these coalition has come up with, companies will use environmentally safe energy and invest in energy conservation.

Companies will minimise health risk to employees and community. These are the short term goals of the sustainability these are the long term goals. Short term immediate health risk has to be maintained these are long term. Companies will sell product that minimise environmental impact and are safe for consumers to use companies will take responsibility to clean up and compensation for environmental harm. Like the more you pollute the equivalent trees are to be planted and conservation has to be done.

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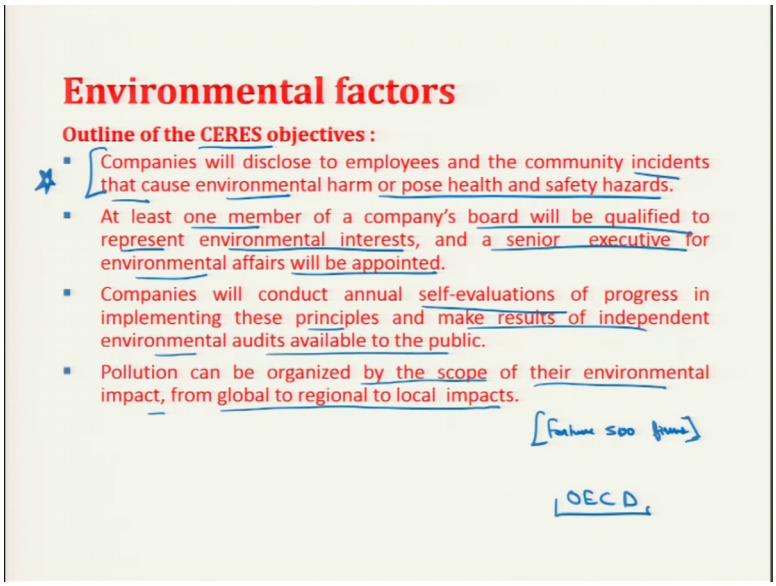


Companies will disclose to employees and the community incidents that cause environmental harm or pose health and safety hazards. This is very important which is actually not generally found. The certain instances that we have seen in Kanpur in leather manufacturing are chromium that is produced as the by product or the pollutant in leather manufacturing because water treatment has to be done on leather hides rawhides.

So, that chromiun the people who are living or along the banks of river Ganges are prone to many diseases of the level of cancer also due to this chromium which has benzene 6 ring. Which has this chromium 3 or chromium 6 is the compound that has certain compounds which are quite detrimental to the health.

Next guideline here is at least one member of the company board will be qualified to represent environmental interests and a senior executive for environmental affairs will be appointed. Companies will conduct annual self evaluations of progress in implementing these principles and make results of independent environmental audits available to the public pollution can be organised by the scope of the environmental impact.

From global to regional to local impacts. So, these are the outlines developed by series and all the companies must adopt it, but not many companies are part of that, but just big pioneer companies are part of this (Refer Time: 06:48) it has fortune 500 firms in certain other pioneer companies. Those have formed this correlation and they are trying to work for the environmental benefit. So, India is not part of OECD. Which I should you OECD

India is a non OECD, but there are certain talks which are going on where we should would use the databases or India's companies be data bases are being used in analyses or a statistical data bases are being developed.

So, those things are slowly coming up, but in India we have different ways to deal with the different ISO standards. Those deal with the guidelines to work on the environmental hazards like I just took the example of the leather industry in Kanpur which is not shifted to a remote place that is Unnao that is a place that is around 40 to 50 kilometres from Kanpur city. And that is that would have it is a centralised and decentralized water treatment plants. So, these are the steps which have been taken by the governments in India in many ways.

