Environmental Geomechanics
Prof. D. N. Singh
Environmental Geotechnology Laboratory
Department of Civil Engineering
Indian Institute of Technology – Bombay

Lecture 07
Scope of Environmental Geomechanics - I

We had been discussing the scope of environmental geomechanics, its genesis and the main emphasis was that why this course should be studied and practised. There is more emphasis on the practice of the concepts, which we are talking about here.

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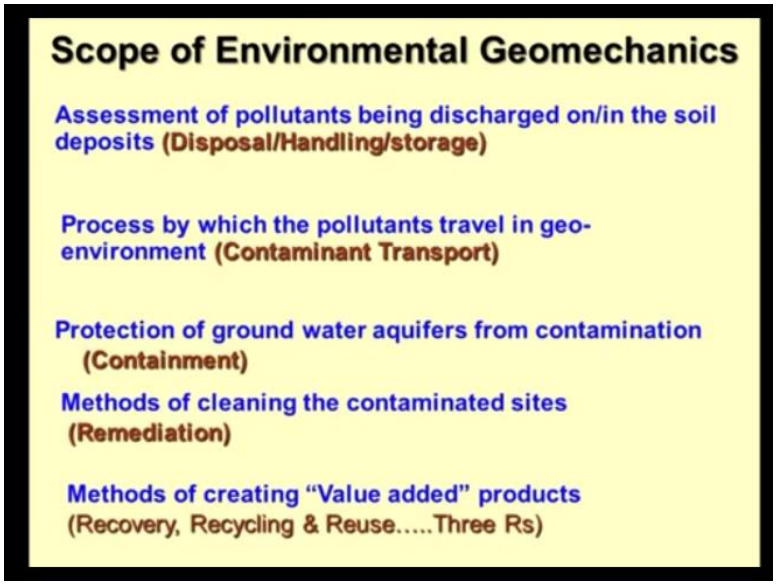

In continuation with this, in today's lecture, I will elaborate upon the scope of environmental geomechanics further in a more compartmentalized manner. The first job of an environmental geotechnologist would be to assess the level of pollution, and it is understood that why this exercise should be done because the source of contamination of the geo-environment is the pollutant or the pollutants. So it becomes very, very important for everybody to understand how the pollutants or the waste is being discharged.

And I hope you will agree that the waste is being discharged mostly from the industrial units because most of you are aware of the municipal solid waste, but here the focus of the discussion is mostly the industrial activities because the impact of industrial activities on the geo-

environment is quite detrimental and this is what is being realized. Now, this is the job of each organization, in fact, the industry to first assess what type of pollutant they are going to discharge in the environment.

I am sure that you must be aware that at the time of writing a DPR for a project, normally these issues have to be declared. So after the DPR is ready, normally the DPR goes for environmental wetting. We call it as environmental assessment or environmental impact analysis. So this what is known as EIA. So these are the mandatory things. Even if you are doing soil investigation these days, the environmental impact has to be studied of the activities, which are going to be taken up at an industrial unit.

Now I have been trying in since several years, particularly through the government and Indian government to make the guidelines and to assess you know what type of pollutants are being discharged from different industries and ultimately this exercise might lead to the creation of a, you know what do you call it as a zonation map sort of a thing, which would be a pollution zonation map of the country. Now, this is where our interaction with the industry starts.

Most of you must be questioning that, ultimately, where the environmental geomechanics concepts are utilized. So this is a subject, or this is the philosophy, which is mostly you know adopted by the industries, and they appoint experts, consultants who help them in coming out of these situations or many times government bodies, they approach you to build them out from a given situation.

So anyway I mean, this is a societal work where the technology is being used, and knowledge is being used to understand, what is the impact of the human activities on the geo-environment. So the first thing is the if you visit any industry or even the mining sector also, the mining is going on, that is the product, main product or for that matter any industry you visit they are producing something, say pharmaceutical industry.

