AN INTRODUCTORY REVIEW OF VEHICULAR AIR POLLUTIONIN INDIA

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INTRODUCTION

Air is the ocean we breathe. Air supplies us with *oxygen* which is essential for our bodies to live. Air is 99.9% nitrogen, oxygen, water vapor and inert gases. Human activities can release substances into the air, some of which can cause problems for humans, plants, and animals. Air pollution has been aggravated by developments that typically occur as countries become industrialized: growing cities, increasing traffic, rapid economic development and industrialization, and higher levels of energy consumption. The high influxes of population to urban areas, increase in consumption patterns and unplanned urban and industrial development have led to the problem of air pollution. Currently, in India, air pollution is widespread in urban areas where vehicles are the major contributors and in a few other areas with a high concentration of industries and thermal power plants. Vehicular emissions are of particular concern since these are ground level sources and thus have the maximum impact on the general population. Also, vehicles contribute significantly to the total air pollution load in many urban areas.

VEHICULAR POLLUTION CONTROL

The Ministry plays a coordinating role in the field of controlling of vehicular pollution

with the concerned Ministries and its associated bodies/organizations including the Ministry of Surface Transport, the Ministry of Petroleum and Natural Gas and the Ministry of Industry for up gradation of automobile technology, improvement in fuel quality, expansion of urban public transport systems and promotion of integrated traffic management as the vehicular emissions is the major cause for deterioration of urban ambient air quality. The Gross Emission Standards for vehicles have been prescribed from time to time and a road map is prepared to improve the quality of the fuel.

1. AIR QUALITY STATUS IN INDIA

Worldwide, the most widely monitored air pollutants are PM, NO2, SO2 CO and O3. They are also called criteria pollutants as they are the most common indicators of air quality and are regulated.Withthe exception of O3 and CO, they are monitored at all stations on regular basis in India. In the PM category, while TSPM is monitored in all stations, PM10 monitoring has also expanded considerably. But chronological data is available for a longer timeframe, (since the late 1980s) and for a larger geographical coverage since the 1990s, only for TSPM, NO2, and SO2. It is, therefore, easy to determine their long-term trend across the country. The latest nationwide data released by the Central Pollution Control Board (CPCB), New Delhi, on its website for 2004 present very scary picture. The data shows that in more than 60 Indian cities being monitored under the National Air Quality MonitoringProgramme (NAMP), at least one criteria pollutant exceeds either the annual average or the 24-hourly ambient air quality standards. The CPCB defines cities as critically polluted if the levels of criteria pollutants are more than 1.5 times the standards. Levels up to 1.5 times the standard are labeled high;

levels dipping till 50 per cent of the standards are considered moderate. Below this they are low. Besides criteria pollutants there is a range of air toxics. These are extremely lethal even in very small trace amounts. These are largely VOCs, including benzene, xylem, toluene and also a group of PAHs. The WHO does not consider any threshold level as safe for air toxics. Most of these are carcinogens and dangerous even at very low concentration. India's capacity to monitor them is still very weak.

AIR QUALITY MONITORING IN INDIA

The goal of air quality management (AQM) is to protect human health and ensure the overall welfare of animal and plant life. If air quality in a city fails to meet prescribed standards then people, especially those sensitive to air pollution-related diseases, fall presto unacceptably high health risks. The governments need to assess different pollution sources and find strategies to control them.AQM has matured considerably in the industrialized West, where sophisticated tools have been developed for rigorous planning and implementation. But AQM capacities are not uniform across the Asian region and fall woefully short of the desired benchmark. Monitoring capacity fluctuates at different levels of sophistication in different cities.

GLOBAL EMISSIONS OF GHG's FROM TRANSPORT SECTOR

Transport sector contributes around 14% towards the global emissions of green house gases. Carbon dioxide represents the largest proportion of basket of greenhouse gas emissions. During, the past three decades, carbon dioxide emissions from transport have increased faster than those from all other sectors and are projected to increase more rapidly in future. The Road transport alone emits around 16% of the global CO_2 emissions (Source: OICA). From 1990 to 2004, carbon

dioxide emissions from the world's transport sector have increased by 36.5%.For the same period, road transport emissions have increased by 29% in industrialized countries and 61% in the other countries (IEA, 2006). The mode wise distribution of CO_2 emissions amongst transport section, reveals that road transport contributes major share of around 73% towards total CO_2 emissions from transport sector. Aviation, International shipping & Railways sector emissions of CO_2 from transport sector are about 11%, 9% & 2% respectively.

