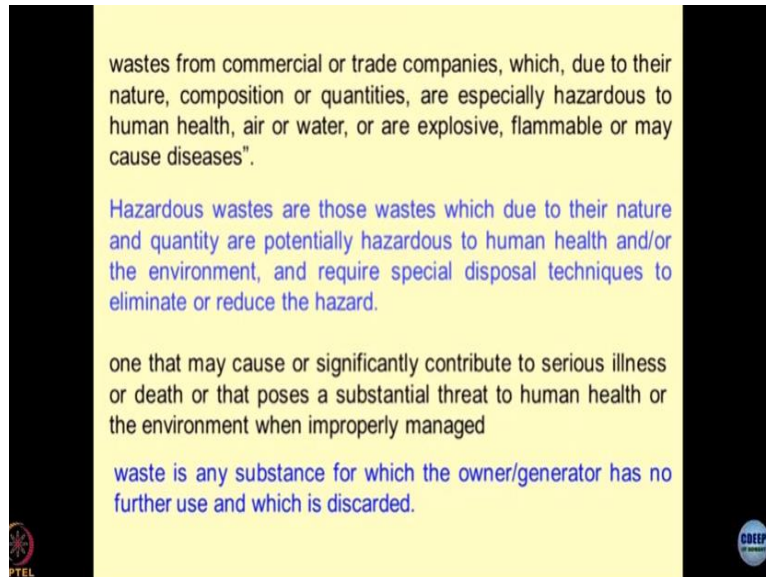


Environmental Geomechanics
Prof. D. N. Singh
Environmental Geotechnology Laboratory
Department of Civil Engineering

Lecture – 21
Waste: A Manmade Resource - II

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Let us go for some few more examples of or the definitions of the waste. So waste from commercial or trade companies which due to their natural composition or quantities are especially hazardous to human health. Air or water or are explosive, flammable or may cause diseases. This is another definition which is given by some organization. If you look at this definition, hazardous waste is those wastes which due to their nature and quantity are potentially hazardous to human health and or the environment.

Everybody talks about the human health and environment and require special disposal techniques to eliminate or reduce the hazard. All right so this is the attribute of the system. Another definition of waste is one that may cause or significantly contribute to serious illness or death or that poses a substantial threat to human health or the environment when improperly managed.

Very simple definition but a lot of messages is given over there. Waste is any substance for which the owner or the generator has no further use, and which is discarded. But I am sure you

will agree now this definition is totally dislodged its totally uncontemporary it is very obsolete why? Yes, the whole idea is to not write this type of statement. The whole idea is to synthesize the material to understand his property and then say yes, this material can be utilized. And that is what the contemporary thought processes say.

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To the types of waste, these are two categories of the waste nonhazardous waste and hazardous waste very wide categories, and in nonhazardous waste, we have municipal waste, and this could be an industrial nonhazardous waste. However, in hazardous waste, normally we talk about industrial waste. Another question is, how do you define an industry? That is an interesting question nowadays whether R&D is an industry or not whether education has become an industry or not.

Do you agree? So these are the questions which are contemporary, and you have to answer, and you have to classify them the way you can in one of these situations. There is an exciting act which is available you should read this, and this is what is known as RCRA. I do not know whether you have come across this or not the Resource Conservation and Recovery Act. How to conserve the resources for making concrete you require sands, you require gravels; you require aggregate, you require cement.

Cement itself is coming out of the natural sources. So truly speaking creation of cement and concrete is not a green solution. Agreed because you are emitting a lot of carbon dioxide into the environment. Now the question is how to recover and how to conserve the resources which I am trying to utilize. So one of the ways would be people talking about the completion of the cycle of sustainability.

So whatever I am digging out of the ground if after the process is complete and if I can put the residues back into the soil, the sustainability is done. So if you go through the papers which my earliest friends have written Prathyusha particularly and she has talked about what is sustainability and why we should be marrying different types of waste with each other to create some useful material.

These types of philosophies people are trying to work on or read the papers by JVP. Prathyusha Jayanthi Prathyusha she has written 2,3 papers on sustainability issues associated with the waste and the conservation. And of course, now this batch of students lots of work in this area if you see the paper which had been written by Rakshit on the utilization of dredged sediments and this was a publication 2,3 years back you can check out all these publications on my website, and you can download them, and you should educate yourself to see where the profession is heading to.

So Rakshit talks about the application of dredged sediments. So coming to the municipal waste the list is not so big. Mostly the municipal waste compost, compost could be pathogenic. It might be having microbial aspects associated with it. Scrap tires so the more and more automobiles you have in the city you buy a car and usually the dictate from the companies is after six months you should do a tire rotation, and you should replace the tires and so on.

