A report on

Industrial Air Pollution: A case study on Bawana Industrial Area

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(Environmental Engineering)

by

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At the end I would like to express my sincere thanks to all my friends and others who helped me directly or indirectly during this project.

CERTIFICATE

This is to certify that this project report " *Industrial Air Pollution: A case study on Bawana Industrial Area* " is submitted by Gautam Aggarwal, Chirag Luthra , Harsh Yadav , Amit Ranjan and Naman Dwivedi who carried out the project work under my supervision.

I approve this project for submission of the Bachelor of Technology in the Department of Environmental Engineering, Delhi Technological University.

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ABSTRACT

Industrial emissions are a major source of respirable particulate matter especially in urban and metropolitan areas. The main pollutants associated with industrial pollution are toxic heavy metals, volatile organic carbon (VOC's), poly aromatic hydrocarbons (PAH's), PM_{10} and $PM_{2.5}$ which can have serious repercussions on not just human health but also on the environment as a whole.

Currently there are several approaches to consider these emissions. However, the uncertainty of the quantification of these emissions is very high. Hence it is necessary to assess the quality of the existing emission factors in order to improve them as well as to verify them. Moreover it is a well known fact that the impacts and effects of industrial pollution have been more pronounced in cities of developing countries due to lack of significant advancement in technologies pertaining to air pollution.

This work provides an in depth analysis of the composition of the various aforementioned pollutants involved in industrial air pollution.. It also urges the environmental authorities to closely monitor these hazardous sources of pollution as well as consider the possibility of narrowing the emission standard limits set for industries, and at the same time encourage the scientific community to improve existing methods to estimate and validate these emissions.

Keywords: VOC's, PAH's, Particulate Matter, Heavy Metals

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List of Abbreviations:

1.VOC- Volatile Organic Compounds

2.PAH- Polyaromatic Hydrocarbon

3.BAP- Benzo(a)pyrene

4. PM- Particulate Matter

4. GC-MS- Gas chromatography-Mass Spectroscopy

5. EDXRF- Energy-dispersive-X-ray-fluorescence

1.0 Introduction

The present review summarises the work done on the various pollutants involved in industrial emissions in the form of a case study. It includes a step by step process from sampling to testing and finally making the requisite calculations of the various pollutants by means of an empirical formula.

The sampling process was carried out in an experimental set-up at a typical industrial site (Bawana Industrial Area, Sector-3) using Respirable Dust Sampler (RDS). The area comprised of a cluster of small scale industries which were setup in a somewhat congested environment. The different kinds of industries that were operating in the vicinity of sampling were metal equipment works factory, Plastic bags factories and manufacturing industries to name a few. The emissions of these pollutants were collected on glass fiber filter paper. The accumulated dust particles were then estimated in quantitative terms in the research labs of Jawaharlal Nehru University (JNU) with the aid of sophisticated technology namely EDXRF for determination of metal composition. The results for metal composition obtained from EDXRF was split into two parts with the first part containing the initial metal composition of the blank filter paper before it was used, while the second part of the result contained information on the concentration of various accumulated metals on the filter paper after sampling was completed. Analysis of organic content was performed using GC-MS , prior to which a Soxhlet apparatus was used to extract the filter contents in an organic solvent (chloroform in this case).

This report also discusses in detail the different major industrial air pollutants along with the numerous health effects associated with industrial pollution. A detailed explanation of the principles involved with equipments has been included for a better understanding of their working mechanism.

All in all, this report gives a comprehensive and detailed study of the industrial air pollution along with authentic results and observations based on the experiment performed (sampling) and testing (using EDXRF and GC-MS).

