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Sources of Air Pollution and Strategies for Its Management In The Nigerian Urban Cities

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Abstract: This study examines sources of air pollution and strategies for its management in the urban cities. Emphasis is laid on industrial air pollution and vehicular emission, which are the major urban air polluters. Various gases that are emitted by industries into the atmosphere near and around dwelling places were analyzed. Also analyzed is the combustion of large quantity of transportation fuels in the urban cities, which releases several contaminants into the atmosphere. These contaminants include carbon monoxide, hydrocarbons, oxides of nitrogen, lead and other particulate matter. Various strategies which can be employed for the management of urban air pollution were discussed, covering stack monitoring, changing process operation and cleaning flue gases for industrial emissions, and changing fuel type, removing gross polluters, cleaning vehicle exhaust gases and traffic management for vehicular emissions.

Keywords: Air pollution, industrial emissions, vehicular emissions management strategies and urban cities.

INTRODUCTION

Society's ability to cause major changes in the atmosphere, and other elements of the environment, is a recent phenomenon, strongly influenced by demography and technological development[1]. Primitive peoples, for example, being few in number and operating at low energy levels with only basic tools did very little to alter their environment. The characteristically low natural growth rates of the hunting and gathering groups who inhabited the earth in prehistoric time ensured that populations remained small. This combined with their nomadic life-style and the absence of any mechanism other than human muscle by which they could utilize the energy available to them, limited their impact on the environment[2].

Today, human activities are already changing the composition and behaviour of the atmosphere. Technology advancement, though is important, desirable and necessary ingredient of economic and social growth, has been at the expense of other form of life. Energy is directly implicated in the atmospheric pollution caused by the burning of fossil fuels for transportation, industry and domestic uses[3].

The concern about environmental pollution was not recognized until the early 1960s when advanced countries such as Europe started giving serious though to it. Environmental pollution in developed countries is due to industrialization, but in underdeveloped countries it is due to waste disposal facilities[4].

Farmer[5] defined environmental pollution as the direct or indirect introduction (as a result of human activity) of substances, vibration, heat or noise into the air, water or land which may be harmful to human health or the quality of environment, result in damage to material property, or impair or interfere with amenities and other legitimate uses of he environment. Therefore, man deliberately or accidentally contaminates the environment with his wastes. These wastes alter the environment by changing the growth rate of species, interferes with the food chain, as well as health, comfort, amenities or property values of people. In general, pollution causes degradation and/or damage to the natural functioning of the biosphere. The pollution of the environment has been found to result from man's determination to match desire with production through the establishment of various industries with potential to pollute the environment[4].

Environmental degradation consists of the despoliation of the soil, water and air components of the earth. While attention in environmental studies is often focused on soil, much more consideration should be given to the air component, which has the largest proportion of the earth's volume and also directly consumed by man.

The release of air pollution in the atmosphere is a concomitant result of human activities. In some instances, naturally produced air pollutants out weigh man-made pollution but the latter tends to be concentrated in urbanized areas where people live and work. Surveying emission sources can either be done on the basis of individual pollutants or individual sources. Motor vehicles, for example, emit a cocktail of nitrogen oxides, carbon monoxide, volatile organic compounds, particulate, heavy metals and (for diesel) suphur dioxide[6].

Table 1: Air quality in some selected Nigerian Cities and FEPA quality standards

Pollutant	**Lagos (mg/m^3)**	**Ibadan (mg/m^3)**	**Port Harcourt (mg/m^3)**	**FEPA (Nigeria Quality Standards (mg/m^3)**
Suspended particulates	230	310	180	0.35
Sulphur (IV) Oxide, SO_2	60	20	30	26
Nitrogen (IV) Oxide, NO_2	12	10	13	0.075 – 0.113
Hydrogen sulphide, H_2S	20	30	5	-

Sources: Ademoroti[9].

Clouds of smoke are a common sight in cities, especially in the Ikeja, Oshodi, Ijora and Apapa areas of Lagos metropolis in Nigeria. These pollutants cause acid rain, which constitute serious damage to young trees. Piled junk, duped waste and burning of solid wastes using incomplete combustion system pollute the environment and cause a nauseating[7]. An international report of emissions of industrial processes reported that Nigeria and other developing countries may have levels of toxic emissions several thousand times higher than the highest reading taken in developed countries[3].