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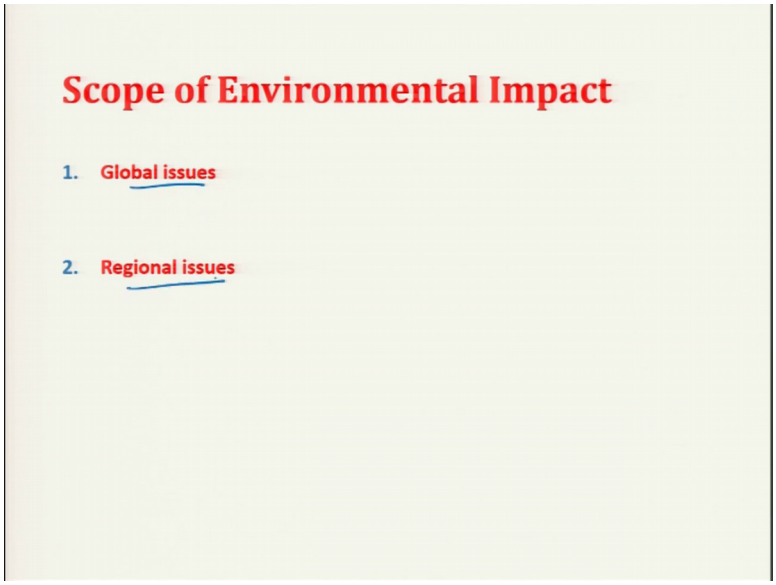


Now, scope of environmental impact number 1 is global issues, number 2 is regional issues.

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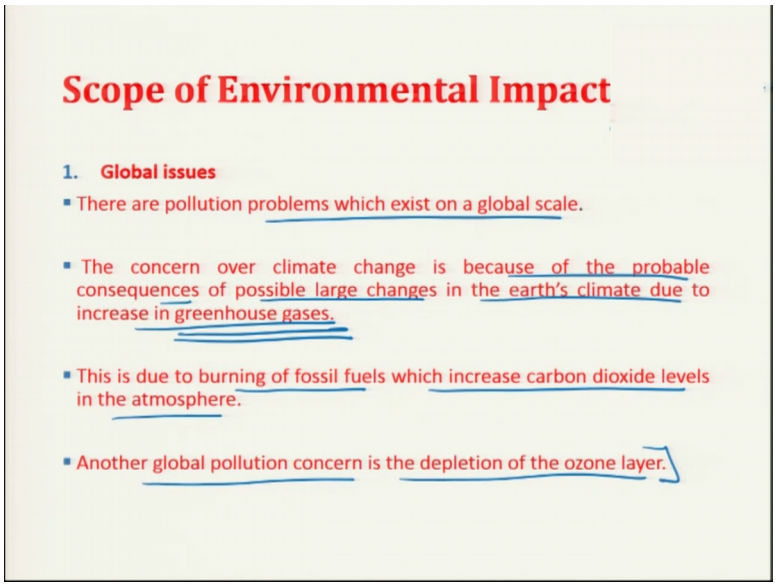


Global issues to discuss their pollution problems which exist on global scale the concern over climate change is because of the probable consequences of the possible large changes in the earth's climate due to increase in greenhouse gases. This is the first global concern. So, this greenhouse gases issue is due to the burning of fossil fuels which increase carbon dioxide levels in the atmosphere. Another global pollution concern is the depletion of the ozone layer.

So, this has also become a global issue which people think of or the these are the concerns over the climate change or the ozone depletion of biodiversity laws. From the product design point of view developing products that use less energy will help to mitigate this problem. The ozone layer is a thin layer of the upper atmosphere you know the flow carbon gases from our industrial society react with and reduce. The ozone gas in this layer from the from a product design view point. Developing products that do not from the product design view point developing products that do not make use of or release these harmful gases. Harmful chemical gases either in use manufacture or disposal this will help you solve the problem.

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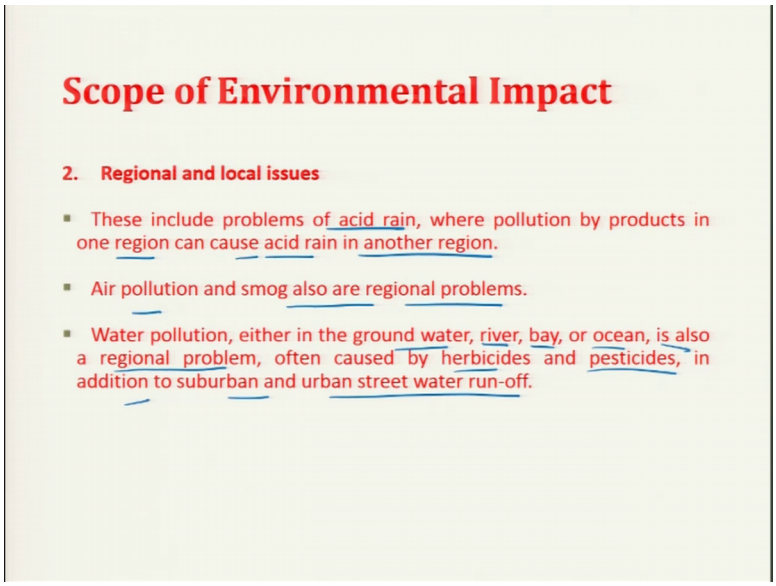


