Sustainable Materials and Green Buildings
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Lecture 2 - Basics of Carbon Cycle

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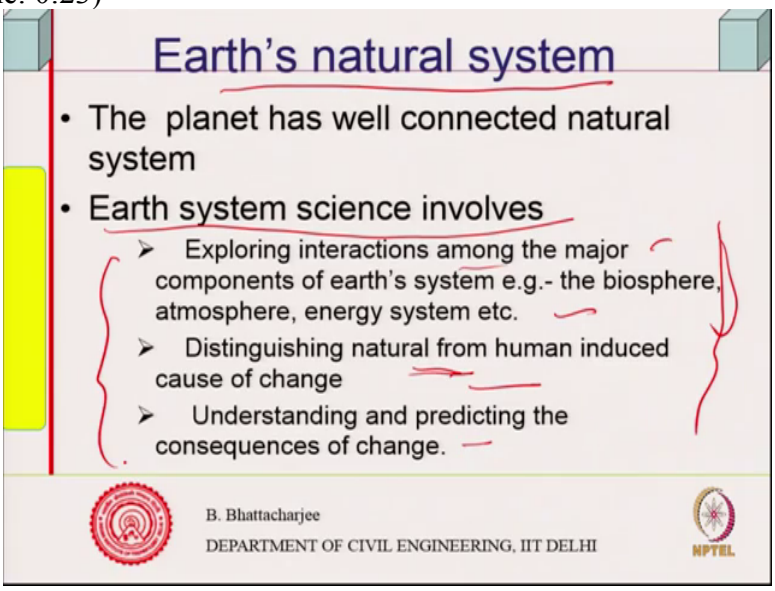

So, continuing from the planet equivalent right, that is what we have seen that if you continue to consume in the same manner then you would require more the, I mean we are not within budget. The other thing that we would like to discuss now is earth's natural system. So, earth system science involves exploring interaction amongst major components of the earth system, for example biosphere, atmosphere, and energy system et cetera, et cetera. Right.

So, we have to actually look also into natural changes that occurs, vis-à-vis human induced changes, right and then we should actually predict what is the impact of such changes, right. If we want to control the you know, we do not want to go to three planets equivalent scenario, then this is what we should look into, exploring the interaction amongst major components of earth system, we must understand this biosphere, atmosphere, energy system although we will not go into great details in this because then that that those are the subjects itself by subject itself. And then any change that naturally brought in by nature or human changes and their impact we must study. So, this is the subject study that one should look into if one looks into the sustainability issues, you know making the planet sustainable.

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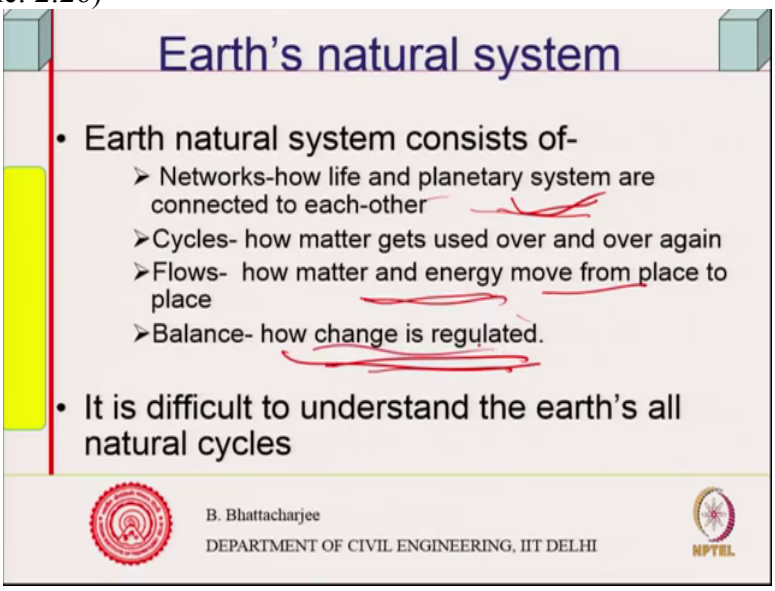

So, the natural system of earth consists of life and planetary system are connected to each other. Cycle, cycle means how much you can use over and over again and energy and matter flows in the nature in the overall system and the balance. If there is a dis-balance, for example you are generating let us say more than what is naturally occurring carbon dioxide at the top of the atmospheric level, then there is a dis-balance. So how would you regulate it? Because human action of using large quantity of fossil fuel has resulted in generating waste of the kind of let us say carbon dioxide.

