Environmental Quality: Monitoring and Assessment
Prof. Ravi Krishna
Department of Chemical Engineering
Indian Institute of Technology – Madras

Lecture – 5
Air Quality Parameters: Sustainability

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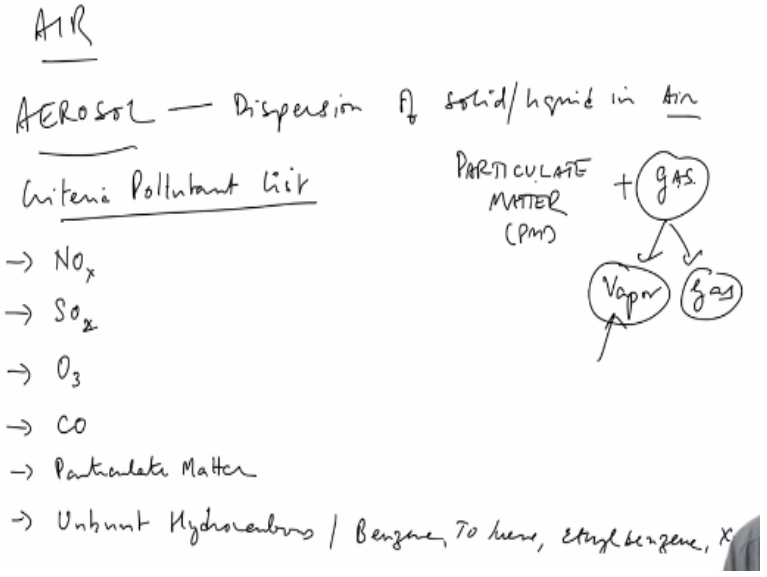

So, you have seen those screening parameters. So we go to air. The air so in air, we have only 2 things. So, there is a term called Aerosol. So, normally when we say air, so air is a mixture, air is really the aerosol because aerosol is dispersion. The term aerosol is dispersion of a solid or a liquid in a gas basically; but in our gas here we are interested in is air, okay, in air. So, here there are 2 components here. One is a solid particulate matter, PM plus whatever is there here, this is really a gas. So there are 2 phases so this is aerosol.

When they say aerosol, the reason they say aerosol is when you sample air or when you breathe, your breathing the aerosol, you are not breathing this you are not breathing one of the other okay, you are breathing both, so that's why the term aerosol is is a is a representation of when we are looking at this a mass of this whatever is here in the air here. So, here particulate matter is very straightforward you know that this is suspended solid, which is floating around in the air or suspended liquid liquid droplets are there or what's a combination of liquid and solid.

Sometimes you have a solid particle on which there is a small liquid coating and that is floating around, but in the other phase here, you have two components again here. This is just not gas, it is a vapor and gas.
Professor: What is the difference between vapor and gas? Why do we have two terms?
Student: above the critical point
Professor: ah?
Student: We have to define in terms of the critical point.
Professor: Okay or have a simpler definition
Student: they are non-condensable,
Professor: non-condensable, they are condensable at some condition right, if I take oxygen, I can condense it at some condition, some temperature and pressure.
Student: after that critical point the vapor phase becomes gaseous.
Professor: So, but here in atmosphere, the common ambient air, we call it as vapor or gas because and at this condition it naturally exists in the vapor phase, in the gas phase, but vapors can coexist as liquid and gas okay, water for example. If I have water at ambient temperatures and pressures, there is water vapor. If I keep water here, some of it will evaporate and it will create humidity as water vapor, okay, but oxygen or carbon dioxide or carbon monoxide or nitrogen, they exist as gas phase under the conditions that we are talking about.

So, thermodynamically they they are they exist as gas phase here, there is no vapor there. So, vapor, a lot of liquids that we are concerned about the organic liquids that we talked about exist as vapor phase also, they have a vapor, they exert a vapor pressure that's the property of the chemical, and if you leave a liquid outside, some of it liquid will vaporize and it will create it will go into vapor form. So, that constitutes part of that.