Then comes the regional issues. These include problems of acid rain where pollution by products in one region can cause acid rain in another region. Air pollution smog are regional problems. Water pollution either in the groundwater river bay ocean is also a regional problem. Often caused by herbicides and pesticides in addition to sub urban and urban street water runoff. So, other contaminants can enter through streams and landfills as water pollution. Herbicides and pesticides are typical problem compounds which are mounds introduced to a regional area must be controlled.

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So, these are a general issues then comes the waste management. So, waste are generated in each phase of life cycle and they need to be properly managed to protect the environment. The management of waste may involve alternative processes such as following.

What are the processes we have discussed this just to put it in a definition form or just to put small meaning of this. Reuse means the use of the product or parts thereof in new units of the same product or in different products. This we have discussed in new units in the same product or in different products in the same product can be using the car the different products or in the different way can be using the components on the nuts and bolts taken from the car into a different kind of the application maybe in a motorbike.

Or using the cotton clothes that are not wearable as mop or to use mop the floors. So, recycling this means the use of material in the product for manufacture of the same or other products. So, this is given by environment management 256m this definition is given by them. Then incineration this refers to the combustion of the product generating heat that may be used for electricity production or heating.

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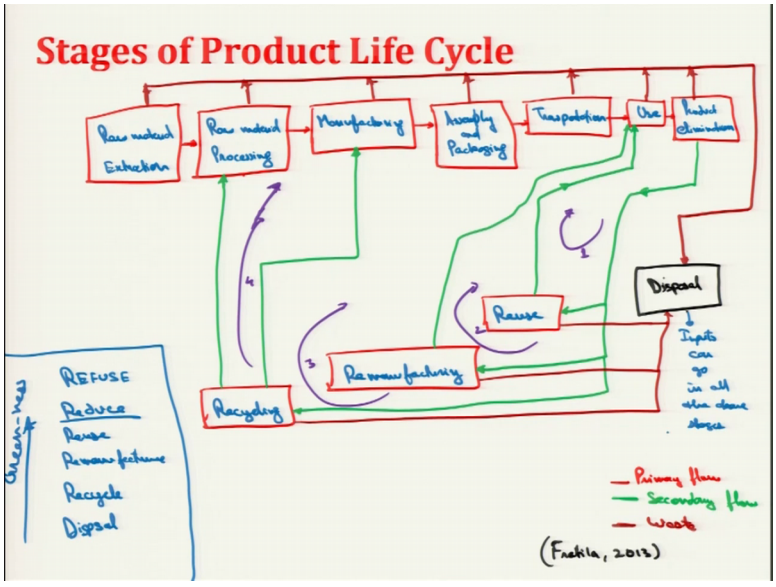


This is something which I just mentioned in the previous lecture. This is something that comes from here as I said some inputs can go. Here inputs can go in all the above stages. So, this burning or the disposal this burning that is mentioned here, that can be there in

the disposal cage as well. Which can be used for electricity production or for heating next is composting.

This refers to the microbial degradation of biological materials yielding compost for improvement of agriculture soils. Waste water treatment this referrers to the organic method degradation and nutrients removal from sewage water. Creating sludge that is deposited on agricultural land. So, this is treatment and again it is used in a different productive formed. Then land filling this means the deposition of the product in the landfills. So, these are the general ways to deal with a waste. What are the various sources of waste? That we need to see. So, each form of waste treatment mentioned here may be considered a processing of waste that is associated with certain consumption of resources again. Everything is consuming resources here.

This results in various releases into the environment and the possible generation of energy or materials that will be an input to the manufacturing process of the present product or maybe for the other products.

