

last time we were talking about air pollutants and well, we classify them in many ways, either sources or pollutants themselves the reason why we have that much classification it depends on the interest of the person using this classification, a physician, a chemist, or somebody in food regulation & so on.. That's why we have different ways to classify air pollutants...

**Pollutants can be classified as:**

primary pollutants  
secondary pollutants

-primary: pollutant released from the source as such, like CO, you burn something and you get CO, it's a pollutant as it is

-secondary: this pollutant isn't coming from the source as a pollutant, but as a result from reaction with atmosphere or another air pollutant, usually what causes it is a photochemical reaction.

\*example: Ozone, but how can we say that Ozone itself is a pollutant?  
Even though Ozone is helpful when its way up (in the stratosphere), in the lower part of the atmosphere is a pollutant, dangerous to lungs.

people mistakenly look at Ozone as being something clean, (the mechanism of making o3 in nature happens when you have rain or lightning), people have an impression that ozone is produced at a clear time of the year, so they think its harmless, some people used to run early in the morning (exercise) because very early, all factories are closed, there are no cars, then they would have a great amount of Ozone. But they don't know that Ozone is made from gases like Methane (product of oil burning).

Though you as a doctor, you have some uses of Ozone in medicine, to treat certain problems (of course, under control).

Well, now, this secondary pollutant isn't released from its source as such, so to regulate how much of this material is in the air, i have to regulate its precursors, (i control the precursor of Ozone, so we regulate ozone.)

Ozone is a major component of urban smug (a combination of fog and smoke), it's a secondary pollutant which is formed from some chemical reactions with various nitrogen compounds, VOCs (volatile organic carbon), and other atmospheric components.

(He reads something from the slide very quickly and says it means this) : when I know how a pollutant is formed, I know its effects, and i know how to limit it, and that's why there are many ways off classifications in this field.

(Reading from the slide, he says: we mentioned this. and then he reads a few causes really quickly from the slide)

Here, you see, this is a picture taken from a major forest fire in the United States and you see a huge amount of smoke from this fire, and this smoke is moving towards places where people live, because in the US, people live inside forests, or sometimes near them. So if you have a major fire like this one, it means people are endangered and will suffer great problems from this fire.

Fires also might impact faraway places, as we'll see in a while.

Now, what will happen to people here? (Pointing somewhere on the slide), they breath from the polluted air, even after the fire is gone.

(Again, reading from the slide he says he already mentioned natural sources)

Again, back to classifying pollutants, remember when we classified them as organic and inorganic? We can also classify them as sulfur containing, nitrogen containing chemicals, carbon containing...etc., again this is also a chemical kind of classification.

Remember, we also classified them before as gases, liquids and solids... and as primary, secondary.

Now according to the state of scale of their affects if I have a problem for example, in my stove in my home, what affects will it have to the people inside? You as a doctor in Jordan will notice that in winter, 100s of people will die because of problems with heaters and stoves.

An old stove/heater, won't burn correctly, releases toxic chemicals, which will kill people if exposed for long periods of time.

Keep in mind, even a bad carpet, the material in it can affect your family, neighbors gathering things from their home and burning it outside can also cause you harm, so you have to be careful.

Sometimes air pollution can be regional, remember 3 years ago there was an eruption of major volcano that stopped the entire air navigation to Europe in the whole world. So pollution can be of a major scale.

There was a problem in the US and Canada, in the upper part of the United States, they burn something and the outcome of this burning goes to Canada and causes them problem.

Another example: Sweden, because of Germany, Holland and Denmark, all the trash from those countries move through air and water to Sweden.

Pollution can also be on a global scale, like the green house phenomenon or Ozone layer, it's the entire world that is affected.

If a volcano had a massive eruption, it could have a global-scale effect, when they burned oil in Kuwait (during the war) smoke coming out reaches places like china and many other countries of the world. When a massive fire happened in a place in America they said even Jordan was affected.

But how? How do places far away from us affect us like that?

Because such major events produce ashes and smoke, and because of the heat, they accelerate at a very high rate, and they would move away from our troposphere, they reach upper layers of our atmosphere, there are air currents there move them to different places, they are very high speed currents.

For example: the problems with chloro fluoro carbon are mainly in the southern pole, even though chloro fluoro carbon doesn't come from there. It comes from Europe and the US and then, by the same mechanism, they move to the southern pole.

This mechanism is also the reason why it's impossible to have a "clean" air sample.

This mechanism is the reason why Chernobyl, Mexican volcano eruption and such events are considered global events.

Keep in mind Ireland's volcano reaches so far, it even was very close to Jordan.

Now, keep in mind we're talking about hundreds and hundreds of pollutants, no matter how you classify them, now out of these hundreds, EPA (environmental protection agency) named 6 chemicals as criteria air pollutants.