So the more and more number of automobiles you have in the city or the country what the big challenge you have is? You are producing more and more scrap tires. So though on one side this is a symbol of status as well as the strength of the country and the prosperity and GDP is going up. But the second side what is happening. So the more and more automobiles you have their engines have to be fine-tuned, and engine oil has to be changed where it is going to be disposed nobody has any idea clear and how these scrap tires should be utilized is a big issue.

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Used oil is a good example of the oil which is coming out of the engines of the automobiles lubricants and transformers because oils are dielectric material. So oils have a certain life once you want to replace the spent oil, used oil, burnt oil what do you do? You do a complete process to clean it all right the way kidney cleans up your blood in the body. So the question is where to dump this used oil and how to rejuvenate it how to use it and so on.

Sewage sludge I think we have discussed a lot about this the biosolids which we have generated, and we are clueless now how to do the biosolids because these biosolids are pathogenic in nature and hence you cannot use them even fertilize as a fertilizer. You cannot spread them on the top of the surface of the earth and so on. Water treatments sludge I think I have discussed all these things earlier if you remember.

So whatever treatment process you follow either the water which is drinking water or the sludge we are going to produce sediments which would require particular treatment. So this is where I suggested reading the papers which are written by Sushmita Sharma you remember I had talked about SEGS socioeconomically generated sediments. So read her papers, and you will realize that what is that we are trying to talk about.

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The list of industrial nonhazardous waste is huge because this is a good sign also that the country is flourishing. We have so many types of industrial activity going on in the country very nice. The more and more industrial activities the more and more prosperity it should have brought but unfortunately what is happening the more and more industry the more and more influence on the environment and contamination of the geoenvironment and now the situation has become desperate we do not know how to handle it.

So coal ash I am sure most of you are aware of you must have worked on this as well. Fly Ash and bottom ash we use 30 to 40% in making concrete fly ash, fly ash are also being used for making embankments that are good examples in India. I think I cited some examples also where the fly ash is being used as the embankment fill material. Right now this type of works is going on the Eastern part of the country close to Calcutta.

If you ever get a chance to move from Calcutta towards IIT Kharagpur, you will see a lot of flyovers are being done where the soil is not being used, but the fly ash is being used as fill material. By virtue of the properties of fly ash and bottom ash that these are stable materials, they do not consolidate they are granular material in a sense silty sandy material easy to place though it flies off, but you cannot compact it is a big issue, but it quite resembles and very close to the natural soil and it can be used.

The second one is ferrous and non-ferrous slags different type of slags which are coming over industries iron slags, Blast furnace slag, copper slag, chromium slag. So these are the industries which are the muscle of the country. The more and more steel you produce the country becomes more muscular. Is this correct? But the issues are that the more and more steel you produce the more and more slag also gets produced. And now you do not have any answers where the slag should be disposed of.

One of the intelligent ways of doing using the slag would have been what people have earlier used is done is they have created PPC Portland Pozzolana cement clear. So this is where the blend the cement with the slag and you can use it. Micro-fines is another good example of sledges converted into micro-fine cement just by crushing it, pulverizing it making it ultra-fine.

Reclaimed paving materials, so the more and more infrastructure is developing roads have been overhauled in the country everywhere. The question is that the top layer of the roads which is asphalt bituminous after you are rehabilitating the entire road where would you dispose of it because this is a source of leaching of carbon. So you must have noticed when the roads are done.

Normally they scrape the top surface and the dispose Macadam in the vicinity itself when rains come the chances of carbon will leach to the groundwater, and it will contaminate the entire unit. So reclaim paving materials are also becoming a focus of discussion Construction and demolition debris millions of tons of the C&D waste is being generated. And unfortunately, it is either being dumped in the landfills or it is stacked somewhere.

Alright because we do not have designated places where the C&D waste should be dumped. So this is becoming a big issue. There were some initiations by NGOs where they used to crush the C&D waste pulverize it and then they used to use it for alternate construction materials. And this material has been shown to be quite good material for creating concretes of low grades.

Some of you might also evolve in this area where people are talking about recycled aggregates. So demolish the RCC structures and then try to retrieve the aggregates and recycle them. So this

is where a lot of efforts have already been made both in our country as well as abroad. Cement and lime kiln dust all right so this is a big issue face. Sulphates where do you use sulphates different types of acids which you are manufacturing alright different type of fertilizers.