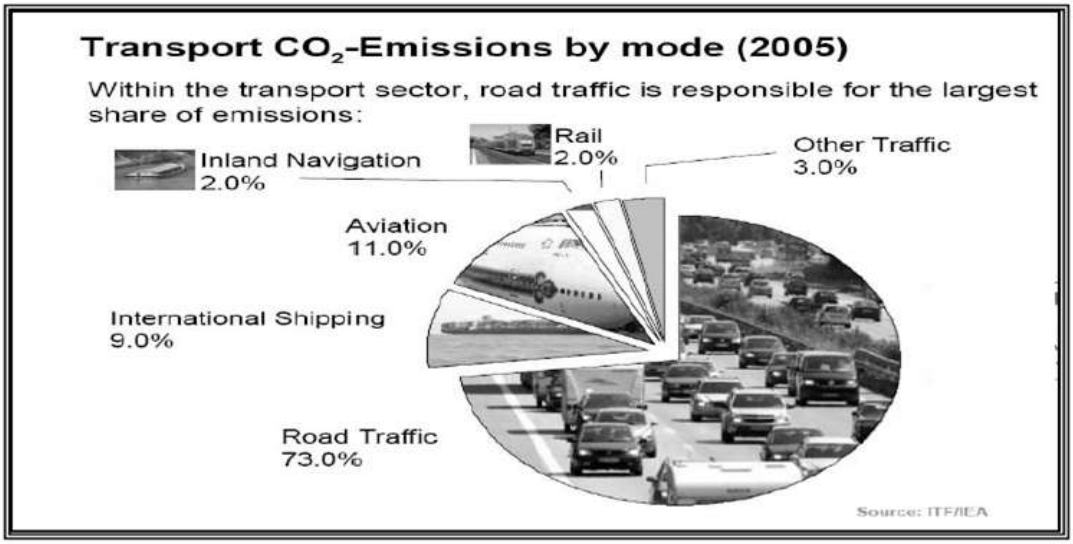
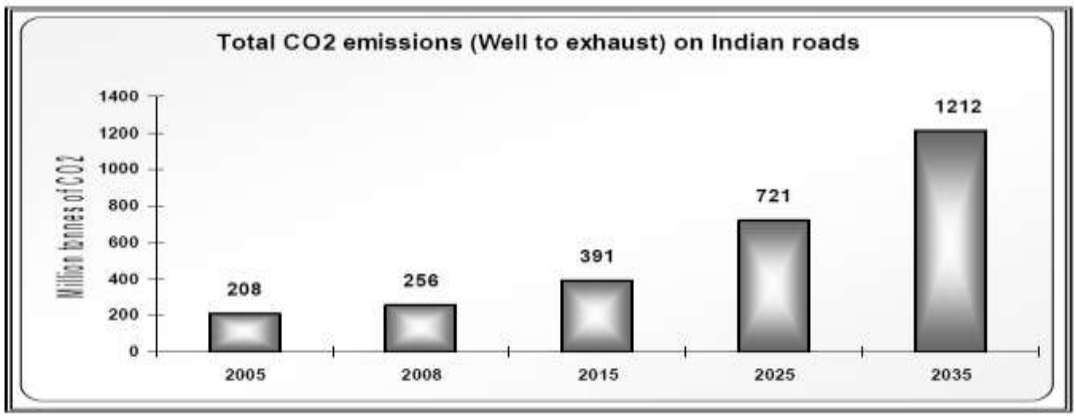


Table: Weighted emissions from Gasoline and Alternative Fuels (Unit: Moles of CO_2 eq per VMT (Weighted)

Greenhouse Gas	Gasoline	Methanol from Natural Gas	Ethanol from Corn	Compressed Natural Gas	Liquefied Petroleum Gas
Carbon Dioxide (CO_2)	7.9	8.7	7.4	5.64	6

Methane (CH_4)	0.22	0.35	0.39	0.91	0.17
Nitrous Oxide (N_2O)	0.54	0.54	2.98	0.54	0.54
Nitrogen Oxide (NOx)	1.06	1.45	2.33	0.97	0.92
Carbon Monoxide (CO)	0.99	0.98	0.78	0.97	0.96
Total	**10.71**	**12.02**	**13.88**	**9.03**	**8.61**



2. HARMFUL EFFECTS OF THE POLLUTANTS IN AIR

The various categories of air pollutants and their harmful effects are summarised in the given table:

Pollutant	Source/Cause	Effect
Carbon monoxide	Automobile exhaust,	Affects the respiratory activity as hemoglobin

	photochemical reactions in the atmosphere, biological oxidation by marine organisms, etc.	has more affinity for Co than for oxygen. Thus, CO combines with HB and thus reduces the oxygen-carrying capacity of blood. This results in blurred vision, headache, unconsciousness and death due to asphyxiation (lack of oxygen).
Carbon di oxide	Carbon Burning of fossil fuels, depletion of forests (that remove excess carbon dioxide and help in maintaining the oxygen-carbon dioxide ratio).	Global warming as it is one of the greenhouse gases.
Sulphur dioxide	Industries, burning of fossil fuels, forest fires, electric generation plants, smelting plants, industnal boilers, petroleum refineries and	Respiratory problems, severe headache, reduced productivity of plants, yellowing and reduced storage time for paper, yellowing and damage to limestone and marble, damage to leather, increased rate of corrosion

	volcanic eruptions.	of iron, steel, zinc and aluminum.
Hydrocarbons Polynuclear Aromatic Compounds(PAC) and Polynuclear Aromatic Hydrocarbons(PAH)	Automobile exhaust and industries, leaking fuel tanks, leaching from toxic waste dumping sites and coal tar lining of some water supply pipes.	Carcinogenic (may cause leukemia)
Chlorofluoro carbons (CFCs)	Refngerators, air conditioners, foam shaving cream, spray cans and cleaning solvents.	Destroy ozone layer which then permits harmful UV rays to enter the atmosphere.
Nitrogen Oxides	Automobile exhausts, burning of fossil fuels, forest fires, electric generation plants, smelting plants, industnal boilers, petroleum refineries and volcanic eruptions	Forms photochemical smog, at higher concentrations causes leaf damage or affects the photosynthetic activities of plants and causes respiratory problems in mammals.

PAN - peroxylacetyl -nitrate	Photochemical reactions of hydrocarbons and nitrogen oxides.	Irritation of eye, throat and respiratory tract, damage to clothes, paint and rubber articles, damage to leaves and stomatal tissue in plants.
Particulate matter Lead halides (lead pollution)	Combustion of leaded gasoline products	Toxic effect in man.
Asbestos particles	Mining activities	Asbestosis - a cancerous disease of the lungs
Silicon dioxide	Stone cutting, pottery, glass manufacturing and cement industries.	Silicosis, a cancerous disease.
Biological matter like the pollen grains	Flowers	Allergy
Fungal spores, bacteria, virus, etc	Microbes	Infectious diseases

3. CONTROL OF AIR POLLUTION

Air pollution can be controlled by different methods depending on the source and the pollutant. The different methods are:

One of the major causes of air pollution is the automobiles. The fuels being used should be lead-free as this will reduce the level of lead in the atmosphere. The carburettor should be cleaned regularly and good quality fuel should be used. This reduces the smoke emission from the exhaust pipes of the vehicles. Efforts to introduce vehicles running on alternate sources (for example solar energy) of energy should be made. These methods will go a long way in reducing the occurrence of photochemical smog.

The industrial pollution is best controlled at source. The polluting gases should be passed through filters and other devices such as cyclone collectors, scrubbers, precipitators, etc. so that the particulate matter is removed before the waste gases are released out. The toxic gases should be detoxified.

The domestic and industrial smoke producing units should have long chimneys to take the polluting gases far above and then disperse over a larger area. They should also invest in solar cookers or bio gas. The pollution by sulphur dioxide is mainly due to coal-based industries. Alternate non-sulphur containing fuel must be used. It is also possible to remove the sulphur from the fuel before use. There are many plant species like the need (Azadirachta indica), bel (Aegle marmelos), gulmohur (Delonix regia), etc. that clean the atmosphere. More trees of such types should be planted.

For effective control and prevention of air pollution it is important to educate people and create public awareness about the ill-effects of air pollution. The following are some methods that may be adopted to control pollution on a large scale:

Combustion

Pollutants in the form of organic gases or vapours can be burnt to convert them into water vapour and relatively less harmful products, such as carbon dioxide.

Absorption

The gaseous effluents may be made to pass through scrubbers or absorbers. These contain a suitable liquid absorbent, which removes or modifies one or more of the pollutants present in the gaseous effluents making it comparitively harmless.