So the pharmaceuticals which they are producing are the main products, but in the process whatever is being generated and you do not have any immediate value for this. This is what is

known as the byproduct, alright. So this is the story of you know the balance between the product and the byproduct. The first question in how much mining should be done so that the amount of overburden which is coming out can be handled easily.

Now, this is a very, very qualitative statement, but once you start working on this statement, you realize that this can be quantified. For a given amount of mining, how much waste I am going to generate, and what I am going to do with that. Now, this is what is meant by assessment of pollutants, which are being discharged either on the surface or inside the soil deposits. This could be soil; it could be rocks, whatever.

So this is where we talk about disposal handling and storage. So as we were discussing in the previous lectures and you rightly said, Gaurav, that you know whatever mining overburdens are coming, they store them, and they have developed manmade mountains in the regions and which are not very stable during the earthquake or even during excessive rains. So these are the major challenges, which industries are facing right now, where the geotechnology is required.

How am I going to dispose of the industrial waste? How I am going to handle it first of all and how I am going to store it, because I hope you realize industry has a limited space to operate from, alright. They have premises. Now it is a very interesting story that the product and byproduct has to be created from within that premises itself, clear, unless there are some designated places which have been created by the municipality or by the government bodies, alright.

So the chances are that most of the time the storage of the industrial byproducts is normally done within the premises only, clear. That means now you can realize the big havoc is, if I want my production to remain unaffected, I should have enough space to store the industrial waste. The second question is the more and more production is occurring, the more and more byproducts are going to generate, and there could be a situation where the storage space might become less.

Most of the industries are facing this acute space crunch. Apart from the space, when you are piling up these byproducts, there are chances that these byproducts might cause a sort of a

hazard. There could be a collapse of the heap, alright. There could be flooding, and during the flooding, the entire thing may get washed out, and hence it may inundate your facilities. You will not like this to happen, is it not? It is a very you know unthoughtful situation if it occurs.

So the first thing with which we interact with the different organizations is, that you like to assess the type of pollutants which they are producing and where they are discharging it, where they are storing it, how they are handling it, what the disposal practices are, whether this is being disposed in a dry form or whether it is being disposed in a slurry form or whatever. Gone are the days when people used to throw all these things, unknowingly unnoticeable on the highways or in the water bodies, because now the environmental rules are very very stringent.

So you cannot just throw them in a water body, alright. So if you read the story about the disposal of the industrial waste up to a certain extent, people use to dispose of them in water bodies, and they used to pollute the entire thing. Now again the question is, the more and more industrialization occurs, the more and more this problem is becoming severe. So when environmental technologists deal with these types of problems for him or her, this becomes a patient.

It becomes a case study and then what we try to do is, we try to give a solution to these issues. So this is the first scope of environment geomechanics, that means you access the extent of pollution and where the whole operations are being done. It so happens when you are storing the waste, it might come in contact with the environment. So the attributes of the environment are mostly solar, light, sunlight, wind, humidity, temperature, rains, what else.

So these are the attributes of the environment, alright. I think we have defined all the parameters which would create an environment. In extreme situations like what is prevailing right now in city like Bombay, when it rains heavily or when the flooding occurs most of the cities in the country are flooded right now. You are aware of this and people are debating whether this is a natural phenomenon or this is a manmade phenomenon.

So you will find you know articles on both aspects. People say, no, this is manmade. I do not know what your view on this is, but I hope you will get convinced that this is manmade. So if this type of situation occurs, where you have stacked the industrial byproduct, and mostly the quantities and the extent of the heaps, which you create are so big, that you cannot cover them so easily overnight. So the chances are that this material is going to interact with the environment, alright.

Suppose fly ash I am sure all of you must be aware of and you must be aware of that, what are the hazards associated with fly ash. So if I am doing dry disposal of fly ash, which is normally not done nowadays, when wind velocities increase, what is going to happen? These particles will become airborne, and they contaminate the entire surroundings. When you are doing wet disposal of fly ash, there are other issues.

