Office of Public Affairs (A-107)
U.S. Environmental
Protection Agency
Washington, D.C. 20460

Official Business
Penalty for Private Use $300

Postage and Fees Paid
Environmental
Protection Agency
EPA 335
Third Class Bulk Rate

United States
Environmental Protection Agency
June 1976

Health Effects of Air Pollutants

In this century, man has increased his productive capability a thousandfold. New industrial processes and a myriad of technological innovations have improved our lives enormously. But we are beginning to realize that the cost of this progress may also be heavy. Man has underestimated his ability to damage the environment and threaten not only the welfare of himself but the lives of his children as well.

In recent years scientists have begun to look at man-made pollution to determine where it originates, how we can reduce it, and most importantly, what effects pollution has on human health.

One area of utmost concern to scientists is air pollution. Most of what we know about the effects of air pollution on human health we have learned in the last decade. And only in the last five years have we begun to understand the way individual pollutants react with other chemicals to affect our health.

Scientists are convinced that air pollution is a very real contributing factor to the three major types of diseases that cause sickness and death in our society—heart disease, lung disease, and cancer. Research has shown that air pollution will accelerate the rate of disease in those persons already afflicted, and earlier death is a very real possibility.

The problem of air pollution is not limited to those persons who live in the cities or near the sources of pollution. Studies have shown that air pollution can actually be hazardous to people who live fifty or a hundred miles away from the pollution source. This is because some common pollutants are transformed while moving through the atmosphere, by chemical reactions with sunlight into more hazardous pollutants, such as photochemical oxidants, which attack our lungs and respiratory system.

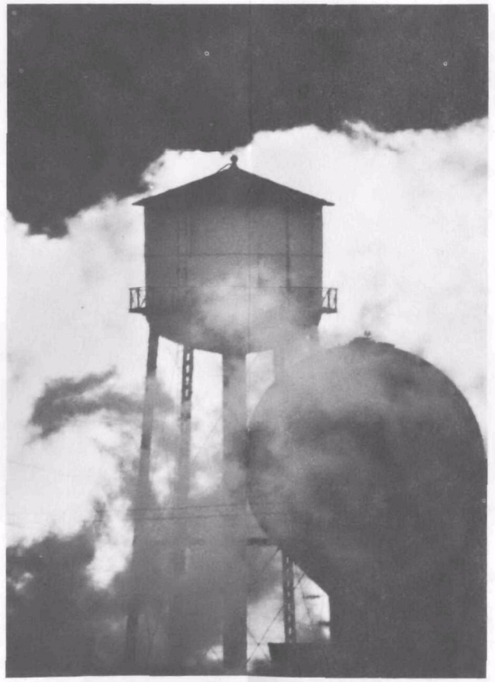
Prompted by widespread public support, Congress in 1970 enacted the landmark Clean Air Amendments, now usually called simply the Clean Air Act, a law which continues to be of major importance in protecting public health and welfare from air pollution.

It gave the U.S. Environmental Protection Agency (EPA) responsibility for setting and enforcing standards on various types of air pollutants suspected of having an impact on public health and welfare. The Agency subsequently set air quality standards for six common classes of pollutants: sulfur oxides, particulate matter, carbon monoxide, photochemical oxidants, nitrogen oxides and hydrocarbons.

Following is a description of the six major air pollutants and their effects on human health:

Sulfur Oxides

Approximately 95 percent of pollution-related sulfur oxide emissions in this country are in the form of sulfur dioxide, a by-product of combustion of fossil fuels such as oil and coal. The remaining 5 percent are in the form of a variety of sulfur compounds that eventually are transformed into sulfuric acid, another pollutant.



Coal or oil-burning power plants produce most of the sulfur dioxide emissions, while autos account for only about 1 percent. Sulfur dioxide oxidizes in the atmosphere to form sulfates, a particulate form of sulfur, the effects of which depend on particle size, dispersion by weather conditions, and the presence of other pollutants which may magnify the effects.

The levels of sulfates in the air often exceed those levels where adverse human effects begin to appear. Sulfate concentrations greater than 9 or 10 micrograms per cubic meter of air will aggravate asthma, lung and heart disease, and the lung function in children.