Sources of air pollution: Air pollution in general, arises from sources of very great variety, many industrial activities contribute as well as domestic and agricultural practices, but industrial emissions and vehicular emissions are the over whelming polluters in the urban cities.

Industrial emissions: Nigeria has witnessed rapid urban growth, increased economic and technological development in the past few years and these have also brought about increasing industrial development coupled with various forms of environmental pollution[8]. Since the production of wastes is an integral part of industrial activities, it is obvious therefore, that industrial growth apparently leads to an increase in production of industrial wastes

Industries emit smokes and various gases of various magnitudes into the atmosphere everyday. In Nigeria, as well as many other developing nations of the world, industries are sited indiscriminately. Therefore, the various gaseous emissions are poured into the atmosphere near and around dwelling places. In this way, most industrial towns and cities in Nigeria are always polluted (Table 1).

Table 1 shows that in many cases, gaseous pollutants (SO_2, NO_2 and suspended particles) exceed the average value acceptable by the Federal Environmental Protection Agency (FEPA). There is a great d earth of data on concentrations of air pollutants in the effluent gases emitted by individual process industries in Nigeria. The reason for the dearth[9], is due largely to lack of proper air-quality-monitoring equipment because of their prohibitive costs. Process industries concern themselves with one or combinations of the combustion of hydrocarbons or carbon derivatives, sulphur and sulphur containing compounds, metals e.t.c. In all these processes, various oxides are produced and are emitted as discussed below:

Combustion of fossil fuels and carbon: Almost every contaminant in the environment can be traced ultimately to a chemical reaction. The amount of the contaminant is linked by a chemical equation to a resource consumed or some other substance chemically altered. The chemical equation, with associated atomic masses, serves as quantitative bridge connecting pollution, resources, and the level of man's activities.

The burning of fossil fuel, carbon or charcoal leads to depletion of oxygen. It may be represented simply by Eq. 1:

$$C + O_2 = CO_2 \qquad (1)$$

Since charcoal is nearly pure carbon (C), this equation serves for the burning of charcoal. Many organic materials, including organic wastes, are largely carbon, so the same equation expresses the most central feature of their oxidation of many organic materials throughout the environment. Therefore, it is one of the most important chemical equations underlying environmental changes.

In the case of the combustion of fossil carbon represented by the above equation, one C atom (along with a diatomic oxygen molecule) has been lost and a gain of one CO_2 molecule has been achieved. In terms of molecule, this is ratio one to one. However, the mass (44g) of CO_2 produced (gained) is more than the mass (12g) of C consumed. So, the mass ratio of CO_2 to C is 44/12 or 11/3. Therefore, for every 3 units of mass of carbon consumed in an environment, there are 11 units of mass of carbon (IV) oxide produced to the environment. This is pollution. Similarly, by using the masses of O_2 (32g) and of C (12g), the mass ratio of consumed O_2 to consumed C is 32/12 or 8/3. Therefore, for 3 units of fossil carbon burnt, 8 units of oxygen is removed from the atmosphere.

Estimated world reserves of recoverable fossil fuels and their carbon content are as shown in Table 2. Coal-burning power plants are found here and there all over the country, each emitting large quantities of combustion gases from smoke stacks. These gases contain sulphur (IV) oxide, oxides of nitrogen and particulate matter as the three major pollutants.

Table 2: Estimated worldwide reserves of recoverable fossil fuels and fossil carbon and the corresponding potential oxygen depletion.

Fossil Fuel	Amount of Fuel (in 10^{12} tons)	Amount of C contaminated in fuel (in 10^{2} tons)	Potential O_2 depletion (8/3 times amount of C) (in 10^{12} tons)
Coal	7.6	5.7	15.2
Oil shale	0.5	0.4	1.1
Petroleum	0.2	0.2	0.5
Natural gas	0.2	0.1	0.3
Tar sand	0.1	0.1	0.2
Totals	8.6	6.5	17.3

Sources: Giddings[10].

Table 3: Major sources of SO_2 pollution in some named areas

Fossil Fuel	Millions tons estimated per year		
	Nigeria	USA	India
Coal (by Combustion and refining	6.8	3.3	20.7
Smelting (From Cu primarily	Not Known	3.9	1.7
Miscellaneous	Not Known	1.4	20.0

Source: Ademoroti[9].