2.1 Ambient Air Quality Standards in India

Sl. No	Pollutant	Time Weighted Average	New Standards (Schedule VII, Rule 3 (3B) 16th Nov 2009 Concentration in ambient air: Industrial Area Residential, Rural & other Areas	Ecologically sensitive area (Notified by Central Govt)	Methods of measurement
1	Sulphur Dioxide(SO2)	Annual Avg*	50.0 µg/m3	20.0 µg/m3	-Improved West and Gaeke method
		24 hours**	80.0 µg/m3	80.0 µg/m3	-Ultraviolet fluorescence
2	Oxides of Nitrogen as NO2	Annual Avg*	40.0 µg/m3	30.0 µg/m3	-Modified Jocob and Hochheise (Sodium Arsenite)
		24 hours**	80.0 µg/m3	80.0 µg/m3	-Chemiluminescence
3	Particulate matter (size less than 10µm)	Annual Avg*	60.0 µg/m3	60.0 µg/m3	-Gravimetric
		24 hours**	100.0 µg/m3	100.0 µg/m3	-TOEM -Beta attenuation
4	Particulate matter (size less than 2.5 µm	Annual Avg*	40.0 µg/m3	40.0 µg/m3	-Gravimetric
		24 hours**	60.0 µg/m3	60.0 µg/m3	-TOEM -Beta attenuation
5	Lead (Pb)	Annual Avg*	0.50 µg/m3	0.50 µg/m3	-AAS/ICP method for sampling on EPM2000 or Equivalent Filter paper
		24 hours**	1.0 µg/m3	1.0 µg/m3	-ED-XRF using Teflon filter paper
6	Carbon Monoxide (CO)	8 hours**	2.0 mg/m3	2.0 mg/m3	-Non Dispersive Infra Red (NDIR) spectroscopy
		1 hour	4.0 mg/m3	4.0 mg/m3	
7	Ozone	8 hours**	100.0 µg/m3	100.0 µg/m3	-Photometric
		1 hour	180.0 µg/m3	180.0 µg/m3	-Chemiluminescence
		24 hours**	60.0 µg/m3	60.0 µg/m3	-Chemical method
8	Ammonia (NH3)	Annual Avg*	100.0 µg/m3	100.0 µg/m3	-Chemiluminescence
		24 hours**	400.0µg/m3	400.0 µg/m3	-Indo-Phenol Blue method
9	Benzene	Annual Avg*	5.0 µg/m3	5.0 µg/m3	-GC based continuous analyzer -Adsorption/desorption followed by GC analysis
10	Benzo(a) pyrene	Annual Avg*	1.0 ng/m3	1.0 ng/m3	-Solvent extraction followed by GC/HPLC extraction
11	Arsenic	Annual Avg*	6.0 ng/m3	6.0 ng/m3	AAS/ICP method for sampling on EPM2000 OR Equivalent Filter paper
12	Nickel		20.0 ng/m3	20.0 ng/m3	-AAS/ICP method for sampling on EPM2000 OR Equivalent Filter paper

Table 1: Ambient Air Quality Standards for Various Pollutants (Source:CPCB:2009)

2.2 Major Industrial Air Pollutants.

1. **Particulate matter (PM)** is the generic term used for a type of air pollutants, consisting of complex and varying mixtures of particles suspended in the breathing air, which vary in size and composition, and are produced by a wide variety of natural and anthropogenic activities.The size of the particles varies ($PM_{2.5}$ and PM_{10} for aerodynamic diameter smaller than 2.5 mm and 10 mm respectively) and different categories have been defined: Ultrafine particles, smaller than 0.1 mm in aerodynamic diameter, Fine particles, smaller than 1 mm, and Coarse particles, larger than 1 mm. The size of the particles determines the site in the respiratory tract that they will deposit: PM_{10} particles deposit mainly in the upper respiratory tract while fine and ultrafine particles are able to reach lung alveoli. So far, no single component has been identified that could explain most of the PM effects. Among the parameters that play an important role for eliciting health effects are the size and surface of particles, their number and their composition. The composition of PM varies, as they can absorb and transfer a multitude of pollutants. However, their major components are metals, organic compounds, material of biologic origin, ions, reactive gases, and the particle carbon core.