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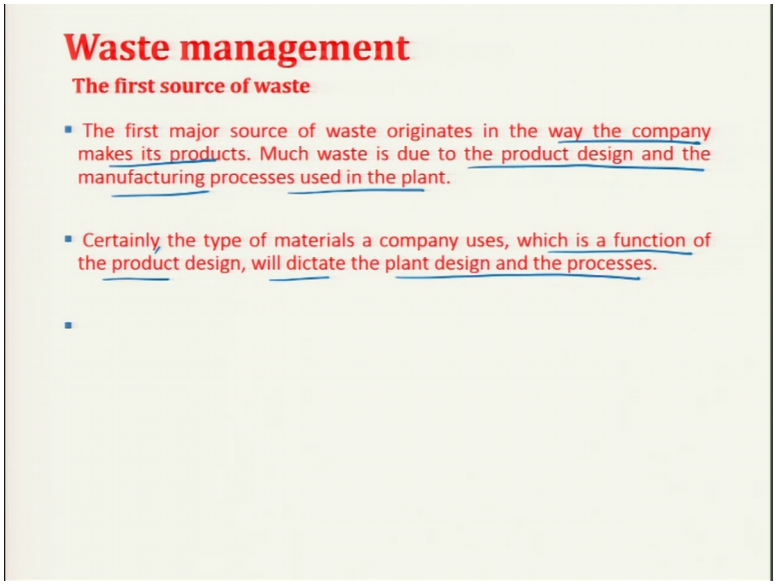


So, it is a good idea to look at the various sources of waste, when we move further the first source of waste originates in the way the company makes it is products. Much waste is due to the product design and manufacturing processes using the plant. Certainly the type of materials a company uses which is a function of product design will dictate the

plant design and the processes. Each material and the associated manufacturing processes have their own set of the waste parameters that defines the facility.

In leather manufacturing as I said the waste is chromium. Or the waste water is there because that is water intensive industry. In manufacturing in maybe chemical factory again the chemical would be the waste materials that all depends upon in automobile assembly there will not be much waste because that is only assembling. There and in manufacturing it all depends at first stage or what is the design of the company that we are talking about. Provided all this still some of the waste occurs due to the organisation of the facility and the operation norms that the organisation has established or developed.

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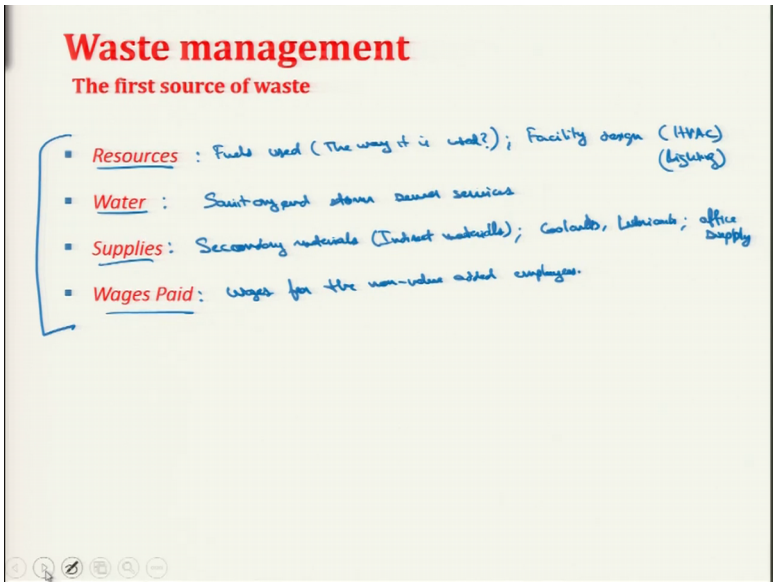


So, these norms operation norms can be from the resource they use, the water they supplies the wages they paid. The fuels needed to operate processes machines and equipment using manufacturing sequence. These are resources ok. Fuels used the way it is used. Now this would also include the plant and office heating lighting air conditioning right then facility management. Management in a way facility design that is heating ventilating air conditioning then lighting.

Because we are talking about manufacturing systems; manufacturing systems often include the design or the facility if we just talk about the machining or strategies and this supply change that also is important that is the part of it, but the sources when we talk about the facility, what is the design of the facility? What is the overall heat that is

required to bring the facility into the workable temperature? Or what is the air conditioning? What is the cooling that is required? The design of the facility based upon the kind of the processes or the products those are produced that is important. Now water consumption is a second part. Now this also includes the associated cause of sanitary and storm sewer services right. Next is supplies; the secondary materials the supplies is a secondary material. So, these are secondary materials that are required to complete a manufacturing operation or process, but do not become the part of the product.