Now that is what I am saying, how human action changes and we have to see how do we balance it. So that is you know the natural system that first is the life and planetary systems they are connected to each other, how much matter we can use use over and over again? For example, water. There is a cycle, you have a monsoon cycle which brings in the rain and the water flows directly over the surface flow, groundwater flows, goes to the ocean, evaporates and there is a cycle. So, that is the cycle part of it. Similarly, there is a carbon cycle we will look into it and then how matter and energy moves from place to place? For example, the moisture vapor bearing air moves upward from the sea and then tends to moves towards the, tends to move towards the higher latitudes and this that is what when it comes in contact with the temperature I mean cool and hot air mixed together, there can be condensation occurring.

So, rainfall because of this kind of scenario, so therefore movement of the material matter, movement of the energy of course is related to the suns and things like that. So how this change is regulated? There is a balance, how the balance is occurring or if there is no balance,

what is happening actually? So it is not very easy to understand all natural cycles, I mean it will take time possibly but one has to look into this kind of, you know one should study those kind of system although we are not going to, as I said in a big way into this.

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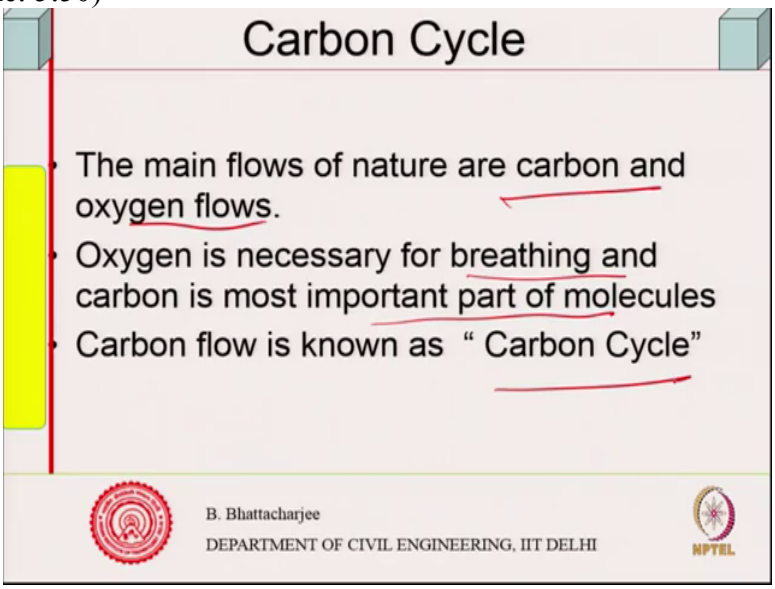

The main of course, the two things; one is a carbon and oxygen flow. The matter flow if you are talking of, carbon and the oxygen flow, right. Oxygen is necessary for life, oxygen is necessary for life and carbon is the most important part of the molecule and we talk in terms of carbon cycle because conversion to let us say heat energy, radiation to chemical energy is through carbon and which even we actually can again convert back into heat by burning since the carbon molecule which is most important. Therefore, we talk in terms of carbon cycle. Therefore, we talk in terms of carbon cycle, right.

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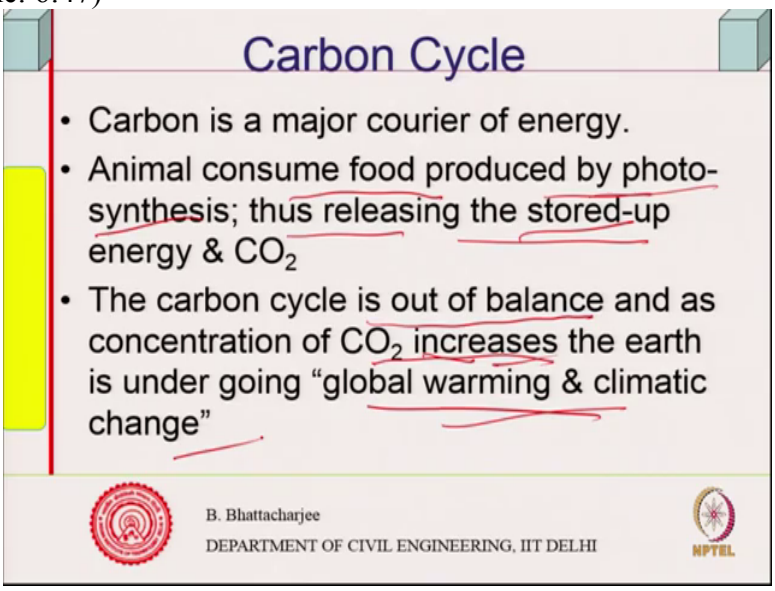