Foundry ceramic silica fumes. All these are good examples of nonhazardous industrial waste. Dredged material I think I talked about this when you dredge the clays or the soils from the seabed, ocean bed or lakes or rivers the problem is that these sediments have mostly high contents of organic matter. And by virtue of this, the water absorption capacity is very low. So the biggest problem is how to reduce the volume where to stack them what to do with them. And truly speaking red material could be a good geo material islands have being made out of it.

So disposal is an issue where are the designated bins you understand bins dustbins where are the designated places where the dredged material can be stored. And how do we reduce the volume? A lot of research is being done in this area. So we were creating solar heated red sediments disposal systems coal ash. So this will be the stack of the material which I can use tomorrow for creating some infrastructure.

Soils are prohibited you cannot dig out the soil nowadays. Now everyone is aware of this because of the various court judgements and so on. So this seems to be a very interesting material for geotechnical engineers to sustain the infrastructure development. Minerals of different types of waste products, mill tailings, coal refuse, washery reject, phosphogypsum. So these are the processes by which you produce a lot of mill tailings. And the question is what to do with the mill tailings.

What you should be doing is you should go to the web internet and check what are waste rocks right what are mill tailings, what are coal refuse I will show you one example of a project which I dealt with as far as the washery rejects are concerned from the coal. Coal is also washed, processed before you start selling it and using it. So I was involved with the project, and I will show you today phosphogypsum when you produce urea fertilizers the phosphogypsum gets produced as a byproduct. Now the question is what to do with the phosphogypsum. So as the name suggests this is having a lot of phosphorous in it and then can this pH be neutralized by

using some other material and can create a composite which becomes the construction material would be an interesting question.

Agricultural waste we have talked about this animal manure crop left out wood which is lying in the field. These are good examples of industrial nonhazardous waste. Then comes the series of organic and liquid waste different type of waste in the liquid form and the organic form. What to do with them where to store them how to dispose them. Even the liquids which are coming in the form of the leachates from the landfills a big question is what to do with those leachates where to dispose of them.

Different types of combustion residues. Some people say that the MSW should be combusted and big question if I combust incinerated at very high temperature whatever residues will be created the ash it might also be having toxicity. So what I am supposed to do with the ash where I should dispose of it? So that becomes a secondary source of contamination and so on.

Plastics is a big issue in the contemporary society, and this is where Goli is trying to work on utilizing the plastic which is coming out of the municipal solid waste and marrying them with the industrial byproducts to create interesting composites which would be a big game-changer in the infrastructure industry. So our idea is to create components which are required for infrastructure development by using these type of industrial and domestic waste and clear something interesting out of it.

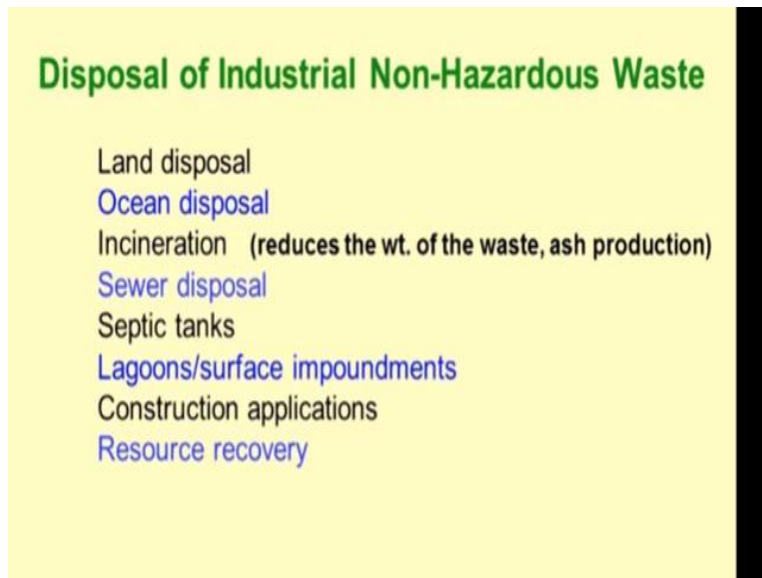
Government of India has a special mission on this how to minimize the waste, and they are encouraging a lot of startups also in this. There is something known as AGNI, and this is the initiative which is taken up by the government of India and check it out what these guys are doing and where the focus is AGNI and then the waste glass. So the more and more industrial development takes place more, and more society attains wealth becomes more affluent.