These are actually indirect materials ok. The examples are coolants, lubricants, then office supply etcetera. Then is wages paid; since we are talking about the environmental waste here wages paid would mean the wages those are paid to you know individuals and to contractors or suppliers who do not add value. Wages for the non value added employees right. So, this is the first source of waste that comes from the way company makes it is product ok.

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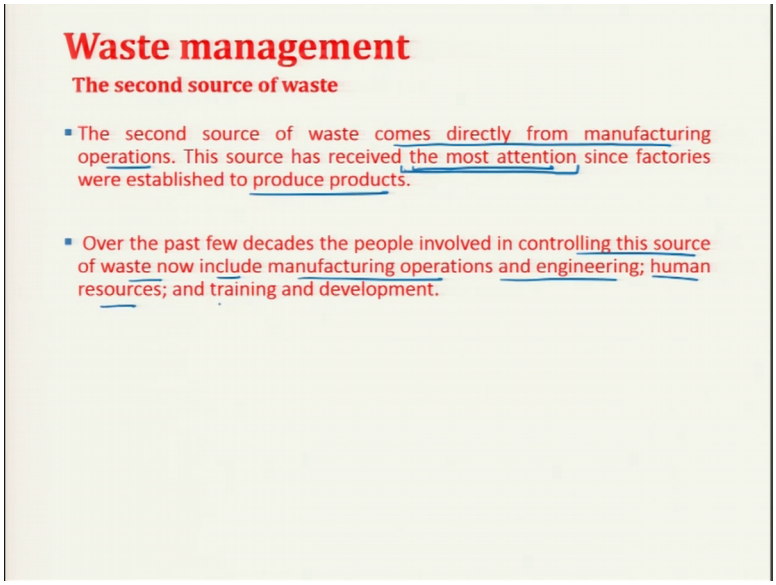


The second source of waste comes directly from manufacturing operations. This source has received the most attentions since factories can see them and this factories were established to produce products. So, over the past few decades, people involved in controlling this source of waste now include manufacturing operations and engineering human resources and training and development.

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So, what are these sources there are certain or maybe 8 major categories. Number 1 is waste from overproduction. There are lot of programs or techniques like we call lean manufacturing. As I said DFE is a big umbrella ok. In which the manufacturing is one of the technique LCA the actually lean manufacturing is actually meant to work on these. This is for the manufacturing LCA is working on the all the sources in a way.

Then now we are talking about agile manufacturing ok. Agile manufacturing now we have green manufacturing. Based from over production is the first point why is overproduction? Overproduction is done to produce more products than are they required by the customers. This is often done to reduce the idle time or to make up for the anticipated defects or product losses.

Excess production also may result in the waste here. The waste of the products which are sometimes not sold then waste in transportation there are made they are made these may there may be excessive movements of the products or it is components during the production process this is the material handling and in practice this is moving working progress and this is out of temporary storage.

And this is moving by because of poor facility arrangement. Then waste of motion this is again the part of material handling. Waste of motion is occurs when the operator has to look for tools or for information when the system is not set in a proper way or to make someone adjustments of repairs or to free regions of blockings those are there. So, these

are few points and waiting also happens then the time that may be wasted to make the setup to complete to wait for the material to arrive to wait for the successive machine to free for work.

So, this waiting time blocking time we will see when we will discuss about the factor design. The simulation of the factor design or plant simulation we will see what is waiting time, what is blocking time there then work in process is also a kind of waste this includes all stocks components sub assemblies in manufacturing system. So, a minimum level has to be kept. Actually for all these processes minimum level has to be there working process then we have finished good also that is also stored some time.

So, handling again after manufacturing the handling of finished good is done and this is also become the source of waste when it takes more space and time. Then defects are there defects are sometimes unavoidable then rejected parts sub assemblies finished goods returns. Warranty work re work after sale sometimes the product recalls those things are there then scrap. Finally, material stocks are turned into scrap because of the product design or poor manufacturing process or product poor design process. So, for these things DFE again has to be worked upon.