So, carbon is a major courier of energy that takes the energy, that is what takes the energy. So how does it happen? It is the plant which traps the solar energy, right in their leaves, chlorophyll, they trap the solar energy and this is what gives rise to your food, right. This is what the seeds finally you know like whatever wheat, rice whatever one takes so that this is the energy stored from there and then the animals should be eating those plants. And if people who eat the non-vegetarian or what you call omnivorous, the herbivorous obviously eats them and the others would eat them, omnivorous like human being they take everything. So in that case you are taking that energy actually but only thing who is trapping it is plants.

And these are also the the dead plants or dead carcasses of animals that has gone down below the earth, gets converted into fossil fuel over the period of time. So, animal consume food produced by photosynthesis thus releasing the stored up energy and carbon dioxide, right so the stored up energy is only through this and by the way people are trying to mimic this trapping the solar energy. You know there is some research is on along that line but can you have something very efficient trapping of solar energy? Nature does it that way, so can we have something? The chemical, chemists they do research along this line.

So, then who eats up those they release carbon dioxide and some of this stored up energy is used up for their activity. Now if the carbon cycle is out of balance and then carbon dioxide concentration can increase, so there is a cycle the you know there is a cycle as you should see, plant traps, animal takes them and converts some of them into carbon dioxide back. Or whatever you are doing, if you are burning the timber, then also you are producing carbon

dioxide. So the cycle of carbon therefore is very important and if this is out of balance that can result in global warming and climatic change, global warming and climatic change that we shall see a little bit.

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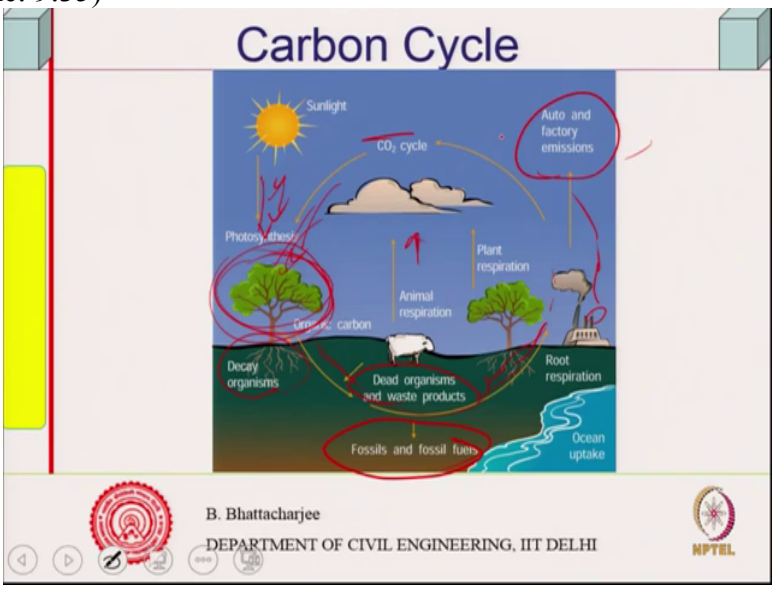

So, the carbon cycle is somewhere here. You have the sun, the photosynthesis the plants captures this, right and then some of those decay of organisms they could be dead organisms and waste products, they get converted into fossil fuels and you take them out. Some of them of course goes out at root respiration, plant respiration, animal respiration, they generate carbon dioxide, right and then you bring out to the plant, auto and factory emissions, then we have transportation energy emission, that again generates carbon dioxide.

Now this carbon dioxide is used up by the plant to convert it into carbon, you know this so basically plants use this carbon dioxide, with the photosynthesis it converts into carbon. So the cycle is something like this: carbon dioxide comes here along with the energy, converts into carbon and that is how the process is, because after all if you want to break carbon dioxide you need energy and the process of photosynthesis does that. The energy is from the sun, that is how it traps it and then this is the process.