Because the slurry, which you have made by dissolving or by mixing the fly ash or an industrial waste with water will have its own stories. So the chances are when you are allowing this type of interaction alright with the environment, the water percolates through these heaps and the leachates get produced. I am sure you must be aware of the word, leachate. I will discuss this in detail today. Now, these leachates are the chemical species, which might contain heavy metals.

Heavy metals are the ones which will act as a contaminant in due course of time alright. So these are the heavy metals, which pollute the groundwater, it pollutes the soil and so on. So the second scope of the work or the scope of the environment geomechanics would be, when the interaction of industrial byproducts or the wastes happens with the environment, particularly rains, the water percolates through the entire heap; leachates get formed, and they migrate into the geo-environment, soils, rocks, groundwater, clear.

So we would like to study this, how this whole process occurs. This is inevitable. You cannot stop this process, because as I said the extent of the heaps is so big, the volumes are so big, that you cannot really do much. Now, this is the genesis of the contaminant transport studies, which is at full swing in most of the western world and of course in our country also, but not many people are still aware of these processes.

But I am sure most of the western world has already mastered these subjects, and now this is high time when India and developing countries should follow these type of concepts and our students and professionals should be trained for this. So this is not a very good scenario, contaminant transport, alright, but we have to study it. Mainly we like to study how contaminants are going to migrate in the geomaterials, soils, rocks, groundwater and the combination of the three.

The third important scope of these studies would be, I do not want this to spread much, contaminant transport alright. So I want to curtail this. I want to contain this so that the disease does not spread in the entire body. So what normally surgeons do? They amputate your hands, legs, body part, is it not? Amputation means they cut it; they eliminate the whole thing. So this is what actually will also do.

We will do the surgery, and we will try that this spread of contaminant in the geo-environment does not become excess. Now, this is what is known as containment, alright and this work only geotechnical engineers can do. Why, because you are the guys who have done seepage theories, you are the guys who have done a shear strength of the material, you are the guys who have done compressibility of the material, consolidation of the material and everything you have done clear, which others have not done.

So these are very specialized subjects, and these are the realm of modern-day geotechnical engineering. I hope you can realize this. So coming back to the point, if I want to contain the spread of contaminants, particularly so that they do not attack my water bodies, the aquifers, although that is what is going to happen. All these contaminants will find out an easy pathway, and they will come and sit into the aquifers.

And that water you are going to take out for drinking purpose, and you understand what health issues we are going to face later on. So in most of the parts of the countries and cities, these type of problems are already happening. You know, in our own country there are several states which

are famous for groundwater contamination. Eastern part of the country is famous for arsenic, and you know the problems associated arsenic when you consume it and so on.

I hope you are aware of this. If not, then better read it okay. The fourth issue is many a times containment might be very expensive, or it might not work 100% efficiently alright. So under those circumstances, what you are going to do? I know that the soil mass, water, the groundwater and rocks have already got contaminated. So then comes the remediation, cleanup, washing alright. So we call this as remediation.

So fully being aware of the fact that the geomaterial is contaminated, I would like to remediate it, like treating a human body, what doctors do. They are aware of the disease. They are aware of the extent of the disease, and then they manipulate with the doses of the medicine in such a manner that the patient can be treated in due course of time. The last, but not the least scope of our activities would be a method of creating value-added products.

So this is what is known as valorization. So valorization is something where you are trying to create value out of a material, clear. So what we are trying to do? We are trying to get valorize you guys. Do you agree with this statement? We are doing valorization of human beings. Value addition to anything, whatever value addition we are doing by giving you lot of ideas, by making your brain to work, to think ahead of time alright.

So this is what the valorization is, creation of value-added things in any material. So this is where the concept of 3 R's comes in the picture. We say recycle, recovery, reuse and the fourth R, which has got added to this is very good, excellent, so reduce. What is that you want to reduce, not the production of the products, but the generation of byproducts. That means what you have to upgrade the entire industrial process.

