

CASE STUDY OF AIR POLLUTION EPISODES IN MEUSE VALLEY OF BELGIUM, DONORA OF PENNSYLVANIA, AND LONDON, U.K.

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Summary

Population increased rapidly after the Industrial Revolution, and pollution became more intense as emissions from homes and factories increased. Such pollutants are derived mainly from the combustion of coals for domestic heating or cooking purposes, for heating or power generation in industry, or for transport, though in some localities there may be additional pollutants from industrial process emissions.

The commonest air pollutants were smoke (suspended particulate matters) and sulfur oxides. Although it has been well known since old times that workers exposed to toxic materials in the industrial workplace may suffer from occupational disease, it was not noticed that serious health damage might be observed in the population exposed to air pollutants emitted from industrial activity and domestic heating until several air pollution episodes had occurred.

1. Meuse Valley Episode

The first acute air pollution episode was observed in Meuse Valley of Belgium in 1930. There were 4 coke ovens, 3 steel mills, 4 glass factories, and 3 zinc smelters along the 15 miles of the narrow valley of the Meuse river from Huy to Liege. A temperature inversion affected this valley from 1st until 5th December 1930, which confined the pollutants emitted from these plants and increased the concentrations of air pollutants. On the third day of this temperature inversion, approximately 6000 residents in the valley became ill with respiratory disease. Sixty had died before the week was over, and there were many deaths of cattle.

Although older people with cardiopulmonary disease had the greatest mortality, all ages from infants to older people complained of irritation of the eye and the respiratory tract. The onset of acute illnesses abated rapidly when the fog dispersed. The death rate in the area was 10.5 times normal. It was estimated that the concentration of sulfur dioxide

(SO₂) was from 9.6 to 38.4 ppm, since the concentrations of air pollutants were not recorded in this area. There were some who thought that fluorides might have contributed to the increase in mortality and morbidity, rather than SO₂.

2. Donora Episode

Although Meuse Valley episode caused sixty deaths from air pollution, it was not recognized that air pollution might have serious adverse health impacts on communities until a similar air pollution disaster occurred in Donora, Pennsylvania in 1948. Donora is located on the inside of a sharp horseshoe valley in the Monongahela River, thirty miles away from Pittsburgh.

The hills of the river rise to a height of about 1100 feet. The area along the riverbank is occupied by a large steel mill, a sulfuric acid plant, and a large zinc production plant. During one week, starting 26th October 1948, a heavy smog settled over the area surrounding Donora because of temperature inversion. This prolonged stable atmospheric condition permitted the accumulation of air pollutants emitted from the plants along the riverbank. At this time, the population of Donora was about 14 000: 42.7% of the population was affected, with a trend for the incidence of adverse effects from smog to increase with age.

This increase was more marked for age groups over 55 years: 15.5% of the this section of the population was mildly affected, 16.8% was moderately affected, and 10.4% was severely affected, and 39.2% reported the presence of upper respiratory symptoms during the smog period. Therefore, over 90% of the affected group reported one or more upper respiratory symptoms. The single symptom most frequently reported was a cough.

Most of those who were affected became affected on the second day of the episode. Twenty people died, and most deaths occurred on the third day. The ages of the people who died ranged from 52 to 84 years. Most of those who died had pre-existing cardiac or respiratory system disease. Although the concentrations of air pollutants had not been measured during the episode, it was estimated that SO₂ had ranged between 1.4 and 5.5 mg/m³ (0.5 and 2.0 ppm) and that the particulate matter (PM) also increased.

In a follow up study of Donora, increased mortality rates were found, and morbidity effects, such as heart disease and chronic bronchitis, among those residents who reported acute illness during the 1948 episode were higher, in comparison with those reporting no acute illness.

The Meuse Valley and Donora episodes demonstrated that severe air pollution can cause death and serious morbidity effects in those human populations that are exposed to it, and that PM and SO₂ are among the air pollutants that can contribute to the induction of such health effects.

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