So, this is the process actually, this is the carbon cycle. As long as it is in balance, now whatever is being generated, what is being you know whatever carbon is trapped and whatever is being generated through this if all of it is consumed by the plants, then everything is in balance. But if it is not consumed then excess will remain somewhere up there and that

means if your generation is too high that can lead to disbalance. So, that is where it comes, factory emissions you know and automobiles there that is what it is. Or else if you are using directly this energy somewhere, instead of this route directly you are using somewhere for your purpose in auto emissions or anything, auto and things like that, emission will come down.

So, the carbon cycle therefore is important like planet equivalent and that planet equivalent uses the consumption of resources, it is consumption of resources. Now what we are saying is that there must be a balance, there should be you know like there is a periodicity every year whatever you get you must consume that only and not more than that and you do not generate excess waste or the kind of this. So this is as I said, this was related to you know this is related to earth's natural system. We must just should not create disbalance. If you create disbalance then of course this will have its own consequences. So, excess carbon dioxide as we said.

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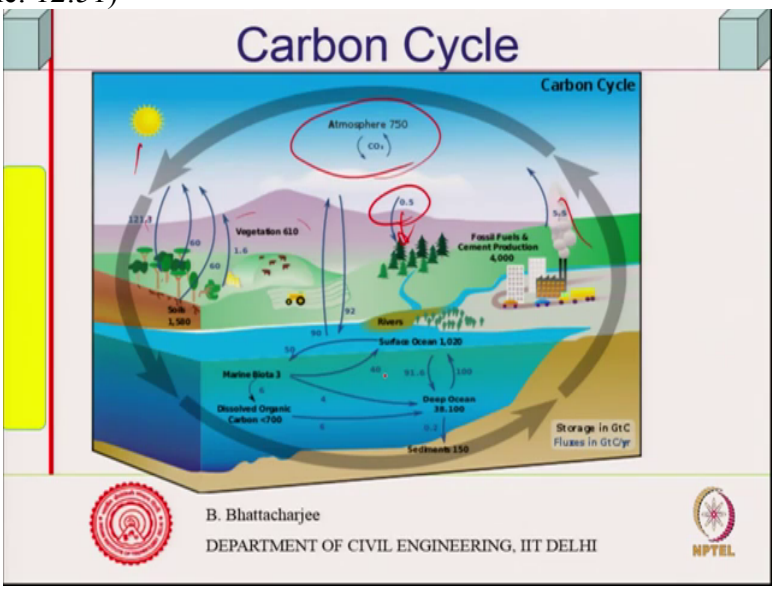

So, carbon cycle is an important issue, you can see the same diagram, it is available on Internet, plenty of them would be available on Internet, so much is being discussed now. Actually it is a big concern, so therefore a lot of it is being discussed now. Same thing, carbon dioxide here, the carbon cycle, the sun rays and this is being absorbed by this system. Ocean, there is some amount might be dissolved in ocean and so on, so it is a complete cycle again. So this is adding up, this is absorbing, accounting is given 0.5 for example here. Proportions

are some given, vegetation et cetera, etcetera, this one can look into. So, carbon dioxide you know carbon cycle is an important issue.

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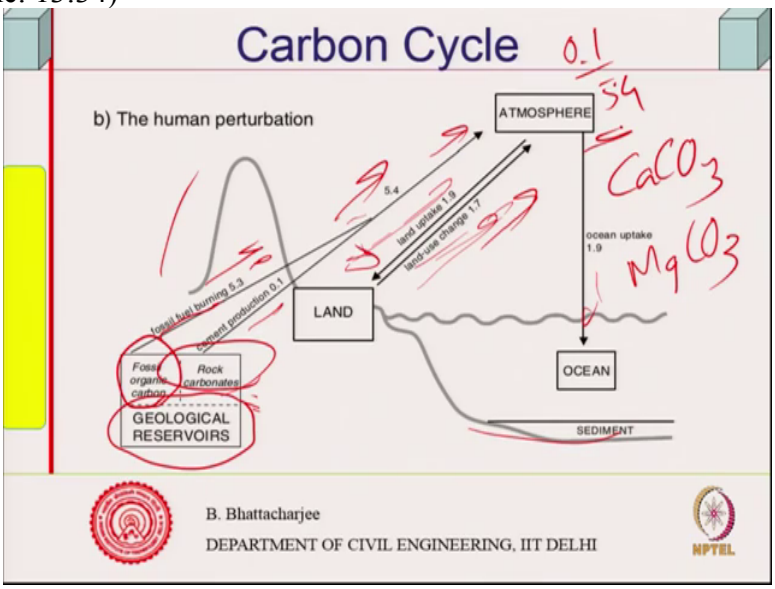