Adsorption

The gaseous effluents are passed through porous solid adsorbents kept in suitable containers. The organic and inorganic constituents of the effluent gases are trapped at the interphase of the solid adsorbent. Adsorbents hold (molecules of a gas or liquid or solute) to its surface, causing a thin film to form.

Methods to Control Particulate Emissions

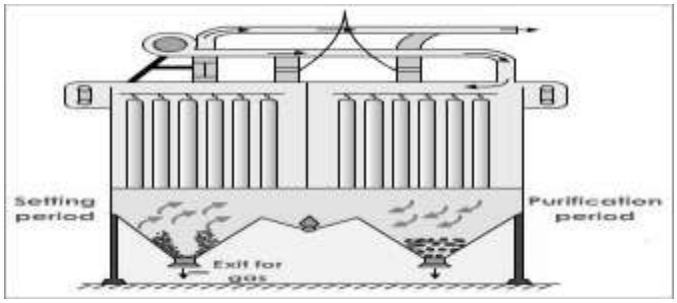
Particulate emissions may be controlled by using mechanical devices that generally work on the basis of the following:

Gravity

In this process, the particles settle down by gravitational force. Sudden changes in the direction of the gas flow causes the particles to separate out due to greater momentum.

Fabric Filters

The gases containing dust are passed through a porous medium. Which are usually woven fabrics? The particles present in the gas are trapped and collected in the filters. The gases freed from the particles are then discharged.



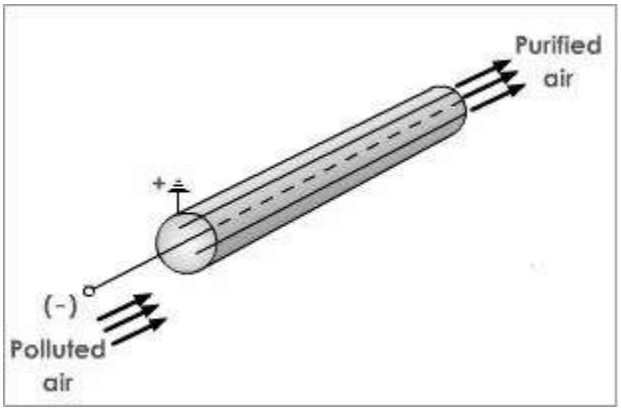
A Typical Bag Filter

Wet Scrubbers

Wet scrubbers are used in chemical, mining and metallurgical industries to trap sulphur dioxide, ammonia, metal fumes, etc.

Electrostatic Precipitators

When a gas or an air stream containing aerosols in the form of dust, fumes or mist, is passed between two electrodes, then, the aerosol particles get precipitated on the electrode.



Electrostatic Precipitator

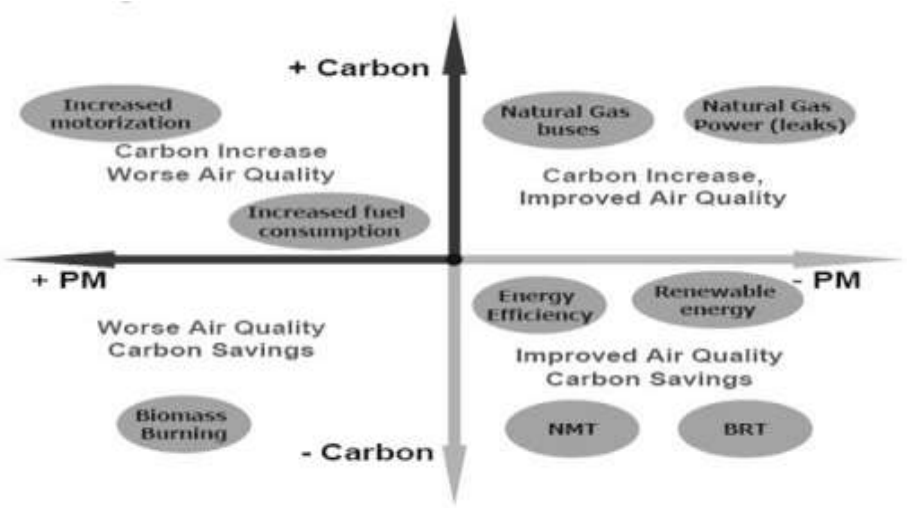
The following practices also help in controlling air pollution:

- Better designed equipment and smokeless fuels must be used in hearths in industries and at home.
- Automobiles should be properly maintained and must adhere to emission - control standards. (Bharat II or Euro II)
- More trees should be planted along road-side.
- Renewable energy sources, such as wind, solar energy, ocean currents, must be tapped to fulfill energy needs.
- Tall chimneys should be installed for vertical dispersion of pollutants.