2. **Heavy Metals** are individual metals and metal compounds that can impact human health. Eight common heavy metals are : arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver. Generally, humans are exposed to these metals by ingestion (drinking or eating) or inhalation (breathing). Working in or living near an industrial site which utilizes these metals and their compounds increases one's risk of exposure, as does living near a site where these metals have been improperly disposed.

3. Organic Pollutants

A variety of organic compounds are emitted into the atmosphere by natural and human activities. They are so diverse that it is difficult to classify them neatly.The gaseous and volatile liquid hydrocarbons are of particular interest as air pollutants. Hydrocarbons can be saturated or unsaturated , branched or straight-chain, or can have a ring structure as in the case of aromatics or other cyclic compounds. In the saturated class, methane is by far the most abundant hydrocarbon constituting about 40 to 80 percent of total hydrocarbons present in the urban atmosphere. Hydrocarbons predominate among the atmospheric pollutants because of their widespread use in fuels. They enter the atmosphere either directly from the fuel or as by-products of partial combustion of other hydrocarbons, which tend to be unsaturated and relatively reactive. Several alkenes including ethylene, propylene, butadiene and styrene are among the top 50 chemicals produced each year and are released to the atmosphere during their production and use similarly aromatic hydrocarbons such as benzene, toluene, ethylbenzene, xylene and cumene are among the top 50 chemicals produced each year and these are also released into the atmosphere during their production and use. Polycyclic aromatic hydrocarbons (PAHs) commonly occur in urban atmospheres up to about 20µg m-3 level. Elevated levels of PAHs are observed in polluted urban atmospheres, in the vicinity of forest fires and burning of coal. Terpenes are a particular class of volatile hydrocarbons emitted largely by natural sources. These are cyclic non-aromatic hydrocarbons found in pine tar and in other wood sources as mentioned earlier.

The organochlorine compounds such as methyl chloride, methyl chloroform and carbon tetrachloride have tropospheric concentrations ranging from ten to several tenths of ppm. Methyl chloroform is relatively persistent in the atmosphere with residence time of several years. Therefore they may pose the threat to ozone layer as CFCs. Another class of organohalides are polychlorinated biphenyls (PCBs). They are made by chlorinating the aromatic compound biphenyl. A complex mixture results with variable numbers of chlorine atoms substituted at various positions of the rings. They were mainly used as the coolant in the power transformers and capacitors because they are excellent insulators, are chemically stable, and have low flammability and vapour pressure. In later years they were also used as heat transfer fluids in other machinery and as plasticisers for polyvinyl chloride and other polymers; they found additional uses in carbonless copy paper, as de-linking agents for recycled newsprint and as weathering agents.

2.3 Health effects of the pollutants

1. **Health effects of heavy metals**

Metal toxicity depends upon the absorbed dose, the route of exposure and duration of exposure, i.e. acute or chronic. Most heavy metals are dangerous because they tend to bioaccumulate in the human body. Bioaccumulation means an increase in the concentration of a chemical in a biological organism over time, compared to the chemical’s concentration in the environment.Various public health measures have been undertaken to control, prevent and treat metal toxicity occurring at various levels, such as occupational exposure, accidents and environmental factors.

Pollutants	Major sources	Effect on human health
Arsenic	Pesticides, fungicides, metal smelters	Bronchitis, dermatitis, poisoning
Cadmium	Welding, electroplating, pesticide fertilizer, Cd and Ni batteries, nuclear fission plant	Renal dysfunction, Lung disease, Lung cancer, Bone defects (Osteomalacia, Osteoporosis), increased blood pressure , kidney damage, bronchitis, gastrointestinal disorder, bone marrow, cancer
Lead	Paint, pesticide, smoking, automobile emission, mining, burning of coal	Mental retardation in children, developmental delay, fatal infant encephalopathy, congenital paralysis, sensor neural deafness and, acute or chronic damage to the nervous system, epilepticus, liver, kidney, gastrointestinal damage
Manganese	Welding, fuel addition, ferromanganese production	Inhalation or contact causes damage to central nervous system
Mercury	Pesticides, batteries, paper industry	Tremors, gingivitis, minor psychological changes, acrodynia characterized by pink hands and feet, spontaneous abortion, damage to nervous system, protoplasm Poisoning
Zinc	Refineries, brass manufacture, metal Plating, plumbing	Zinc fumes have corrosive effect on skin, cause damage to nervous membrane
Chromium	Mines, mineral sources	Damage to the nervous system, fatigue, irritability
Copper	Mining, pesticide production, chemical industry, metal piping	Anemia, liver and kidney damage, stomach and intestinal irritation