EPA makes the standards for clean air, which is very difficult and expensive.

Now, one of the most important things they do is to monitor those 6 pollutants (at least) on daily basis and take the concentration of each of them, then put them in a formula & they came up with a figure, which indicated how healthy/unhealthy the air is in a particular area. (They give it a score, like 6/10 for example, or in colors), this figure changes daily, so it's good to keep track and manage your out-door activity according to that figure.

**Those 6 chemicals are:** Ozone (as a pollutant), CO, CO<sub>2</sub>, SO<sub>2</sub>, NO<sub>x</sub> (NO<sub>2</sub>, NO, NO<sub>3</sub>, N<sub>2</sub>O<sub>5</sub>... nitrogen reacts with oxygen in various manners), and Pb.

PM<sub>10</sub>: particular matter, 10 is the size of the matter (matters smaller than 10 micrometers), because size is important, that's why you have to label the size of these particles. PM<sub>10</sub>s are dangerous because they can get into the lungs.

**Let's see:**

1) Ozone: in Jordan, we use chlorine to treat (disinfect) water before we drink it. In France, they use ozone to treat water. In Jordan, those water stations you buy water from (tb3at el cooler), some of them treat water with ozone.

So ozone in this action is similar to Chlorine, but why do we use chlorine in Jordan? Because its available, cheap, easy to store, easy to add to water, and easy to test for. (where as Ozone is expensive and hard to find)

now, though chlorine's not so toxic, the question between the toxic and non-toxic levels of ozone are wide, which is good, (wide here means that it'll take a huge change of concentration to make ozone toxic), yet, if the water (that's going to be disinfected) contained some organic pollutants, like human or animal stool, Humic acid(?), then there's a good chance that this will end up causing what we call trihalomethanes, those compounds are carcinogens (they cause cancer) that's why you got to be careful and look at the source of water before treating it with chloride or ozone, otherwise people will be harmed.

2) Sulfur Dioxide: a product of burning fossil fuels (coal, petroleum and natural gas.), fossil fuels contain sulfur, but as a pollutant (remember previous lecture we said sulfur isn't actually harmful), so sometimes when you hear the news, you'll notice the prices of petrol worldwide, one of the determinants is the sulfur inside, the more sulfur there is inside the petrol, the worse it is, because burning that petrol will produce SO<sub>2</sub> (sulfur dioxide) which of course, is a bad pollutant.

Remember when we talked about "planktons" during the process of synthesizing organic matter in them SO<sub>2</sub> can be produced.

Sea water, plants, bacteria and volcano eruptions can also release SO<sub>2</sub>.

Remember, SO<sub>2</sub> sources can be natural or manmade.

3) Nitrogen: we mentioned that to have SO<sub>2</sub> we should have sulfur in the oil; does the same apply to nitrogen? Not necessarily, materials that have no nitrogen can produce NO<sub>x</sub> if burned, but why? Because Nitrogen is abundant in the atmosphere, if anything heat from burning will produce NO<sub>x</sub>, this means we can't have a fire without producing NO<sub>x</sub> (unless, in a controlled environment of course).

Remember? we mentioned before that sulfur is colorless as gas, this is bad for us because we can't see it if for example its inside the room, what helps with recognizing sulfur is the bad, extreme, strong odor it

has, so you can tell that you have it from its smell. BUT, there are gases (like methane & ethane, which we use for cooking) that have no odor and no color, these are very dangerous, that's why companies added other material with odor to the containers, so if there's a leakage you'd smell that other material and know about the leakage.

4) CO:

-this gas is odorless and colorless a while ago, there was something called 7mmam geezer el 76ab, used to be very common, this geezer el 76ab was inside the bathroom, you put some wood in it and you burn it & close the container, this would heat the water, this is dangerous because sometimes incomplete combustion occur, which produces CO, since its colorless and odorless, you can't know there's CO, so many people died while they were in the bathroom.

remember we mentioned families dying of a bad stove or bad heater, because of CO poisoning, since its odorless and colorless, it can't be detected, add to that, it causes illusions, misjudgment and confusion, that's why CO is extremely dangerous, (for example, a person sensing something wrong in the room due to CO leakage might go and close the window, misjudgment).

Usually, heaters produce CO in the "boiler room", which is usually away from the rest of the house's rooms.

- 4% of what's coming out of cigarettes is CO, and in a major study in Jordan, they discovered that no.1 factor in Jordan for causing heart attacks is CO (which comes out of smoking).

- Another source of CO is oxidation of methane and other hydrocarbons.

***Sry for any mistakes, wish you all the best of luck !***

***Special thanks to Bashar Mahmoud***