In such a manner, that earlier you are producing, let us say x portion of the byproducts, now this should become x/2, x/4, x/10, clean technologies. I hope you are aware of some of the clean coal technology as a beautiful example of how you can reduce the level of contamination of the geo-

environment. Is this fine, any questions here? So have you understood, what is the scope of environmental geomechanics?

More or less, the entire thing looks like the procedures which are followed by surgeons. So this is where I say, that our profession is very similar to the one which is being adopted by medical professionals, doctors and surgeons and I will emphasize on this henceforth on most of the things, which I will speak out. So what do we do? We have a patient in the form of industry, in the form of a polluting body and then what is our job?

Do whatever you can, come out of this situation, clear. So truly speaking, the practice of environmental geomechanics is bottom to the top of this ladder. I hope you will agree with that. The first thing, I should be doing is, whatever waste is getting generated, I should try to reduce its volume, its intensity. Is this part clear? The second thing is, I should try to recover whatever I can recover from this, extraction of the precious things.

Whatever is remaining, I should recycle it and again make it a part of the chain of the process and then try to reuse it. A good example of this could be, even the fly ash is also combusted most of the time. I hope you might have heard about this because if industrial plants or the power plants are not working very efficiently if the machinery is quite old, the chances are that the unburned carbon in the fly ash could be very significant.

So rather than disposing of it somewhere, the logic says you recycle it and try to incinerate it to produce energy. This is one of the optimal ideas, which people are working on. Let us have a round of discussion. See, this subject is not, which can be taught easily. I hope you can realize you agree. Here the concepts can be discussed only and then ultimately who plays an important role, the surgeon or the doctor because he understands the patient better.

So this comes by practice or by sharing the thoughts or by reading more and more about what is happening in the world today, but let me tell you one thing you will realize that, this is the future of geomechanics. Otherwise, the conventional geomechanics would not have much of scope in

the present day scenario. So if you really want to do something interesting, you have to be on your toes to adopt new practices, is this okay. Yes.

"Professor - student conversation starts" Sir, as you said, there are heaps of disposals, so can we made some galleries or pipelines inside them to collect those leachates or contaminants, so it cannot be connected with the soil actually present under it. So it is possible to make. Very good, so on paper everything is possible. So if you see the designs, which have been done by the industries, 1) everything exists on the paper, 2) Nothing exists in the field. Why?

You require a very strong will to execute things, which are going to be good practices and by nature, we do not want to follow good practices, do you agree? So we do not believe in good practices. So everything is on paper, but when you dig out the site, and you ask them to show it, whether it is there or not, you will find that they did not provide this. Why, they just wanted to cut corners, save that 10 cents and which has put them in a bigger, bigger mess today.

So utopian thought, everything exists on paper, make sure whether it exists in the field or not, fine. It is a quick answer to your question. Most other things you have to discover. We have studied that like methods of waste disposal, like will create pits and dispose of all the solid waste and we create parking spots and all over that. So, in the long run, these are also going to affect the environment negatively, right?

Yes, so half information is correct, your half information is not correct, because nobody is going to let you dispose of anything these days. Why? Rules, there are many watchdogs, there are many NGOs. What are these NGOs doing? Protect the environment. God knows, but anyway there are so many interests, clear. So what is their job? We call them environmental watchdogs, alright. So most of the projects, if you read the history, they are under the big question mark.

So civil engineers say this project has to be done; someone else says no. These are the issues; first, you answer them. So all the projects are held up. We are losing time and money, and people are unable to develop. They are not able to enjoy the comforts. So imagine you know, when you

come into it, you will realize that these are the issues. Technology is one part of this, one-eighth of the pie, which I discuss. "Professor - student conversation ends."

Social issues, political issues, economic issues, you might have given a solution, which nobody will be able to buy. They will say it is very expensive. They will take two years to call you back, like okay whatever you said two years back, no let us do it. Some of my projects got materialized after 13 years. You know this, yeah, so R&D is all about patience and whatever.