Table 2: Heavy metal Pollutants sources and their effects on human

2. **Health effects on exposure Particulate matter :**

Particulate matter with size less 10 micron include inhalable particles that are small enough to penetrate the thoracic region of the respiratory system. The health effects of inhalable PM are well documented. They are due to exposure over both the short term (hours, days) and long term (months, years) and include:

• respiratory and cardiovascular morbidity, such as aggravation of asthma, respiratory symptoms and an increase in hospital admissions;

• mortality from cardiovascular and respiratory diseases and from lung cancer

Susceptible groups with pre-existing lung or heart disease, as well as elderly people and children, are particularly vulnerable. For example, exposure to PM affects lung development in children, including reversible deficits in lung function as well as chronically reduced lung growth rate and a deficit in long-term lung function (4). There is no evidence of a safe level of exposure or a threshold below which no adverse health effects occur. The exposure is ubiquitous and involuntary, increasing the significance of this determinant of health.

3. **Health Effects of Organic air Pollutants:**

Health effects may include:

- Eye, nose and throat irritation
- headaches, loss of coordination and nausea
- damage to liver, kidney and central nervous system

- Some organics can cause cancer in animals, some are suspected or known to cause cancer in humans.

Key signs or symptoms associated with exposure to VOCs include:

- conjunctival irritation
- nose and throat discomfort
- headache
- allergic skin reaction
- dyspnea
- declines in serum cholinesterase levels
- nausea
- emesis
- epistaxis
- fatigue
- dizziness

The ability of organic chemicals to cause health effects varies greatly from those that are highly toxic, to those with no known health effect.

As with other pollutants, the extent and nature of the health effect will depend on many factors including level of exposure and length of time exposed. Among the immediate symptoms that some people have experienced soon after exposure to some organics include:

- Eye and respiratory tract irritation
- headaches
- dizziness
- visual disorders and memory impairment

At present, not much is known about what health effects occur from the levels of organics usually found in homes.

2.4 Principle of equipments

2.4.1 Respirable Dust Sampler:

The Respirable Dust Sampler is used to monitor the Total Suspended Particles (TSP) in ambient air conditions. It can also be simultaneously used for sampling the pollutant gases like SO_2, NOX, CL_2 H_2S, and CS_2. These gases are analyzed to determine the concentration of specific pollutant.

This sampler separates the particles larger than 10 microns that are present in air stream. These coarse particles are separated before filtering the air on 0.5 micron size filter and allows the measurement of TSP and Respirable fraction of the Suspended Particulate Matter (SPM). The sampler draws the air with the help of high flow rate blower at a nominal flow rate of 1. 4 cubic meters per minute.The air passes through the cyclone inside the sampler, the coarse and non-respirable dust is separated from the air stream using the centrifugal force and is collected inside a sampling bottle. This dust size varies from 10 to 100 microns. The fine dust with a diameter of less than 10 microns will pass through the filter paper.

APM 460 DXNL used in this experiment is one of the most advanced PM_{10} samplers manufactured in India. It is based on CSIR NEERI technology and is the only PM_{10} sampler in India that conforms to BIS 5182 (Part 23): 2006.

Special features-

· Automatic Flow Controller with electronic feedback for constant sampling rate throughout the sampling period.

· Brushless regenerative blower with very little noise.

· Heavy duty Induction motor fitted in blower requires no maintenance.

· Blower immune to voltage fluctuations thus eliminating need of voltage stabilizer.

· Electromagnetic interference (EMI) to TVs is totally eliminated.