CO-BENEFITS ANALYSIS OF AIR POLLUTION AND GHG EMISSIONS

A co-benefits approach as outlined in figure below is increasingly becoming a starting point for discussing integrated programs benefiting climate change and air quality alike. Figure depicts a scenario where the co-benefits can aide decision making over a variety of control measures. For example, policies designed to reduce the impact of transport on air quality by tackling congestion and encouraging a shift to public

transport, walking, and cycling should also reduce CO2 emissions. Measures to improve energy efficiency and cut energy demand, reduces air pollutants and GHG emissions together during electricity generation. In the developing countries, this approach is being recognized as a practical and effective tool in technical, policy, economic, and institutional perspectives.



Source: Dr. Cornie Huizenga, Executive Director, CAI-Asia, Manila, Philippines

POLLUTION FACTS

- According to research conducted by the World Health Organization, around 2.4 million people die every year because of air pollution.
- In India, air pollution is believed to cause 527,700 fatalities a year.
- Engine exhaust (diesel and gas) contains more than 40 hazardous air pollutants.
- Traffic areas around schools - where vehicles are often left idling - show significantly higher pollution levels outside (and inside) their buildings.

- Emissions from vehicles are producing around 70% of the air pollution. There are about 500 million cars on the planet and by 2030, that number is expected to double to 1 billion cars.
- A decreasing trend has been observed in sulphur dioxide levels in residential areas of many cities such as Delhi, Mumbai, Lucknow, Bhopal during last few years. The decreasing trend in sulphur dioxide levels may be due to recently introduced clean fuel standards, and the increasing use of LPG as domestic fuel instead of coal or fuel wood, and the use of LPG instead of diesel in certain vehicles.
- Under standard Indian driving conditions, a standard petrol-vehicle is expected to emit over 8000 grams of carbon dioxide per day while travelling. For a usual commuter that amounts to over 1.92 tons of carbon dioxide emitted annually by a single vehicle.
- Under standard Indian driving conditions, a standard petrol-vehicle is expected to emit over 800 grams of carbon dioxide per day just while idling.
- A decreasing trend has been observed in nitrogen dioxide levels in residential areas of some cities such as Bhopal and Solapur during last few years. The decreasing trend in sulphur dioxide levels may be due to recently introduced vehicle emission standards, and the increasing use of LPG as domestic fuel instead of coal or fuel wood.
- Many industries are still dumping their waste in water bodies like lakes, oceans or rivers. Bacteria born because of industries dumping their waste in water bodies are responsible for causing of about 250 million water borne diseases annually. Due to these diseases 5 to 10 million deaths are occurring every year.

- Most Indian cities greatly exceed acceptable levels of suspended particulate matter. This may be because of refuse and biomass burning, vehicles, power plant emissions, industrial sources.
- An estimated 14 billion pounds of trash, much of it plastic, is dumped in the world's oceans every year.
- A staggering 250 million Indians make their living in some form from the forests. At present, India has 70 million hectares of forest cover. But 40% of that cover is sadly, 'open degraded forest'.
- The cost of one nuclear weapons test alone could finance the installation of eighty thousand hand pumps, giving third world village's access to clean water.
- The Indian air quality monitoring stations reported lower levels of PM10 and suspended particulate matter during monsoon months possibly due to wet deposition and air scrubbing by rainfall. Higher levels of particulates were observed during winter months possibly due to lower mixing heights and more calm conditions. In other words, India's air quality worsens in winter months, and improves with the onset of monsoon season.
- Combined with industrial runoff, the garbage thrown into the Yamuna totals over 3 billion liters of waste per day.
- According to the World Health Organization, each year an estimated four billion people get sick with diarrhea as a result of drinking unsafe water, inadequate sanitation, and poor hygiene. Nearly two million people die from diarrhea each year, and many of them are children under the age of five, poor, and living in the developing world.
- The average annual SOx and NOx emissions level and periodic violations in industrial areas of India were significantly and

surprisingly lower than the emission and violations in residential areas of India