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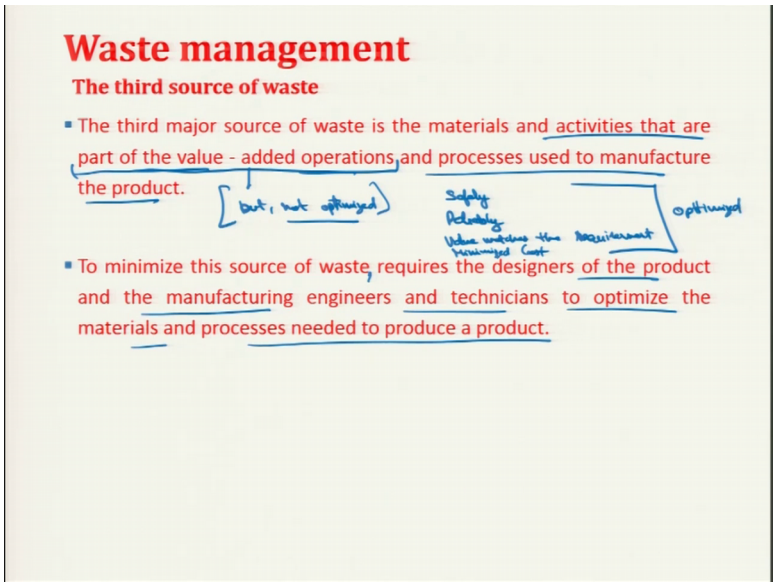


Next comes third source of waste. Third source of waste is the materials and activities that are part of the value added operations and processes used to manufacture the product. To minimise this source of waste it requires the designers of the product and the

manufacturing engineers and technicians to optimise the materials and processes needed to produce a product. So, this is actually nothing other than the optimisation. So, these are the part of value added operations ok, but not optimised.

This is what we are discussing in the previous lectures. We are trying to see how can we optimise the production? What is the specific production run for? How much time the machine has to run or what is the final production units? That we need to produce the certain probabilities discussing how to quantify the products? And in ANOVA we have seen that what is the significant factor that we can work on that is an optimisation.

We can also discuss about the algorithms of optimisation. So, this is the waste that is due to the not optimised techniques or the general techniques that we work on. What is optimisation? Actually optimisation is selecting material and processes that minimise waste while providing a product that needs it is intended function I will put the words safely reliably ok. And value matches the value that is value matches are requirement. So, the cost is also in such a way we say minimised cost this means it is optimise.

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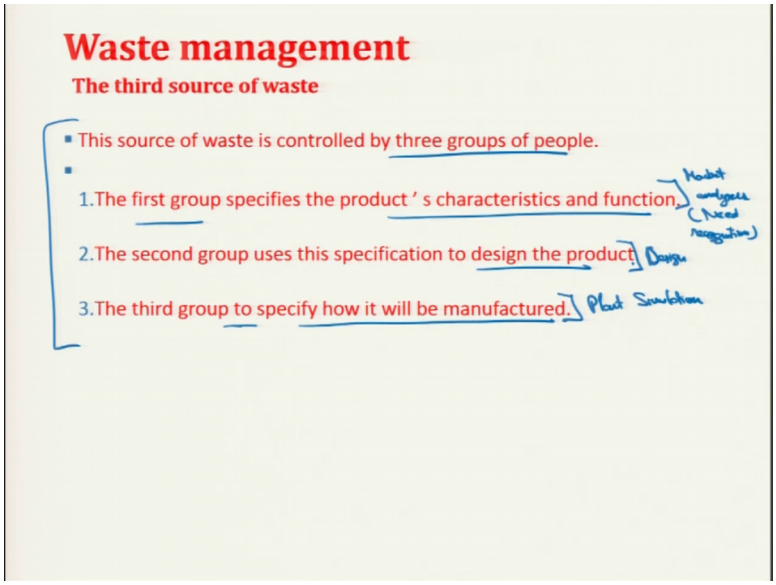


Now, this source of waste is controlled by 3 groups of people. Number first group is that specify the product characteristics and it is function. Who tell that what is the product; that means, to work on the second group uses this specification to design the product. And the third group involves the people who specify how it will be manufactured. This is plant simulation these are the market analysis who work on the need recognition right.

The second group is this specify these are actually design people. So, they can all together works to optimise what best is good for the company. So, these three groups or I can say the functions of the people involved in this activity are following.

This in marketing, product design engineering, manufacturing engineering and operations and so on. As I just discussed these are the sources of waste the major sources of waste the 3 major sources of waste or the kinds of waste that we have seen or a categories of waste. I will take this lecture to the implementation of DFE in the next part. So, this war the second part where we discussed about the waste management and importance of DFE. Next we will see how to implement design for environment and what is life cycle assessment. So, let us meet in the next lecture.

Thank you.