Smog

Smog is a kind of air pollution - it was originally named for the mixture of smoke and fog in the air during the late 19th and early 20th centuries. Historically, it was produced by the burning of large amounts of coal within a city. This smog contained soot from smoke, sulphur dioxide and other particulate matter.

Modern smog, for example in Los Angeles, is a type of air pollution derived from vehicle emission from internal combustion engines and from industrial fumes. These particles react in the atmosphere with sunlight to form secondary pollutants that combine with the primary emissions to form photochemical smog, also known as ground level ozone. In contrast, ozone found in the earth’s upper atmosphere, is beneficial and forms a protective layer that shields us from the sun’s harmful UV rays.

As smog levels increase it becomes highly toxic to humans and can cause severe sickness, breathing problems, shortened life or death. In March 2014, the World Health Organisation (WHO) announced that air pollution kills 3.7 million people worldwide every year. Most of these deaths take place in developing countries, where the problem is at its worst, but hundreds of thousands are also believed to occur in the developed world each year.

Causes

- **Coal** - coal fires, either domestic or industrial, can emit significant clouds of smoke that contribute to smog. Air pollution of this type is still a problem in fast-developing cities, for example in China.

- **Vehicle Emissions** - exhaust pollution from cars, trucks and buses is a major contributing factor to smog in large cities, in particular. The major culprits are carbon monoxide, nitrogen oxides, sulphur dioxide and hydrocarbons. These molecules react with sunlight, heat, ammonia and moisture to produce both ground level ozone, and other particles that comprise smog.

- **Photochemical Smog** - first described in the 1950s, it is the chemical reaction of sunlight, nitrogen oxides and volatile organic compounds in the atmosphere, which leaves airborne particles and ground-level ozone.

- **Natural Causes** - erupting volcanoes can emit high levels of sulphur dioxide along with a large quantity of particulate matter. This is sometimes referred to as ‘vog’ to distinguish it as a natural occurrence. The radiocarbon content of some plant life, for example the “creosote bush” in LA, has been linked to the distribution of smog in some areas. Saharan dust has also been carried by prevailing winds over Europe, precipitating a smog-like atmosphere.
Health Effects

Smog is a serious health problem in many cities. Ground level ozone, sulphur dioxide, nitrogen dioxide and carbon monoxide are especially harmful for the elderly, children and people with known heart and lung conditions such as asthma, bronchitis and emphysema. It can cause breathing problems, eye and nose irritation and makes people more susceptible to infections. Hospital admissions and deaths often increase when ozone levels are high.

There is increasing evidence about the effects of air pollution and, in particular, fine particulate matter (PM) on cardiovascular and respiratory diseases (such as heart attacks, heart failure, asthma, respiratory infections, and lung cancer). There is emerging but as yet inconclusive evidence about the effects on premature births, intrauterine growth restriction, and lung development throughout the life course.

Studies over the last 20 years by the American Cancer Society have found that cumulative exposure increases the likelihood of premature death from respiratory disease. Two newly published European studies found that regularly breathing in air tainted with even low levels of air pollution raises your long-term risk of lung cancer. That finding came from a review of data from nearly 313,000 people across nine European countries. The study was published in The Lancet Oncology.

Studies in areas of California have linked smog with an increased incidence of birth defects affecting the spinal cord. In October 2013, studies of some 74,000 births in 12 European countries concluded that babies in polluted areas were more likely to have low birth weight and a smaller head circumference. A major study across 25 cities has reckoned that living near major urban roads could account for 30 per cent of all asthmas in children.

Short-term exposure to smog has also been linked to an increased risk of hospitalisation or death from heart failure, according to a study led by the University of Edinburgh that reviewed data from 12 countries worldwide, published in The Lancet.

What can be done...

Employees travelling to cities with high levels of smog should be advised to take the following precautions:

- Stay informed about the official pollution warning levels, especially ozone levels
- Avoid going outside during times of very heavy concentrations of air pollution
- Schedule outside activities for early morning or evening when ozone levels are lower
- Limit strenuous outdoor activity, particularly on hot sunny days, if you have noticed that your breathing effort is affected, since this increases the intake of pollutants
- Known sufferers of respiratory and cardiac disease should adjust medication as appropriate, for example with use of a ‘reliever inhaler’ in asthmatics - this should be discussed with a medical practitioner
- If re-locating to cities with high levels of air pollution, consider installing HEPA (high-efficiency particulate air) filters in the living space, especially if known sufferers of respiratory disease.