- Vapi in Gujarat and Sukinda in Orrisa is among the world's top 10 most polluted places, according to the Blacksmith Institute, a New York-based nonprofit group.
- Air pollution caused by the burning of fossil fuels like coal and diesel has contributed to a worrisome slowdown in rice harvest growth in India in the past two decades.
- India has been ranked as the seventh most environmentally hazardous country in the world by a new ranking released recently. The study is based on evaluation of "absolute" environment impact of 179 countries, whose data was available and has been done by researchers in Harvard, Princeton, Adelaide University and University of Singapore on January 12, 2011.
- Of the four major Indian cities, air pollution was consistently worst in Delhi, every year over 5 year period (2004–2008). Kolkata was a close second, followed by Mumbai. Chennai air pollution was least of the four.
- Vehicle emissions are responsible for 70% of the country's air pollution. The major problem with government efforts to safeguard the environment has been enforcement at the local level.
- Air pollution from vehicle exhausts and industries is a worsening problem for India. Exhaust emissions from vehicles has increased eight-fold over levels of twenty years ago; industrial pollution has risen four times over the same period. The economy has grown two and a half times over the past two decades, but pollution control and civil services have not kept pace. Air quality is the worst in big cities like Kolkata, Delhi, Mumbai, Chennai, etc.

- Bangalore holds the title of being the asthma capital of the country. Studies estimate that 10 per cent of Bangalore's 60 lakh population and over 50 per cent of its children below 18 years suffer from air pollution- related ailments.
- Chennai: Exhaust from vehicles, dust from construction debris, industrial waste, burning of municipal and garden waste are all on the rise in the city. So are respiratory diseases, including asthma.
- Mumbai: The air pollution in Mumbai is so high that Mumbai authorities have purchased 42,000 litres of perfume to spray on the city's enormous waste dumps at Deonar and Mulund landfill sites after people living near the landfill sites complained of the stench.
- Most Indian cities continue to violate India's and world air quality PM10 targets. Respirable particulate matter pollution remains a key challenge for India. Despite the general non-attainment, some cities showed far more improvement than others. A decreasing trend has been observed in PM10 levels in cities like Solapur and Ahmedabad over the last few years. This improvement may be due to local measures taken to reduce sulphur in diesel and stringent enforcement by Gujarat government.
- Pune: According to a study by Environment Status Report (ESR) in July 2010, air pollution in Pune has become a serious problem. The respiratory suspended particulate matter (PM 10) in the air is more than the standard national level. About 93,000 commercial properties which include hotels, malls and hospitals emit 204 tonne PM10 every year.
- Delhi: According to a study conducted in June 2011 by The Energy and Resources Institute (TERI), Delhi has high levels of

air pollutants and ozone, and the latter has a harmful impact on health and agricultural yield. TERI found that cities like Delhi and Ghaziabad violate annual ambient air quality standards for particulate matter concentrations.

- Indoor air pollution: Indoor air pollution is the most important cause of chronic obstructive pulmonary disease (COPD) in India, says a prevalence study conducted by Pune based Chest Research Foundation (CRF) and the Imperial College, London in November 2010. Over 700 million people in India suffer from high levels of indoor air pollution affecting women and young children as 75 per cent homes use biomass fuel like wood, crop residue and dung cakes.
- The National Institute of Environmental Health Sciences (NIEHS) is working to understand how exposure to environmental agents trigger diseases such as Asthma, and how these diseases can be prevented, diagnosed and treated.
- Municipal solid waste: With India's urban population slated to increase from the current 330 million to about 600 million by 2030, the challenge of managing municipal solid waste (MSW) in an environmentally and economically sustainable manner is bound to assume gigantic proportions. The country has over 5,000 cities and towns, which generate about 40 million tonnes of MSW per year today. Going by estimates of The Energy Research Institute (TERI), this could well touch 260 million tones per year by 2047.
- Taking a cue from the finding, the Central Pollution Control Board (CPCB) formulated NAAQS and checked the air quality, which led to the revelation about air quality in leading cities.

- According to the report, Gobindgarh in Punjab is the most polluted city, and Ludhiana, Raipur and Lucknow hold the next three positions. Faridabad on the outskirts of Delhi is the 10th most polluted city, followed by Agra, the city of the Taj Mahal. Ahmedabad is placed 12th, Indore 16th, Delhi 22nd, Kolkata 25th, Mumbai 40th, Hyderabad 44th and Bangalore stands at 46th in the list. The Orissa town of Angul, home to National Aluminium Company (NALCO), is the 50th polluted city of the country.

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