Air Pollution Causes and Effects

by **Tom Socha**

History

Humans probably first experienced harm from air pollution when they built fires in poorly ventilated caves. Since then we have gone on to pollute more of the earth's surface. Until recently, environmental pollution problems have been local and minor because of the Earth's own ability to absorb and purify minor quantities of pollutants. The industrialization of society, the introduction of motorized vehicles, and the explosion of the population, are factors contributing toward the growing air pollution problem. At this time it is urgent that we find methods to clean up the air.

The primary air pollutants found in most urban areas are carbon monoxide, nitrogen oxides, sulfur oxides, hydrocarbons, and particulate matter (both solid and liquid). These pollutants are dispersed throughout the world's atmosphere in concentrations high enough to gradually cause serious health problems. Serious health problems can occur quickly when air pollutants are concentrated, such as when massive injections of sulfur dioxide and suspended particulate matter are emitted by a large volcanic eruption.

Air Pollution in the Home

You cannot escape air pollution, not even in your own home. "In 1985 the Environmental Protection Agency (EPA) reported that toxic chemicals found in the air of almost every American home are three times more likely to cause some type of cancer than outdoor air pollutants". (Miller 488) The health problems in these buildings are called "sick building syndrome". "An estimated one-fifth to one-third of all U.S. buildings are now considered "sick". (Miller 489) The EPA has found that the air in some office buildings is 100 times more polluted than the air outside. Poor ventilation causes about half of the indoor air pollution problems. The rest come from specific sources such as copying machines, electrical and telephone cables, mold and microbe-harboring air conditioning systems and ducts, cleaning fluids, cigarette smoke, carpet, latex caulk and paint, vinyl molding, linoleum tile, and building materials and furniture that emit air pollutants such as formaldehyde. A major indoor air pollutant is radon-222, a colorless, odorless, tasteless, naturally occurring radioactive gas produced by the radioactive decay of uranium-238. "According to studies by the EPA and the National Research Council, exposure to radon is second only to smoking as a cause of lung cancer". (Miller 489) Radon enters through pores and cracks in concrete when indoor air pressure is less than the pressure of gasses in the soil. Indoor air will be healthier than outdoor air if you use an energy recovery

ventilator to provide a consistent supply of fresh filtered air and then seal air leaks in the shell of your home .

Sources of Pollutants

The two main sources of pollutants in urban areas are transportation (predominantly automobiles) and fuel combustion in stationary sources, including residential, commercial, and industrial heating and cooling and coal-burning power plants. Motor vehicles produce high levels of carbon monoxides (CO) and a major source of hydrocarbons (HC) and nitrogen oxides (NOx). Whereas, fuel combustion in stationary sources is the dominant source of sulfur dioxide (SO2).

Carbon Dioxide

Carbon dioxide (CO2) is one of the major pollutants in the atmosphere. Major sources of CO2 are fossil fuels burning and deforestation. "The concentrations of CO2 in the air around 1860 before the effects of industrialization were felt, is assumed to have been about 290 parts per million (ppm). In the hundred years and more since then, the concentration has increased by about 30 to 35 ppm that is by 10 percent". (Breuer 67) Industrial countries account for 65% of CO2 emissions with the United States and Soviet Union responsible for 50%. Less developed countries (LDCs), with 80% of the world's people, are responsible for 35% of CO2 emissions but may contribute 50% by 2020. "Carbon dioxide emissions are increasing by 4% a year". (Miller 450)

In 1975, 18 thousand million tons of carbon dioxide (equivalent to 5 thousand million tons of carbon) were released into the atmosphere, but the atmosphere showed an increase of only 8 billion tons (equivalent to 2.2 billion tons of carbon". (Breuer 70) The ocean waters contain about sixty times more CO2 than the atmosphere. If the equilibrium is disturbed by externally increasing the concentration of CO2 in the air, then the oceans would absorb more and more CO2. If the oceans can no longer keep pace, then more CO2 will remain into the atmosphere. As water warms, its ability to absorb CO2 is reduced.

CO2 is a good transmitter of sunlight, but partially restricts infrared radiation going back from the earth into space. This produces the so-called greenhouse effect that prevents a drastic cooling of the Earth during the night. Increasing the amount of CO2 in the atmosphere reinforces this effect and is expected to result in a warming of the Earth's surface. Currently carbon dioxide is responsible for 57% of the global warming trend. Nitrogen oxides contribute most of the atmospheric contaminants.

N0X - nitric oxide (N0) and nitrogen dioxide (N02)

- Natural component of the Earth's atmosphere.
- Important in the formation of both acid precipitation and photochemical smog (ozone), and causes nitrogen loading.
- Comes from the burning of biomass and fossil fuels.

- 30 to 50 million tons per year from human activities, and natural 10 to 20 million tons per year.
- Average residence time in the atmosphere is days.
- Has a role in reducing stratospheric ozone.

N20 - nitrous oxide

- Natural component of the Earth's atmosphere.
- Important in the greenhouse effect and causes nitrogen loading.
- Human inputs 6 million tons per year, and 19 million tons per year by nature.
- Residence time in the atmosphere about 170 years.
- 1700 (285 parts per billion), 1990 (310 parts per billion), 2030 (340 parts per billion).
- Comes from nitrogen based fertilizers, deforestation, and biomass burning.