The effect of sulfur dioxide is magnified by the presence of other pollutants such as photochemical oxidants and by-products such as sulfuric acid and hydrogen sulfide. The combination of these is known to affect the respiratory tract.

Many scientists also believe this exposure to sulfates may be cumulative, causing or increasing the likelihood of respiratory illness such as bronchitis, emphysema, and asthma. Studies show that children exposed to continuous high SO_2 concentrations are more likely to develop respiratory illness when high concentrations of particulates are present.

Particulate Matter

Total suspended particulates (TSP) is a term for the measurement of all particles in our air, including soot, mists, and sprays. TSP includes a wide range of non-toxic materials such as dust and dirt, and many other materials that we know or suspect to be toxic, such as beryllium, lead, asbestos, certain hydrocarbons which may be carcinogenic, suspended sulfates and nitrates, and possibly, radioactive elements.

The amount of toxic materials in our air will vary geographically, depending on the man-made and natural sources in a particular area. To date, few studies have been conducted on the health effects of individual particles because of the wide range of differences in the makeup of particulate concentrations. Particulate matter is studied for the most part as a single contaminant, and most studies relate particulate concentrations to death, respiratory illness, and breathing problems in urban industrial areas where energy supplied by fossil fuel consumption is a major concern.

The effects of particulate air pollution on health are related to injury to the surfaces of the respiratory system, that is, to the linings of the lungs and throat. Such injury may be temporary or permanent. It may be confined to the surface. However, by weakening resistance to infection, such pollutants may affect the entire body adversely. Chemicals carried into the lungs by particulates, for example, may cause cancer to develop on the lung lining, which then may spread throughout the body and prove fatal. Inhaled lead particulates may cause lead poisoning—manifested by nervous and blood symptoms—while causing very little damage to the lung itself.

In studies of air pollution in London and New York City, a rise in the number of deaths has been recorded when both smoke and sulfur oxides levels were high. Studies in Buffalo and Nashville also showed increased death rates, particularly among older persons, where combined pollution from particulates and sulfur oxides were recorded. Eye irritation from dust particles also can be a problem in many areas.

Carbon Monoxide

Carbon monoxide (CO) is a colorless, odorless, tasteless gas commonly found in our urban atmosphere in concentrations that can be harmful to people. It is a by-product of combustion, and the greatest single source of this pollutant is the automobile.

Carbon monoxide is inhaled through the lungs and enters the blood stream by combining with hemoglobin, the substance that normally carries oxygen to the cells. CO combines with hemoglobin much more readily than oxygen does. The result is that the amount of oxygen getting to the tissues is drastically reduced in the presence of CO, and this can have a profound effect on our health. CO also impairs heart function by weakening the contractions of the heart which supply blood to the various parts of the body. The effect of this on a healthy person is to reduce significantly his ability to perform exercise, but in a patient with heart disease, who is unable to compensate for the decrease in oxygen, it can be a life-threatening situation. A person who has a heart attack in the presence of heavy carbon monoxide air pollution is more likely to die than if the attack had occurred in clean air. And carbon monoxide is also harmful to persons who have lung disease, anemia, or cerebral-vascular disease.

Carbon monoxide can also affect mental function at relatively low concentrations. Visual perception and alertness can be affected.

Photochemical Oxidants

Photochemical oxidants are not emitted directly into the atmosphere but are produced by a complex series of chemical reactions initiated when certain emissions by autos and other sources—hydrocarbons and oxides of nitrogen—are exposed to sunlight. Ozone, peroxyacyl nitrate (PAN), formaldehyde, acrolein, nitrogen peroxide, and organic peroxides are all formed in this manner. The presence of these pollutants in the atmosphere is dependent on sunlight, so after nightfall their concentrations are very low.

This type of pollution first gained attention in the 1940's as the main cause of smog in Los Angeles. Since that time photochemical smog has become common in many cities.

Photochemical oxidants are responsible for a number of health effects in humans. They can affect the lungs and eyes. They may cause respiratory irritation and even changes in lung function. They may result in eye irritation with the familiar symptoms of tears and inflammation. At certain concentrations they have been shown to impair the performance of athletes, and to affect persons with asthma.