One of the ways of judging the affluent of society is the amount of glass which is discarded do you agree with this. So this is directly proportional to the affluence of the society. So glass is used everywhere alright different types of beverages, a different type of drinks, different types of

waters and different types of containers, and so on. So the more and more glass a society produces it is understood that affluent.

It is a very interesting philosophy, and now you have to work on this philosophy to produce guidelines and see what can be done and what is being done I will show you.

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So the disposal of industrial nonhazardous waste is a big question. Most people dispose of waste on the ground biggest stack which we have been talking about alright it has the only issues we have discussed this in the previous lectures. So when the rain comes, the water will start seeping through it and ultimately contaminates the geoenvironment. Stability of these types of the stack is an issue under static conditions and earthquake conditions both how high I should be going how much base width these stacks will be the occupying footprint of those stacks is a big question.

So land disposal has its own pros and cons. You might be disposing of the waste which is likely to become airborne ashes, red muds alright, so it is big havoc. So the moment you dispose of it if it flies of becomes airborne. The society gets affected you will be surprised to know that guidelines are not available what poor industries are going to do whose job was to create guidelines and the code of practice. What again I am asking the question what is central pollution control board? It is not chairs and tables clear. What was my question? Whose job is it?

Ultimately the scientists, the policymakers who should have come out with the policies of how to dispose of the waste, what should be the modality, how much should we dispose of in what manner treated or not by the pretreatment is the master not after stacking. What should be the policy further? How long do I want to store it over there? Is there a policy on this? And if I do not follow any norms, ultimately what is going to happen? These stacks are rising every day. And then the chances are that they may fall on your head. They may cause accidents.

So now you can realize the whole thing. So, this becomes a chicken egg story. Even if I do educate people to throw the garbage in the dustbin, ultimately where the garbage is going to go the chances are that it will end up in a landfill. So what I am supposed to do with this material if it is not degradable are you realizing, so these are the issues. So as a nation, what we should be doing and how we are supposed to take care of our waste is a big question.

So the time has come, and people like you should adopt this material as a manmade resource and create something out of it. Is this okay? Why do excess mining when I might be having a resource in another form available by as an outcome of some human activity? So these are the thought processes which are framing research concepts. And this is where your research theses or the paper that you write become policy papers for the government.

Do not think that nobody is reading these papers. A lot of guys who read and they communicate with you, and they contact you, and they ask for your help is this clear? The Genesis of ideas and how it goes up to the planning stage of ocean disposal. So there was a time people used to dispose of everything in the ocean, particularly industry which is operating in the coastal areas they thought that nobody sees so you just dispose of everything in the ocean.

Sewage is a good example, and what happens during high tide? Most of you are from the coastal belt when high tide comes what happens? Everything comes back to the ground, so ocean gives you back to dumped over there a few months a few weeks back. So this type of ping pong goes on again you will collect it and well dump it in the ocean again one fine day ocean will spill out

of the thing. This is particularly in context with nuclear waste disposal. And the thermal power plants which are operating adjacent to the water bodies.

So what they used to do, they used to dispose of things in the ocean beds until the international agencies started observing this and serving you notices. Nations can get also know even the nations if they are not following, they will be served notice and even if after seven notice they do not follow then okay. Again if you do not follow sanction in the history of using last 15 years what has happened, and then suppose if you still do not follow the dictates war.

So the whole story is connected from here to here. I hope you got all of all the idea. So if somebody says show me how are you managing your atomic activities. So these are the treaties these are the proliferation rules which have been created, and if some nation does not follow, we have to face it incineration just now I talked about. At very high temperature you try to convert from solid to the gaseous phase. And this is the best way to deal with hazardous waste. But unfortunately, the question is, do we have so much electricity as a nation?

Imagine what the calorific value and city like Bombay we are four months it rains is. So most of the waste is in the wet form of organic matter. If I am trying to incinerate it, I have to pretreat it, I have to precondition it I have to heat it to remove the moisture from this. So these are the big challenges, and these are not grams and few kilograms of the material which we are talking about. These are millions of tons. Bombay city might be producing 7000 tons of municipal solid waste per day.

So imagine this is the magnitude of the problem which you are supposed to handle. Different types of sewer disposal septic tanks whatever sediments, lagoons, surface impoundments all these are examples of how to dispose of the waste and construction applications, construction demolition debris and resource recovery also comes in the picture. So, this is the strategy which has to be created.

This subject is quite a demand-supply type of management skills sort of subject. People should realize that a lot of industries which are driving on the concepts of waste utilization. So this topic

is now number one in all R and D activities. Most of the time industries and government and people are supposed to be aware of what is happening in the country.