Combustion of sulphur and sulphur containing compounds: The burning of sulphur leads to the depletion of oxygen. This may be represented by the Eq. 2:

$$S + O_2 = SO_2 \quad (2)$$

Equation (2) shows that the mass ratio of SO_2 to S is 64.1/32.1 and to a close approximation, the ratio is 2/1. Therefore, 1 tons of S will form 2 tons of SO_2.

Considerable sulphur (IV) oxide pollution is often found in the vicinity of copper, lead and Zinc smelters. According to Giddings[10], the sulphur in sulphur (IV) oxide has its origin in certain copper ores; chalcocite (Cu_2S) and chalcopyrite ($CuFeS_2$). In the roasting and smelting process, chalcocite reacts with oxygen to produce metallic copper and sulphur (IV) oxide. From Eq. 3, for each ton of Cu produced, 0.505 of SO_2 is released to pollute the air. Also for each ton of CuS that is smelted, as much as 0.403 ton of SO_2 is released to the atmosphere.

$$Cu_2S + O_2 = 2Cu + SO_2 \quad (3)$$

Chalcopyrite ($CuFeS_2$) is the principal mineral processed at most smelters, possibly because of its iron content and possibly because of its more abundant nature. The roasting and smelting of chalcopyrite can be describe by Eq. 4:

$$2\,CuFeS_2 + 5O_2 = 2Cu + 2Fe_2O + 4SO_2 \quad (4)$$

From Eq. 4, each ton of Cu produced yields 2.016 tons of SO_2 and each ton of $CuFeS_2$ smelted produces 0.7 ton of SO_2. Clearly the processing of chalcopyrite ore has more serious implications for SO_2 production than does the processing of chalcocite ore. Table 3 shows major sources of SO_2 pollution and the estimated quantity released per year in some named areas.

Combustion of nitrogen and oxides of nitrogen containing compounds: There are at least five kinds of nitrogen containing gas molecules in the atmosphere viz: nitrogen (N_2), nitrogen (II) oxide (NO), nitrogen (IV) oxide (NO_2), nitrogen (I) oxide (N_2O) and ammonia (NH_3). Among these compounds, nitrogen (II) and nitrogen (IV) oxides are major air pollutants. Upon raising air to high temperature, NO is produced by the chemical reaction.

$$N_2 + O_2 = 2NO \quad (5)$$

Such heating occurs in flames and therefore most NO comes from combustion of fuels such as coal, petrol and oil. Table 4 shows the world-wide urban emissions of nitrogen oxides. All emission values are reported in terms of NO_2, the chemical form to which NO invariably becomes oxidized in the atmosphere. NO and NO_2 exist side by side, therefore, they are sometimes represented by the collective symbol NO_x.

Vehicular emissions: Thousands of motorized vehicles ply the major roads and streets of Nigerian cities daily. The same is true of many other countries of the world. In doing this, the vehicles consume millions of litres of petrol daily. The combustion of transportation fuels by these vehicles releases several contaminants into the atmosphere, including carbon monoxide, hydrocarbons, oxides of nitrogen, and lead and other particulate matter. Once emitted into the atmosphere, air pollutants undergo mixing or diffusion, the degree of which depends on topographic, climatic, and meteorological conditions[6].

Table 4: World wide Urban Emissions of Nitrogen Oxides

Fuel	Source Type	NO_2 Emission (in Million tons)
Coal	Power generation	12.3
	Industrial	13.7
	Heating	1.0
Petroleum	Refineries	0.7
	Gasoline	7.5
	Kerosine	1.3
Natural gas	Power generation	0.6
	Industrial	1.1
	Heating	0.4
Others	Incineration	0.5
	Wood fuel	0.3
	Forest fire	0.8

Source: Giddings[10].

Combustion of petrol takes place in the internal part of the engine of a vehicle. If a typical hydrocarbon octane is taken to represent petrol, an equation may be written for the combustion occurring in the engine as follows:

$$2C_8H_{18} + 25O_2 = 16CO_2 + 18H_2O \qquad (6)$$

Carbon (II) oxide, CO, may be formed due to incomplete combustion that may take place. Also other hydrocarbons occur as well. In order to raise the octane number of petrol to achieve super grade level, tetra-ethyl lead, is added and during combustion in the engine, we have:

$$2(C_2H_5)_4Pb + 27O_2 = 2PbO + 16CO_2 + 20H_2O \quad (7)$$

There are halogen carriers: $FeCl_2$ and $FeBr_2$ co-additives of the tetra-ethy lead, which also go into the engine. During combustion, PbO reacts with the halogen carriers to form halides: $PbCl_2$; PbBr Cl and $PbBr_2$, which escape to the atmosphere through vehicle exhausts. It should be realised that the O_2 used in internal engine combustion (Eq..6) is a component of air which contain 78.08% N_2. As combustion occurs, oxides of N_2 are formed also. In total, the following products of combustion are obtained; CO, CO_2, NO, NO_2, PbO, FeO, Fe_2O_3, lead halides and divers hydrocarbons (some of which are carcinogenic). They are poured into the atmosphere daily through the exhausts. They are discharged in streets and market places where vehicles and people intermingle most freely. Therefore, the people in the urban area are exposed to serious air pollution.

Management strategies for the urban air pollution: The management of environmental air pollution is an increasingly complex subject, both scientifically and politically. Air pollution manager has to be in formed by a wide range of rapidly developing scientific information and yet, at the same time, has to make decisions that may be driven by social or political factors. The problems of uncertainly which exists in dealing with the management of air pollution make the task a difficult one. These problems include:

- Lack of time to collect sufficient information especially when examining longer-term impacts, e.g chronic health problems, effects of low-level radiation or subtle changes to ecosystems.
- Some environmental air systems are so highly complex that our ability to predict their responses is very limited.
- It may be possible to under take experimental studies to obtain sufficient information, which however, might mean manipulating the air of the environment that one is concerned to protect. This defeats the purpose of pollution regulation.
- The cost of obtaining sufficient information may outweigh the economic benefits of discharging the pollutants.

Managing air pollutants from industry: Industry, in its broadest sense, has been and still is a major contributor to air pollution. However, the management of these sources of pollution has not always been undertaken in the most efficient manner. The following two points should be considered in any current management strategy:

- A holistic view of pollutant emissions must be taken. Thus strategies to reduce air pollution must not lead, for example, to greater water pollution.
- The whole process operation must be examined. Far too often environmental managers and engineers have sought answers to what to do with pollutants once they are emitted (‘end - of - pipe’ solutions), rather than seeking to prevent their formation. Pollutants may actually represent losses of valuable material (e.g. solvents), and measures to prevent their loss may actually save money.

Stack monitoring: Stack monitoring is particularly important where pollutant concentrations may vary widely. One example would be the incineration of waste. Waste combustion requires the maintenance of very high temperatures to ensure complete destruction of the waste and to prevent, for example, the formation of dioxins from the incineration of plastics. However, the waste itself provides much of the fuel and, as this is very variable, the temperatures may vary considerably. While modern incinerators supplement the waste with gas burners to ensure temperature maintenance, it is important to monitor the flue gases to ensure that changes in conditions do not lead to unacceptable pollutant emissions.

Stack monitoring is not always possible. There is considerable concern at present regarding the overall emissions of the volatile organic compounds that act as precursors for ozone formation. Large sources of these are the solvents used in industry. However, rather than being emitted from one or a few chimneys, these tends to rise from many points in an industrial plant, often from leaks, e.t.c. These are known as fugitive emissions. It is possible to estimate loss by keeping a careful balance sheet of solvent use and recovery and assuming the difference is lost to fugitive emissions. However, monitoring the environment around the process can also provide information on these emissions. Obviously, monitoring stack emissions does enable an operator to judge whether pollution abatement equipment is functioning adequately.

Changing the nature of the fuel: Where pollutant emissions are due to the type of fuel being used for combustion, modifying the fuel can have significant effects on emissions. For example, cleaning of flue-gas in order to reduce sulphur emissions is unnecessary, since environmental objectives can be met without wasting resource on emission controls[11]. Emission of sulphur can be reduced to negligible quantities by the selective burning of low sulphuur coal and by the construction of gas-fired power stations. It is also possible to use traditional fuel sources and treat them prior to combustion to remove substances, which may cause air pollution.

Changing process conditions to reduce pollutant production: Some pollutants are produced during the process itself. Examples include the production of nitrogen oxides during combustion, dioxins during incineration. Alterations to the way that processes are operated can significantly reduce the creation of these pollutants.