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Measuring Smog levels

The US Environmental Protection Agency (EPA) has developed an *Air Quality Index* in order to provide the public with timely and easy-to-understand information on local air. It measures 8-hour average ozone concentrations and is focused on health effects that can happen within a few hours or days after breathing polluted air.

<table>
<thead>
<tr>
<th>Air Quality Index Levels of Health Concern</th>
<th>Numerical Value</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>0 to 50</td>
<td>Air quality is considered satisfactory, and air pollution poses little or no risk</td>
</tr>
<tr>
<td>Moderate</td>
<td>51 to 100</td>
<td>Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.</td>
</tr>
<tr>
<td>Unhealthy for Sensitive Groups</td>
<td>101 to 150</td>
<td>Members of sensitive groups may experience health effects. The general public is not likely to be affected.</td>
</tr>
<tr>
<td>Unhealthy</td>
<td>151 to 200</td>
<td>Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects.</td>
</tr>
<tr>
<td>Very Unhealthy</td>
<td>201 to 300</td>
<td>Health warnings of emergency conditions. The entire population is more likely to be affected.</td>
</tr>
<tr>
<td>Hazardous</td>
<td>301 to 500</td>
<td>Health alert: everyone may experience more serious health effects</td>
</tr>
</tbody>
</table>

An AQI value of 100 generally corresponds to the national air quality standard for the pollutant, which is the level that has been set to protect public health. AQI values below 100 are generally thought of as satisfactory. When AQI values are above 100, air quality is considered to be unhealthy- at first for certain sensitive groups of people, then for everyone as AQI values get higher.

Areas Affected

Smog can form in any climate where industries or cities release large amounts of air pollutants. It is worse during periods of warm, sunny weather when the upper air is warm enough to inhibit vertical circulation. It is especially prevalent in geologic basins encircled by hills or mountains.

- **Delhi, India** - this is the most polluted city in the world and it is estimated that air pollution causes over 10,000 deaths every year. The problem of high emissions is exacerbated by crop burning in adjacent states. Since the mid-1990s the government has taken measures to try to address the problem including: mass tree-planting programs; the introduction of the largest fleet of environmentally friendly compressed natural gas buses; banning the use of leaded petrol and supporting alternative fuel initiatives. However, many of these gains have been lost due to an increase in stubble burning, a rise in market share of diesel cars and decline in bus use.

- **Mexico City, Mexico** - the city’s location in a highland ‘bowl’ results in cold air trapping the industrial and vehicle pollution underneath, turning it into the most polluted city in Latin America.
Los Angeles and San Joaquin Valley, USA - these areas, notorious for smog because of their locations in low basins that are surrounded by mountains, are subject to the fumes pouring out of millions of vehicles, as well as the emissions from port complexes at San Francisco and Long Beach.

Ulaanbaatar, Mongolia - massive immigration in the 1990s to the outskirts of the capital city with the subsequent burning of fossil fuels for heating, has led to severe pollution. The particulate matter levels are among the worst in the world - when inhaled these particles settle in the lungs causing health problems.

South East Asia - cities in Indonesia, Malaysia, Singapore and Thailand, are especially affected by land and forest fires, used by landowners to clear areas for further planting. This kind of pollution is usually referred to as ‘haze’ rather than smog.

Beijing, China - there is a severe smog problem in major cities in China, especially Beijing, caused by the rapid rate of economic growth resulting in widespread industrial and vehicle pollution. On Feb 25 2014, Beijing had been shrouded in heavy smog and hazardous levels of fine particulate matter (PM2-5) for 6 consecutive days. That morning the PM2-5 level read 383 μg/m3, which is 15 times the recommended safe WHO limit (25 μg/m3), but not the worst reported, in a week when levels soared to over 500 μg/m3.

Sources

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