In all previous models of particulate samplers in use in the country, the sampling rate varies with dust loading on the filter and fluctuates with changes in the mains voltage. The APM 460 DXNL uses an electronic flow controller to automatically maintain constant sampling rate through the filter/cyclone assembly. The size fractionating cyclone of the APM 460 DXNL thus operates close to its designed separation velocity resulting in a sharper cut-off for particulates larger than 10 microns. When the dust load on filter becomes excessive and exceeds the capacity of the blower the electronic circuits provided in the flow controller automatically shut down the machine.

Owing to its modular design, APM 460 DXNL can be easily paired with a gaseous sampling attachment (for monitoring SO_2, NO_x, NH_3, Ozone etc) as gaseous sampling requires only a few LPM of air flow. This is possible through an attachable subsidiary unit APM 411 or the more modern APM 411 TE.

Fig1: RDS used at sampling site

2.4.2 GC-MS(Gas Chromatography-Mass Spectrometry):

GC/MS-a combination of two different analytical techniques, Gas Chromatography (GC) and Mass Spectrometry (MS), is used to analyze complex organic and biochemical mixtures. GC can separate volatile and semivolatile compounds with great resolution, but it cannot identify them. MS can provide detailed structural information on most compounds such that they can be exactly identified and quantified, but it cannot readily separate them, therefore the two techniques are used in a combination

. The GC-MS instrument consists of two main components. The gas chromatography portion separates different compounds in the sample into pulses of pure chemicals based on their volatility (Oregon State University, 2012) by flowing an inert gas (mobile phase), which carries the sample, through a stationary phase fixed in the column (Skoog et al., 2007). Spectra of compounds are collected as they exit a chromatographic column by the mass spectrometer, which identifies and quantifies the chemicals according their mass-to-charge ratio (m/z). These spectra can then be stored on the computer and analyzed (Oregon State University, 2012).

2.4.2 ED-XRF Spectrometer for Elemental Analysis:

X-ray Fluorescence Analysis using ED-XRF spectrophotometer is a commonly used technique for the identification and quantification of elements in a sample.

The ED-XRF(energy-dispersive X-ray Fluorescence) is based on the following principle:

The atoms in the sample material, which could be any solid, powder o liquid are excited by X-rays emitted from an X-ray tube or radioisotope. For increasing sensitivity, the primary excitation radiation can be polarised by using specific targets between the X-ray and the sample . All element have specific X-ray fluorescence signals emitted by atoms after the ionisation which are measured simultaneously using a fixed mounted semiconductor detector or sealed gas-proportional counter.

The radiation intensity is proportional to the concentration of each element in the sample, is calculated internally from a stored set of calibration curves and can be shown directly in concentration units

Epsilon 5 Panalytical used in this experiment is the most sort after XRF Spectrometer. The Epsilon 5 is a fully integrated energy dispersive XRF analyzer consisting of a spectrometer, built-in computer, touch screen and analysis software. Powered by the latest advances in excitation and detection technology the Epsilon 1 is a star performer in the low-cost benchtop instrument class.

Special features-

· Epsilon 5 produces fast, cost-effective, precise and accurate data with minimal operator dependence and sample preparation.

· The total running cost is therefore much lower than other analytical techniques such as AAS, ICP and wet chemical methods that are costly and also require a dedicated skilled operator.

· Epsilon 5 is built for the characterization and analysis of any type of sample in many industry segments such as cement, cosmetics, environmental, food, forensics, metals and coatings, mining and minerals, nanomaterials, petrochemicals, pharmaceuticals and polymers.

3. Methodology:

3.1 Sampling

- The filter used for the sampling was Whatman glass fibre filter paper.
- The filter was placed in a hot air oven to remove the moisture content of the filter paper at 105ºC for 15-20 minutes and was weighed using digital weighing balance.
- The filter paper was stored in an airtight packet so that the filter doesn’t come in contact with the VOC’s and moisture.
- Respirable Dust Sampler APM 460 DXNL was set up in Sector-3 Bawana Industrial area outside a metal equipments factory and the filter was placed gently by holding it from the corner onto the Dust sampler.
- The machine was run for 4 hours from 2PM - 6PM.
- The initial flow rate was set to 1.1 m^3/min.
- After sampling period, the final rate was noted down
- The filter paper was gently removed and stored in a clean airtight packet.