If you see, this is the you know this is the, so nature if nature you would have actually kept, it would have maintained the balance. Balance would have been maintained by nature and that must have been happening in earlier days when population was small etcetera etcetera and their consumption rate, autos were not there and things like that. Now then human perturbation causes the carbon dioxide excess carbon dioxide to occur, so you see the land area, somewhere there ocean, so if you see land use change you know land uptake is 1.7 okay.

So, carbon dioxide, mainly two places from where carbon dioxide comes, one is a fossil fuel and you are taking it from geological results. The other is in the rock, for example calcium carbonate and magnesium carbonate or any other carbonates they are there in the you know carbon dioxide in some form they got trapped in this one only. So these are the geological reserves, limestone reserve and fossil fuel reserve. So, when you burn them that is what results in, right. So relative values are given, 5.3, cement production 0.1, they add 5.4 there to the atmosphere. While this one land uptake and land use change, there is like some carbon dioxide is taken up by the land in the like your plants and trees and things like, they use up some and some go up as well. So there is a nearly balance in this kind of scenario, right.

There is ocean which will actually take up some of those because there are plants and elements, those are living things are also there in those places. So this is disbalancing and approximately you can see typically 0.1 of the 5.4, means around, there is of course slightly higher figure, 10 percent or so. 7 to 10 percent comes from the cement production, 10 to 7 percent comes but rest all is fossil fuel, rest all is fossil fuel.

So, it is the fossil fuel is the main thing which is adding up to carbon dioxide and due to human activity and then the cement. Cement is one of the major contributor to fossil fuel and that is why there is a big concern related to cement or similar sort of thing, so that is actually being said to the end of this discussion. What we have looked into let us summarize before we close down.

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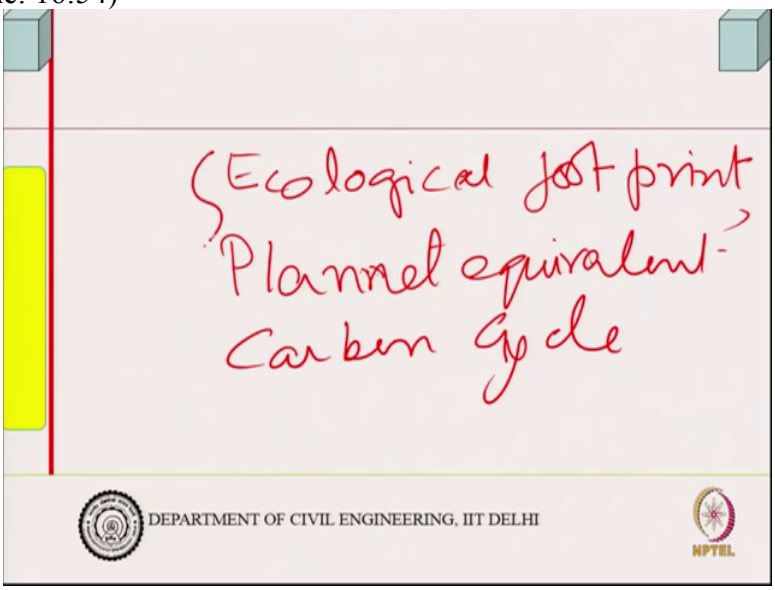

First, in the last two sessions what we have looked in? First, we have looked into what is called ecological footprint, followed from that we talked of planet equivalent you know, then we looked into lastly the carbon cycle. These are related to resources and energy put together and this is related to basically kind of unbalancing or not maintaining the balance in related to generating waste which I am not able to handle. Essentially carbon is the courrier of energy in the natural system, carbon dioxide is converted into carbon by plants and then you burn it, you can release that energy.

So, these three aspects we have discussed today, right. So I think at the point of time at this point of time we will be closing our discussion. If you have any questions I would like to handle it.