So, this is this is the part that we are worried about more because gas is there, that is one part, this this is the one we are worried a lot about because this can move from place to place because it can be if you are in the liquid phase it can go to the gas phase and so on. So, the vapor, when we measure the aerosol, we measure particulate and these these 3 components and these 2 are combined when we measure it, we don't but we can separate sometimes, we can separate this part depending on how we are doing, so we will come to that anyway.

So, this is all there is to aerosol, air and aerosol. So this smoke for example is an aerosol, it is a dispersion of solid and sometimes liquid particles in, so all exhaust is like that, anything exhaust coming out of a gas of a engine, any engine is an aerosol and this aerosol then mixes with whatever is there in the ambient air and then things happen, okay, alright. Any questions? So, from a regulatory point of view, we have to still finish this part. So if we look at go back to the, so here again, what are the there are large number of things that can get into air.

So, like the water, we also trying to prioritize, we need to look specifically at some big impactful pollutants first before we go and investigate what else is there in the environment. So when we say the air is polluted, we need some handle on that. We cannot just say air is polluted and because I may think the air is polluted, you may not think the air is polluted, so we need some kind of reference point for that. So again, there are large number of pollutants that are possible that can be present in the environment

So, people have a criteria pollutant list air pollutant list and this again keeps changing, but here what is the most commonly contributing source to air pollution? It is 'combustion'. The biggest contributor to air pollution is 'combustion' that's the biggest activity where there is something that is converted and an exhaust is released, okay. So from combustion, the the pollutants that that are coming out, one of the big pollutants is NOx. Then if it has sulfur there's SO2, then there is some ozone. These are 3 big pollutants.

What else comes out of combustion, 'particulate matter', there's carbon monoxide. You also have other things here. So long back when this criteria pollutants started, so this I will give you a little bit of history on it. There used to be another compound called lead, it's not there in most of the list now okay. This lead is to be a big part of petrol, gasoline, and it is used for as an anti-knocking agent and there is to so you have this leaded petrol, now you have unleaded petrol, there is no lead in this.

So, big chunk of the emissions does not have lead now. So it's being phased out. So as long as there is no leaded petrol and there is no need for lead to be in this most of it, but it may be an environment already, that's something that people don't, we have to see the data. If you see, there is enough amount of lead still in the in the particulate matter coming in the atmosphere, then we have to look at cleaning it up, but from a point of view of this, so there

there is not much reason for lead to be there, but sometimes now if a lead is not there, there is another people look at what is called ‘unburnt hydrocarbons.’

These these five are definitely there, the top five are there as criteria pollutants, but this sixth one and then there are a few more, sometimes people use unburnt hydrocarbons is when you put a fuel, combustion doesn’t happen properly, the fuel just gets hot and becomes vapor and comes out and it can condense when it comes out on particles or somewhere else or it can stay as a vapor phase for some time and go around. So, this is the fuel itself.

So, you can smell sometimes that when you stand near a vehicle, if combustion is clean, you shouldn’t smell anything, or if it is not, you can smell something, very pungent sometimes, that’s not a good thing okay. You also have along with this unburnt hydrocarbons and this thing you if you if you can get compounds that are there in the fuel as additives, not the main component of fuel. So, this includes compounds like benzene, toluene and xylene, ethyl and ethyl benzene and this constitutes what we call as BTEX, yeah.

So, these are all there in and out of several lists. So the Indian CPCB has this in their criteria pollutants and they have hydrocarbons they have this thing. Some other regulatory agencies do not have this, okay. The reasons are borne from monitoring. If you find a lot of if you do air sampling, monitoring, and if you find that these are all there and atmosphere, then it is important to monitor these things from time to time and therefore they become a criteria pollutant.

So it’s a very, it’s a loop that you have to do monitoring and then go back and see if there is any correlation and then that’s how the regulations are done. So, I will talk a little bit about regulation. The reason being why are, see this is a big critical part of the environmental business, science business unfortunately, but we have to that that is there.