Fig2: Sampling Site

Fig 3: Nearby metal equipment factory

3.2 Extraction of Organic Compounds

- Soxhlet apparatus was used for the extraction of the contents from the filter paper.
- The apparatus was properly rinsed with distilled water and then with chloroform.
- 200 ml of Chloroform was used as the organic solvent for extraction of organic contents.
- The temperature of the apparatus was maintained at 70 degree celsius throughout the process of extraction.
- Continuous supply of water was provided via an inlet pipe to cool down the vapours.
- The process of extraction was carried out for 3 hours after which the extract was collected in a conical flask.
- The extracted sample was then stored in an airtight container.

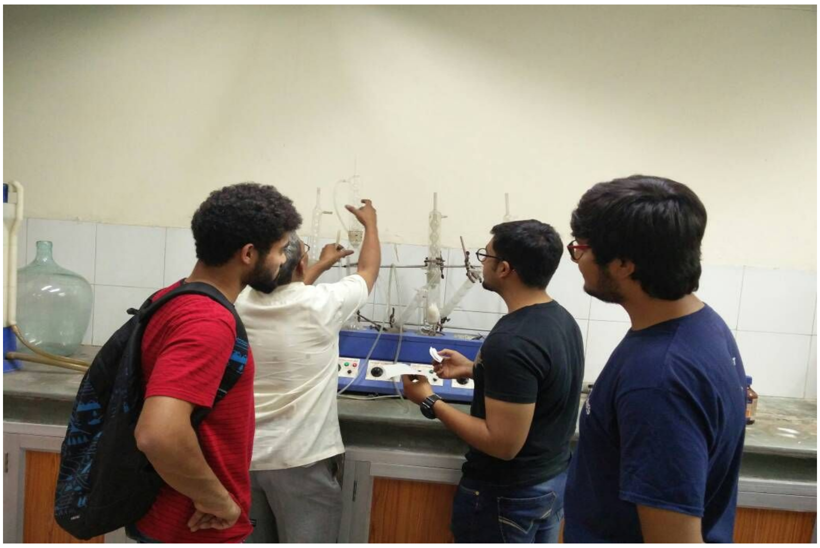

Fig.4 Extraction using Soxhlet Apparatus

3.3 Chemical Analysis

3.3.1 Organic Content Analysis using GC-MS technique

- 2 ml of the extracted sample was used for the analysis of organic such as PAH's and VOC's in the GC-MS machine.

3.3.2 Metal concentration Analysis using ED-XRF.

- A circular piece of diameter 3cm was cut from the filter sample and was weighed using digital weigh balance.
- The piece was inserted into the EDXRF to find the concentration of various metals like lead, iron , strontium, nickel, copper etc.

4.0 Observations & Calculations:

Initial weight of the filter = 2.73g

Final weight of the filter after sampling of 4 hours = 2.81g

Initial flow rate = 1.1m^3/min

Final flow rate after sampling = 0.9 m^3/min

Calculations :

Average flow rate = (initial + final)/2= (1.1+0.9)/2 = 1m^3/min

Total volume of air sampled = Avg. flow rate*Total Time of Sampling

= 1*4*60 m^3

= 240 m^3

Concentration of Total Suspended Particulates

= (Final w.t of filter -Initial wt of filter)/volume of air sampled

= (2.81 - 2.73)/240

= **333.34 µg/m^3**

5.0 Results:

1.Concentrations of total suspended matter in the ambient air at the site of sampling came out to be **333.34** micrograms/m^3.