Sulfur and chlorofluorocarbons (CFCs)

Sulfur dioxide is produced by combustion of sulfur-containing fuels, such as coal and fuel oils. Also, in the process of producing sulfuric acid and in metallurgical process involving ores that contain sulfur. Sulfur oxides can injure man, plants and materials. At sufficiently high concentrations, sulfur dioxide irritates the upper respiratory tract of human beings because potential effect of sulfur dioxide is to make breathing more difficult by causing the finer air tubes of the lung to constrict. "Power plants and factories emit 90% to 95% of the sulfur dioxide and 57% of the nitrogen oxides in the United States. Almost 60% of the SO2 emissions are released by tall smoke stakes, enabling the emissions to travel long distances". (Miller 494) As emissions of sulfur dioxide and nitric oxide from stationary sources are transported long distances by winds, they form secondary pollutants such as nitrogen dioxide, nitric acid vapor, and droplets containing solutions of sulfuric acid, sulfate, and nitrate salts. These chemicals descend to the earth's surface in wet form as rain or snow and in dry form as a gases fog, dew, or solid particles. This is known as acid deposition or acid rain.

Chlorofluorocarbons (CFCs)

CFCs are lowering the average concentration of ozone in the stratosphere. "Since 1978 the use of CFCs in aerosol cans has been banned in the United States, Canada, and most Scandinavian countries. Aerosols are still the largest use, accounting for 25% of global CFC use". (Miller 448) Spray cans, discarded or leaking refrigeration and air conditioning equipment, and the burning plastic foam products release the CFCs into the atmosphere. Depending on the type, CFCs stay in the atmosphere from 22 to 111 years. Chlorofluorocarbons move up to the stratosphere gradually over several decades. Under high energy ultra violet (UV) radiation, they break down and release chlorine atoms, which speed up the breakdown of ozone (O3) into oxygen gas (O2).

Chlorofluorocarbons, also known as Freons, are greenhouse gases that contribute to global warming. Photochemical air pollution is commonly referred to as "smog". Smog, a contraction of the words smoke and fog, has been caused throughout recorded history by water condensing on smoke particles, usually from burning coal. With the introduction of petroleum to replace coal economies in countries, photochemical smog has become predominant in many cities, which are

located in sunny, warm, and dry climates with many motor vehicles. The worst episodes of photochemical smog tend to occur in summer.

Smog

To enlarge the image, click on it.

Photochemical smog is also appearing in regions of the tropics and subtropics where savanna grasses are periodically burned. Smog's unpleasant properties result from the irradiation by sunlight of hydrocarbons caused primarily by unburned gasoline emitted by automobiles and other combustion sources. The products of photochemical reactions includes organic particles, ozone, aldehydes, ketones, peroxyacetyl nitrate, organic acids, and other oxidants. Ozone is a gas created by nitrogen dioxide or nitric oxide when exposed to sunlight. Ozone causes eye irritation, impaired lung function, and damage to trees and crops. Another form of smog is called industrial smog.

This smog is created by burning coal and heavy oil that contain sulfur impurities in power plants, industrial plants, etc... The smog consists mostly of a mixture of sulfur dioxide and fog. Suspended droplets of sulfuric acid are formed from some of the sulfur dioxide, and a variety of suspended solid particles. This smog is common during the winter in cities such as London, Chicago, Pittsburgh. When these cities burned large amounts of coal and heavy oil without control of the output, large-scale problems were witnessed. In 1952 London, England, 4,000 people died as a result of this form of fog. Today coal and heavy oil are burned only in large boilers and with reasonably good control or tall smokestacks so that industrial smog is less of a problem. However, some countries such as China, Poland, Czechoslovakia, and some other eastern European countries, still burn large quantities of coal without using adequate controls.

Pollution Damage to Plants

With the destruction and burning of the rain forests more and more CO2 is being released into the atmosphere. Trees play an important role in producing oxygen from carbon dioxide. "A 115 year old Beech tree exposes about 200,000 leaves with a total surface to 1200 square meters. During the course of one sunny day such a tree inhales 9,400 liters of carbon dioxide to produce 12 kilograms of carbohydrate, thus liberating 9,400 liters of oxygen. Through this mechanism about 45,000 liters of air are regenerated which is sufficient for the respiration of 2 to 3 people". (Breuer 1) This process is called photosynthesis which all plants go though but some yield more and some less oxygen. As long as no more wood is burnt than is reproduced by the forests, no change in atmospheric CO2 concentration will result.

Pollutants such as sulfur dioxide, nitrogen oxides, ozone and peroxyacl nitrates (PANs), cause direct damage to leaves of crop plants and trees when they enter leaf pores (stomates). Chronic exposure of leaves and needles to air pollutants can also break down the waxy coating that helps prevent excessive water loss and damage from diseases, pests, drought and frost. "In the midwestern United States crop losses of wheat, corn, soybeans, and peanuts from damage by ozone and acid deposition amount to about $5 billion a year". (Miller 498)

Reducing Pollution

You can help to reduce global air pollution and climate change by driving a car that gets at least 35 miles a gallon, walking, bicycling, and using mass transit when possible. Replace incandescent light bulbs with compact fluorescent bulbs, make your home more energy efficient, and buy only energy efficient appliances. Recycle newspapers, aluminum, and other materials. Plant trees and avoid purchasing products such as Styrofoam that contain CFCs. Support much stricter clean air laws and enforcement of international treaties to reduce ozone depletion and slow global warming.

Earth is everybody's home and nobody likes living in a dirty home. Together, we can make the earth a cleaner, healthier and more pleasant place to live.

Works Cited:

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NOTE: You can help to reduce air pollution by improving energy efficiency so that less fossil fuel is burned. This will help you to endure the oil shortages and natural gas shortages.