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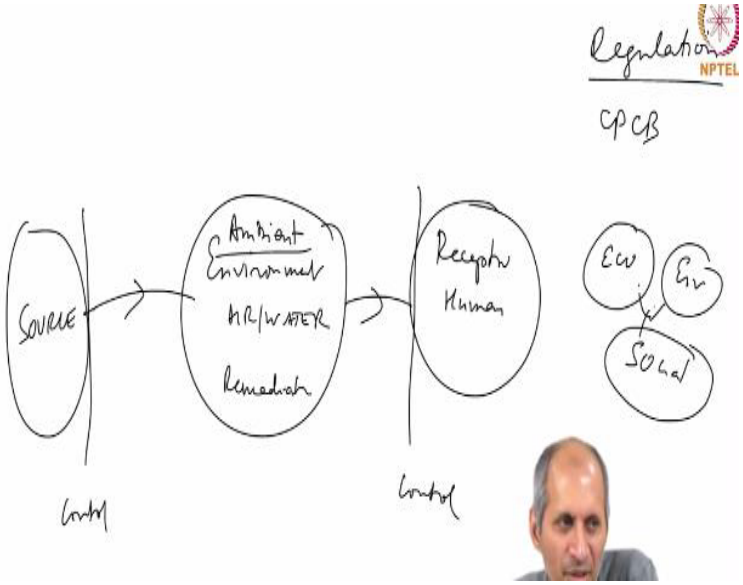

So there is we have seen that in the in the we seen in our initial discussion, we have a source, we have the we have the environment and we have the receptors, which is the humans. Here, we have pollutants going from here to here and you can either control it here or control it here or do remediation. Now, this part, it is environment, we also give it a specific term called ambient environment. The ambient environment is is common, is public property, it does not belong to any specific person, okay.

So as a society, this is a common property, air and water are expected to be common, okay. The air that one person breaths, if somebody else pollutes it, it is uncommon. So, if you have somebody who is smoking, so there is a lot of campaign about passive smoking. If somebody is standing next to you and smoking, you there may be things going into that person's lungs, but then whoever is standing next also maybe inhaling some part of it and that is that is secondary smoking and that people have a big problem with, okay. So it is the same kind of thing.

So, I am doing I am doing, I am smoking for my pleasure, somebody else can be paying the price for it. So, if some groups of people are doing an economic activity for a particular this thing and then that causes as a consequence of the economic activity, there is a release and emission that goes into the environment into the common domain and somebody who is not part of it is paying the price, okay. Now, for example, it is a very good example for this, say you are working in a factory, you have to handle hazardous chemicals, but you are getting paid for it.

There is social there's an economic factor there, but you may also get sick because you are working exposed to those chemicals, okay. So, say let's say that the company is giving you enough protection. You also know that you are getting exposed, so you protect yourself enough and you do the work yeah. So you are getting paid, so you are you'r taking enough precautions, you know what you are doing and you are handling it properly, but then you are finishing a process and it's gone. You are releasing some exhaust into the air or.

I will talk about air because air is more direct and visible immediate effect. It goes out and it goes out and lands into somebody else's territory and they are breathing it. They have nothing to do with this economic process. They don't even know this is happening, yeah. So who is responsible for it, so the liability, so to speak, comes to the polluter who is doing it, and therefore somebody has to intervene, and this is the role of the government. That's why we have regulatory bodies.

The regulation has to come from a from society and government is a representative of the society. So, the society should give feedback to the government to act on this thing. So, this is how regulations are put in place. So, the regulatory bodies agencies such as the CPCB are responsible for creating regulation and enforcing it so that the ambient environment is not polluted. So, for this, you first have to decide what is the ambient regulation that you need to have? What is the safe standard that you can live under? Okay.

Why is that? I can blanket, I can say that it is causing problem, I will shut down the industry and that's not a feasible thing because we have, here is where this question of, suppose say say vehicles are causing problems, I am going to stop all vehicles tomorrow. I can I can if I am an administrator, I can come and say oh yes too many people are complaining about vehicles in Delhi, let's just ban all vehicles in Delhi, the problem will go away, nobody will have a problem.