2. The concentrations of metal content in the sample and the blank filter are given in the following figures.

5/2/2017 10:48:00 PM
AIRF-JNU
Auto Quantify - Solid -

Sample Id.: BLANK DTU
Date / Time: 5/2/2017 10:25:27 PM
Type: Routine - 1/1
Initial weight (g): 0.10
Total weight (g): 0.10

				Result
Compound	Corr. (cps/mA)	Conc.	Unit	Status
Na	1.171	7.677	%	Calibrated
Al	13.687	4.950	%	Calibrated
Si	260.393	63.370	%	Calibrated
Cl	2.951	0.238	%	Calibrated
K	216.536	4.280	%	Calibrated
Ca	140.620	1.932	%	Calibrated
Ti	10.593	0.200	%	Calibrated
Fe	6.720	337.006	ppm	Calibrated
Zn	1051.786	3.631	%	Calibrated
Rb	1.112	19.374	ppm	Calibrated
Sr	0.784	126.185	ppm	Calibrated
Zr	1.746	256.141	ppm	Calibrated
Ag	0.316	39.113	ppm	Calibrated
Ba	261.421	4.634	%	Calibrated
Sum		90.989	%	

Fig 5:Results for blank filter paper

5/2/2017 4:11:00 AM
AIRF-JNU
Auto Quantify - Solid -

Sample Id.: DTU
Date / Time: 5/2/2017 3:13:33 AM
Type: Routine - 1/1
Initial weight (g): 0.10
Total weight (g): 0.10

Compound	Corr.(cps/mA)	Conc.	Unit	Status
Na	0.759	5.252	%	Calibrated
Mg	0.314	0.555	%	Calibrated
Al	16.346	6.041	%	Calibrated
Si	215.855	55.044	%	Calibrated
S	2.318	0.478	%	Calibrated
Cl	23.307	1.847	%	Calibrated
K	192.426	3.840	%	Calibrated
Ca	187.862	2.605	%	Calibrated
Ti	11.651	0.223	%	Calibrated
Fe	280.933	1.428	%	Calibrated
Ni	9.038	326.561	ppm	Calibrated
Cu	7.729	230.658	ppm	Calibrated
Zn	985.787	3.469	%	Calibrated
As	0.000	0.000	ppm	Calibrated
Rb	1.141	20.078	ppm	Calibrated
Sr	0.762	123.407	ppm	Calibrated
Zr	1.445	213.095	ppm	Calibrated
Pd	0.184	20.118	ppm	Calibrated
Ag	0.361	44.788	ppm	Calibrated
Ba	224.475	3.983	%	Calibrated
Pb	0.852	47.402	ppm	Calibrated
Sum		84.869	%	