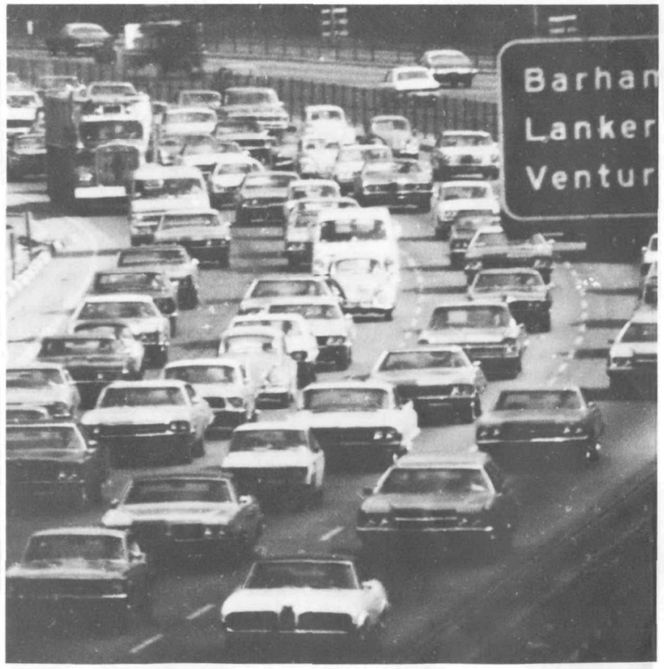
Ozone, the main constituent of photochemical smog, is a severe irritant to all mucous membranes, and its main health effects are on the respiratory system. It is virtually intolerable at levels of 1 part per million. At considerably lower concentrations (.1 to .2 ppm) which often occur in the air of many American cities, ozone in conjunction with other photochemical oxidants causes a variety of health effects which are aggravated by exercise. Ozone also has an increased effect on respiratory function in the presence of sulfur dioxide.

Nitrogen Oxides

Oxides of nitrogen usually originate in high-temperature combustion processes, and to a lesser extent in chemical plants.

Although measurement of this pollutant in the atmosphere is difficult, experience has shown that in various forms, oxides of nitrogen can affect humans as well as materials and vegetation.

Based on occupational exposures to nitrogen dioxide by firemen, welders, silo fillers, miners, chemists, and other industrial workers, we know that at high concentrations this pollutant can be fatal to humans. At lower levels of 25 to 100 parts per million, it can cause acute bronchitis and pneumonia.



The group of pollutants known as nitrogen oxides also can affect lung tissue and lower the resistance of laboratory test animals to influenza. Scientists suspect the same effect may occur in humans. In one study of schoolchildren living near an industrial plant producing nitrogen dioxide, an increase in respiratory disease was noted.

Oxides of nitrogen also can react with hydrocarbons, in the presence of sunlight, to form photochemical oxidants which, as noted elsewhere in this pamphlet, can affect human lungs and eyes as well as cause respiratory irritation.

Hydrocarbons

Motor vehicles are the chief source of hydrocarbon emissions, with the remainder coming from evaporation of industrial solvents in painting, dry cleaning, and so on, and from gasoline marketing and incineration.

No adverse effects on human health are directly attributed to hydrocarbons. However, this pollutant does react under sunlight, as indicated earlier in this pamphlet, to form photochemical oxidants which do affect people, causing respiratory irritation and the stinging, watery eye reaction associated with urban smog.

Conclusion

Since passage of the Clean Air Act in 1970, the Nation has demonstrated in these ways that it can do something about air pollution:

- Sulfur dioxide concentrations nationally were reduced approximately 25 percent between 1970 and 1975.
- The national average for particulate matter, which includes dust, smoke, and soot, dropped 14 percent between 1970 and 1973.
- Concentrations of photochemical oxidants showed improvement in key cities. The Los Angeles and San Francisco areas were cases in point.
- Nationwide, the percentage of air measurements exceeding the ambient carbon monoxide standard declined by more than 50 percent between 1970 and 1975.
- Of 20,000 major stationary sources of air pollution (industries, power plants, municipal incinerators, etc.) by 1975, 16 271 or 82 percent were complying with emission regulations or were meeting an abatement schedule.

"The Nation has made significant progress in cleaning up the air," declared Russell E. Train, EPA Administrator, "but there is still a long way to go. If citizens, industries, and officials at all levels of government work hard together, we can and will attain the health protection goals established in the Clean Air Act. I am confident that we have both the will and the means to do so."