It's not a sustainable solution, the solution then it will cause a lot of problems, everything the structure in which the city is built so far, economic activity will suffer and as a result of it, you will have other social problems, everything may happen, very bad things can happen okay. This is the crux of what we call as the, in the discussion what we call as sustainability. It should not an isolation, you have sustainability where you have an economic model and we have the environmental the environment, and we have society, all these three have to merge.

These are these three are when they combine, we call it as a ‘sustainable solution’. It also has to be social. The reason when we are talking about economic is I cannot have an environmental regulation that is so prohibitively expensive that I cannot have an economic activity. I should have economic activity. If you go and ask somebody on the street and say that you are polluting, please don’t know my lifespan will be reduced by 5 years because you are polluting, and that person will say I am not even sure if I will I can have sustenance for the next five 5 years. So, I don’t care about your last 5 years of your life, I am worried about my 5 years now. So, this is the response you might get from somebody. So, this is a very difficult question to answer. Our society as large at large you if you look at different societies, we have we all have tolerances, you know. Our society has large tolerant of certain degree of pollution. They will say we will because we want our priority something else at this point, we will. So as the standard of living increases, your expectation of quality of life also increases and you can’t then tolerate.

How many of you drink water from a tap anywhere in the city anymore? You don’t, 20 years back people used to drink, I have had when I was a kid, so now I don’t, I don’t, I carry a bottle of water everywhere because I don’t trust the water because my expectation for quality of life is very high than it was 30 years ago or 25 years ago. So this is not an easy question to answer and I think as environmental scientist, I cannot answer this question, it’s not my role to answer this question, I can only give information.

This is what will happen if I do this, you make the decision and the decision is made by society. So you have all the things, I have the cost of doing this is this much, the cost of not doing is this much and you make the decision and the decision has to come from a government which is basically public referendum, okay. So in a lot of countries, people make decisions like this, say if you if you want to ban a particular activity, economic particular process because that’s supposed to pollute or it is doing a lot of bad things or this thing.

As a society you make a decision, whether you want it or not, that’s it, so so but as an environmental scientist, you don’t have the you cannot make that call. At least, this is my opinion that you cannot make the call. You are giving information as an engineer or scientist okay and this is what we are trying to do. We also give information to the CPCB, the regulatory agencies. The regulatory agencies will ask us information as to, you know, give

your opinion about can we use this process? Can we use this process? What will what'll happen?

So, so lot of research projects that are given through universities and individual researchers are based on that, they say can you predict what will happen to the climate if I continue this process? Should we continue burning this sort of things, so there are debates going on at the level of you know climate treaties and all that, right, so that's a different issue, it is not pollution related, it is a climate related, but at the local level, for example, people at least in places like Delhi there is a big debate going on.

There are a lot of groups which are meeting and figuring out what could be the reasons for this, why is it happening now? Was it happening 20 years back? It very well could be happening 20 years back, but you just have not noticed it because it has not become important. Now, it's become very important. For example, there is fog in several places. There is a question that came up because fog in a particular city in India, suddenly now they said we want to know if fog is related to pollution.

For this, you to make a decision, you have to go back and say was the occurrence of fog the same 50 years back and this is the same now because now you are realizing that fog is a problem because you have a big airport there and you have 25 flights flying out and the flights will get delayed and your economic activity will suffer, 20 years back you did not have an airport, so you do not even care, yeah. I don't I don't I don't even know, otherwise fog, very beautiful fog, nice in the morning, it is very happy, everybody is happy.

Now you get economic activity suffer. So, Delhi probably had fog for the last 50 years, we we don't know, but now because they have a lot more economic activities related to that, so we have a problem. So these questions are not easy. You have to you have to do whatever information that you need to get and then others have to decide, so administrators have to decide and you can give your arguments in favor of something, you can give you a recommend. People usually don't ask us a decision, they ask us recommendations and they will make the decision. So this is usually that is how it works.