

11. Urban Air Pollution In World Megacities

Introduction

A megacity is defined as a city with an estimated population of more than 10 million people by year 2000. Megacities are the largest cities in the world but may not necessarily be the most polluted. Urban air pollution, however, is a particularly serious environmental problem in the developing countries of the world.

Urban Air Quality Monitoring in Megacities

The World Health Organisation (WHO) and the United Nations Environment Programme (UNEP) operate an air pollution monitoring network as part of the Global Environment Monitoring System which was set up in 1974. This network has enabled monitoring equipment to be established in more than 50 cities of the world in 35 countries. Initially sulphur dioxide (SO₂), suspended particulate matter (SPM) and lead were monitored, but in 1991 the network was expanded to measure SPM less than 10 microns in diameter, carbon monoxide (CO), nitrogen dioxide (NO₂) and ozone (O₃).

The Quality of Air in World Megacities

Results of the WHO / UNEP study of megacities show that the most severe air pollution is monitored in cities in developing countries, but that air pollution is a widespread problem in megacities with at least one major air pollutant exceeding health guidelines in all of the 20 megacities studied.

Air Quality in 20 Megacities (based on WHO/UNEP data, 1992)

Megacity	Country	Population in 2000 (million)	Ranking (population)	SO ₂	SPM	Lead	CO	NO ₂	O ₃
Bangkok	Thailand	10.26	19	*	***	**	*	*	*
Beijing	China	11.47	16	***	***	*	-	*	**
Bombay	India	15.43	6	*	***	*	*	*	-
Buenos Aires	Argentina	13.05	9	-	**	*	-	-	-
Cairo	Egypt	11.77	13	-	***	***	**	-	-
Calcutta	India	15.94	5	*	***	*	-	*	-
Delhi	India	12.77	12	*	***	*	*	*	-
Jakarta	Indonesia	13.23	8	*	***	**	**	*	**
Karachi	Pakistan	11.57	14	*	***	***	-	-	-
London	UK	10.79	18	*	*	*	**	*	*
Los Angeles	USA	10.91	17	*	**	*	**	**	***
Manila	Philippines	11.48	15	*	***	**	-	-	-
Mexico City	Mexico	24.44	1	***	***	**	***	**	***
Moscow	Russia	10.11	20	-	**	*	**	**	-
New York	USA	16.10	4	*	*	*	**	*	**
Rio de Janeiro	Brazil	13.00	10	**	**	*	*	-	-
São Paulo	Brazil	23.60	2	*	**	*	**	**	***
Seoul	S. Korea	12.97	11	***	***	*	*	*	*
Shanghai	China	14.69	7	**	***	-	-	-	-
Tokyo	Japan	21.32	3	*	*	-	*	*	***

*** Serious problem, WHO guidelines exceeded by more than a factor of two.

** Moderate to heavy pollution, WHO guidelines exceeded by up to a factor of two (Short term guidelines exceeded on a regular basis at certain locations)

* Low pollution, WHO guidelines are normally met (short term guidelines may be exceeded occasionally)

- No data available or insufficient data for assessment.

The Most Polluted Megacities

Seven of the megacities had three or more pollutants which exceeded WHO health protection guidelines, Mexico City, Beijing, Cairo, Jakarta, Los Angeles, Sao Paulo and Moscow. Mexico City was classified as having serious problems for sulphur dioxide, suspended particulate matter, carbon monoxide and ozone plus moderate to heavy pollution for lead and nitrogen dioxide. Mexico City suffers in particular due to its high altitude and climate which results in poor ventilation, in addition to the large number of old and poorly maintained vehicles.

Suspended Particulate Matter

The worst pollutant affecting the megacities as a whole is suspended particulate matter (SPM), particularly amongst megacities in the continent of Asia. This is of particular concern as high levels of SPM are known to be related to increased mortality rates, and in many of the megacities in developing countries health care for acute cases is less proficient than in developed countries. The sources of SPM are varied and can include natural sources such as wind blown dust from desert areas and the generally more toxic SPM from man-made sources such as power generation, motor vehicles (particularly diesel) and industrial processes. The three megacities which meet WHO guidelines are those which have undergone large scale control measures to reduce man-made SPM.

Sulphur Dioxide

Many of the megacities have reduced emissions of SO₂ through changes in fuel use from high sulphur coal and oil to cleaner fuels such as natural gas. Three megacities, Beijing, Mexico City and Seoul continue to have serious SO₂ problems, although the closure of a major refinery in Mexico City is expected to lead to a reduction in levels there. In Shanghai, SO₂ is a problem due to its heavy dependence on coal.

Carbon Monoxide, Nitrogen Dioxide and Lead

The main source of these pollutants, and hydrocarbons which are not monitored in all the megacities, is road vehicles. The number of cars across the world has grown tenfold since 1950 to around 630 million vehicles, and is expected to double within the next 20 - 30 years. Although leaded petrol has been phased out or greatly reduced in many countries, serious lead problems are still experienced in Cairo and Karachi. Lead has serious health implications particularly for infants and young children.

Ozone

Data on ozone, available for only 10 of the megacities, show that the most serious ozone problems are recorded in the three largest megacities, Mexico City, Sao Paulo and Tokyo, and also in Los Angeles. Ozone is a secondary pollutant and requires a high degree of sunshine and vehicle pollution for its formation. These conditions are experienced in many of the ten megacities that do not record ozone levels, and hence high levels would be expected in Bombay, Cairo, Calcutta, Delhi and Manila.

Conclusion

Air pollution is a widespread problem in megacities. The main pollutant of concern is suspended particulate matter. In addition, the megacities experiencing high SPM levels usually also experience high sulphur dioxide levels. These pollutants can act synergistically, exacerbating health problems. Pollutants arising from vehicle emissions are also a major cause of poor air quality in megacities.

There is a great need to implement control measures in most of the megacities of the world to improve air quality and hence protect public health. As many of the developing countries are becoming more industrialised, emissions of air pollutants are likely to increase dramatically as exemplified in the past by megacities in developed countries. There is also a great need to improve the air pollution monitoring capabilities in many of the megacities; at present data availability is hardly comparable between the megacities.