The amount of nitrogen oxides produced can be reduced in various ways. These oxides are produced by the oxidation of atmospheric nitrogen and oxygen in the combustion chamber. It is possible to achieve a 20 – 30% reduction in nitrogen oxide production with careful control of the amount of air admitted into the combustion chamber[12]. However, care has to be taken, as an air content that is too low may result in the creation of enhanced carbon monoxide levels. An increasingly used technique for nitrogen oxide reduction is the used of low NO_x burners. These carefully control fuel air mix and have been developed for coal, oil and gas use. They can achieve a 30 – 50% reduction in the production of nitrogen oxides[13].

Cleaning the flue gases: If it is not possible to prevent the production of pollutants, then it is necessary to prevent their release into the environment by cleaning the exhaust gases. Almost all processes have some form of gas cleaning, generally to remove particulates. A range of techniques is available, depending on the size of the process and quantities of pollutant.

***Using filter bags*:** For small processes, particulates can be collected from the waste stream using filter bags through which particles above a given size cannot pass. These are efficient, but do become blocked and need regular replacement.

***Using cyclones*:** The most common technique for particulate removal is the use of cyclones. In effect cyclones can be viewed as containers that form a large expansion (increased diameter) within the exhaust pipes, e.t.c., through which the waste gases pass. By increasing the size, the velocity of the gases decreases and particles can settle out. With correct positioning of inlets and outlets to cyclones, they can form efficient particulate traps. If high levels of particulate retention are required, more than one cyclone can be used in a progressive series. Because cyclones operate by means of physical deposition of particles from the waste stream, they operate more efficiently for larger particle sizes, which are more likely to settle out.

***Using electrostatic precipitators*:** A more elaborate method of particulate removal is the use of electrostatic precipitators, which may remove up to 99% of the particulates present[5]. This involves the waste gases passing through electrically charged plates to which the particles are attracted. In this case smaller particles are just as likely to be removed as larger ones.

***Techniques for removing sulphur dioxide from exhaust emissions*:** Sulphur dioxide could be removed from exhaust emissions by wide variety techniques, collectively known as *flue gas desulphurisation* (FGD). Most of these involve the injection of an alkali into the gas stream, to which the sulphur dioxide will react, forming a solid waste product. The best-developed systems involve the use of limestone. This can either be used dry or wet. At present a number of smaller processes tend to use dry limestone, while larger plants have used wet techniques. Such flue gas desulphurisation can reduce sulphur dioxide emissions by at least 90%[14, 15].

***Techniques for removing nitrogen oxides from exhaust emissions*:** Nitrogen oxide can be cleaned from exhaust gases through two principal techniques – selective catalytic reduction (SCR) and selective non-catalytic reduction (SNCR). With SCR, a metal catalyst is used to reduce the nitrogen oxides to ammonia. It needs to operate between 200^0C and 400^0C and it can achieve 80-90% reduction in emissions. SNCR involves the injection of ammonia or urea into the flue gases to reduce chemically the nitrogen oxides. These reactions will only operate at high temperatures (between 900^0C to 1100^0C), so the technique is less versatile than SCR. SNCR can achieve a reduction in emissions of 70%, although in practice lower figures are usually found[16].

Managing pollution from motor vehicles: The problem of traffic pollution is a particularly difficult issue for the pollution manager especially in the urban cities. Locally motivated air quality programmes for urban transport are found to have very limited collateral benefits in terms of protecting the global environment. In locally motivated air pollution control programme attempts are made in reducing emissions of carbon (II) oxide (CO) and hydrocarbons (HC). The result is merely to increase the share of carbon atoms that are emitted directly as carbon (IV) oxide (CO_2) (more complete combustion). Such technical controls, therefore, have no significant effect on global warming. As traffic volume is increasing rapidly in almost every country in the world, appropriate strategies to manage the resulting pollution are desperately needed. There are a number of types of management that can be adopted:

- Changing the type of fuel used to one that produces less pollution.
- Removing inefficient and grossly polluting vehicles.
- Adopting measures to clean the exhaust gases
- Adopting measures to manage the use of motor vehicles.

Some of these measures are best adopted at national or international levels; others are open to local management. These options are discussed below:

Managing fuel type: The best-known example of this has been the adoption of unleaded petrol[17]. Lead is added to increase the octane level, and there are two ways to produce the same effect in unleaded fuel. The first is to improve the octane level of the petrol with a substitute for the lead, such as tertiary butyl ether. The alternative is to change the refinery process so that a higher-octane product is made at the outset using catalytic reformation.

Consideration should also be given to proposals to change completely the type of fuel used. Biofuels are one option and the most extensively used of these is ethanol. Biofuels are produced from specially grown crops. For example, sugar cane can be converted to ethanol as substitute for petrol. Methanol from wood production is another alternative. Rape-seed oil can be converted to a methyl ester, which can substitute for diesel. Research into the use of biofuels should be intensified because their use is still limited, except in Brazil where over four million cars now run on ethanol[5]. Biofuels not only have very low pollutant emissions, but they are also important in controlling green house gas emissions, as the production and use of the fuel results in a low net carbon dioxide production.

Removing grossly polluting vehicles: The problems of traffic pollution are particularly acute in a number of major cities, especially in cities where traffic jam is a common experience as considerable amount of fuel is used while cars are trapped in traffic congestion. Research carried out on emissions from different types of motor vehicle and fuel type reveals that older vehicles and those that are incorrectly maintained contribute a disproportionate amount to aerial pollution[18]. Therefore, active policies must be adopted to remove older cars from vehicle fleet most especially in the urban cities. The gross polluters must first be discovered. This can be done by involving a requirement that a vehicle pass an emission test in motor-vehicle road worthy tests. Also, a "smoky vehicles hot line" can be adopted whereby the public can report vehicle with visibly very high particulate emissions.

Cleaning vehicle exhaust gases: The recent increase in the number of vehicles on the road in Nigeria especially in the urban cities, is a welcome development, as the movement of people and goods are greatly enhanced. But this has increased air pollution through vehicles exhaust emission. Since it is difficult to produce emissions free vehicles, it is necessary to focused on "end-of-pipe" technology, i.e. cleaning the pollutants from the exhaust gases. This can be done by fitting catalytic converters to vehicles. There are two types available; the first is simple porous ceramic structure coated in a catalyst (usually platinum), through which the exhaust gases pass. The catalyst converts carbon monoxide and hydrocarbons to carbon dioxide and water vapour, but does not affect nitrogen oxides[19].

The second type is the three-way catalyst, which combines the use of different catalytic metals. In this type, platinum is still used to oxidise carbon monoxide and hydrocarbons, and rhodium is used to reduce the nitrogen oxides to nitrogen, carbon dioxide and water. The efficiency of this type of catalyst is particularly sensitive to the air/fuel ratio in the engine. In Japan and parts of the

US most cars are now fitted with a lambda sensor in the exhaust to monitor emissions and feed back to the fuel injection systems. Also, all current regulations in the Europe now require manufacturers to fit three-way catalysts[20].

Traffic Management: One alternative to prevention and management of vehicular emissions is to reduce the need for or the use of motor vehicles. As congestion in towns and cities increases and traffic slows down, emissions are increasing much faster than the actual growth in vehicle numbers. This requires a management response to reduce vehicle use and to keep moving those vehicles that are on roads.

Free flowing of vehicles on roads requires the creation of clear through-routes and precise management of road junctions such as traffic lights and roundabouts. Creation of clear ways (no parking) and their enforcement aids traffic movement. Various methods can be used to reduce vehicle use. Land-use planning decisions can be made to discourage private car use. The creation of pedestrian zones, specified cycle and bus lanes/roads and adequate provision of public transport for key services all play a part. However, management of traffic pollution through reduction in vehicle use will be a difficult task because it goes against trends in popular culture. People now consider car use to be almost a 'right' and demand an ease of mobility that was unobtainable a few years previously. Therefore, the most important task is one of public education and lifestyle change and, of all the means available for attempting to reduce traffic pollution, this is most definitely the hardest, but the most fundamental.

CONCLUSION

The Release of air pollutants in the atmosphere is a concomitant result of human activities. There is a wide range of air pollutants, but those from industrial emissions and vehicular emissions are the over whelming villains in the urban cities. Process industries concern mostly with one or combinations of the combustion of hydrocarbons or carbon derivatives, sulphur and sulphur containing compounds, metals e.t.c. In all these processes, various pollutants are produced and are emitted into the atmosphere near and around dwelling places, which are extensively analysed in this paper. Also analysed, is the combustion of transportation fuels, which releases several contaminants into the atmosphere. These vehicular emissions include carbon monoxide, hydrocarbons, oxides of nitrogen, lead and other particulate matter. Various management strategies, which can be used to combat these menaces, are discussed. These include stack monitoring, changing process operation and cleaning flue gases for industrial air pollution and changing fuel type, removing gross polluters, cleaning exhaust gases and traffic management for vehicular pollution.

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