Fig 6: Results for Metal Concentration in Sample

3. Various organic compounds which were found in the sample prepared and analysed using GC-MS machine:

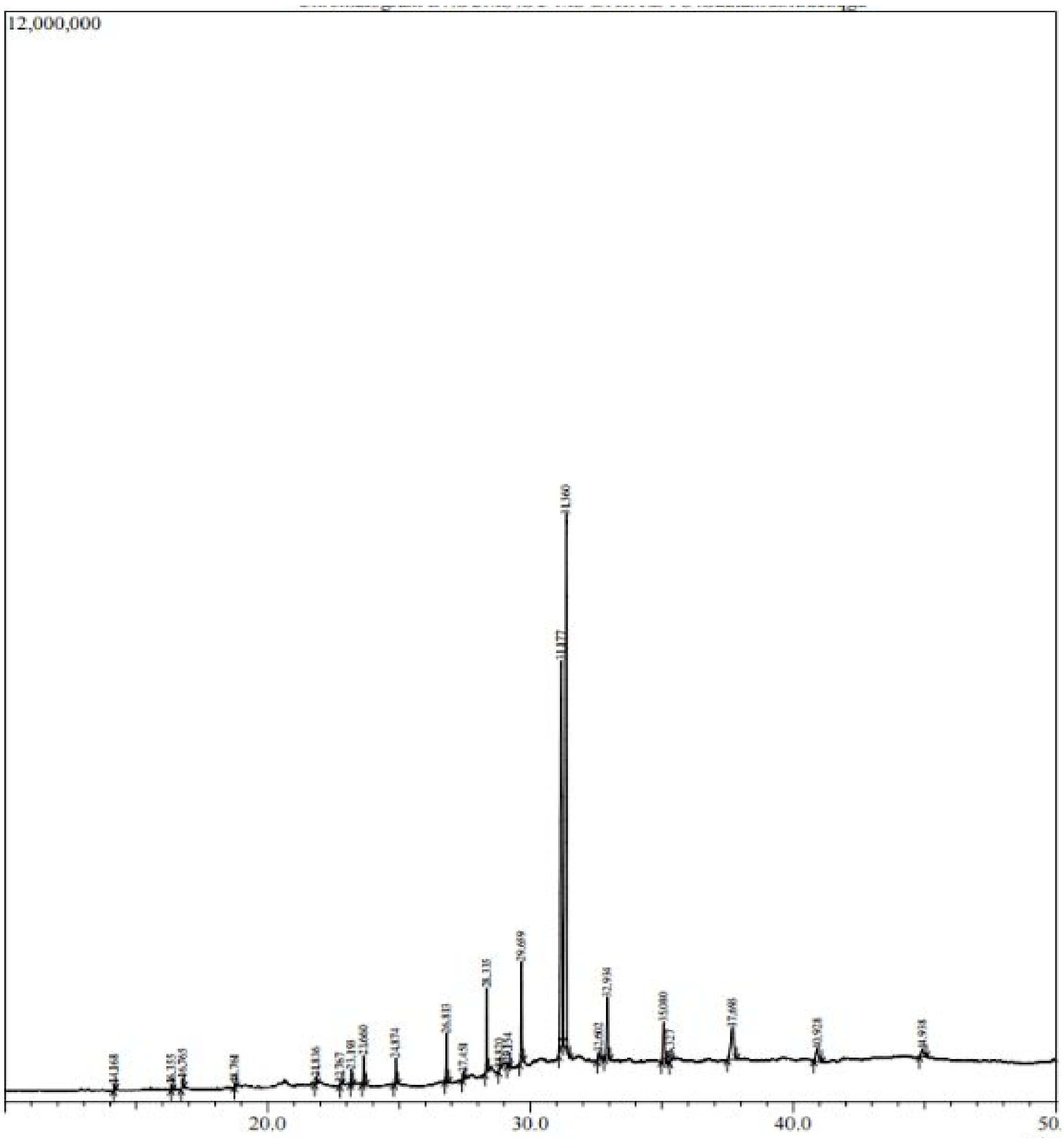

Fig 7:CHROMATOGRAM

Peak#	R.Time	Area	Area%	Name
1	14.168	117931	0.18	TETRADECANOIC ACID
2	16.355	102351	0.16	9-OCTADECENOIC ACID, 12-(ACETYLOXY)-, METHY
3	16.765	286611	0.44	l-(+)-Ascorbic acid 2,6-dihexadecanoate
4	18.761	70406	0.11	EICOSANOIC ACID, METHYL ESTER
5	21.836	147807	0.23	PENTACOSANE
6	22.767	44715	0.07	2,2,4,4,6,6,8,8,10,10,12,12,14,14,16,16,18,18,20,20-ICOSA
7	23.193	455237	0.70	TETRACONTANE
8	23.660	904704	1.40	BIS(2-ETHYLHEXYL) PHTHALATE
9	24.874	916817	1.42	TETRACONTANE
10	26.813	1638952	2.53	HEXATRIACONTANE
11	27.451	243751	0.38	
12	28.335	2217644	3.42	HEXATRIACONTANE
13	28.820	44798	0.07	Difenoconazole
14	29.154	79841	0.12	2-[1-(2-[1,3]Dithian-2-yl-ethyl)-pent-4-enyloxy]-tetrahydrop
15	29.659	2900435	4.48	HEXATRIACONTANE
16	31.177	17944925	27.71	Difenoconazole
17	31.360	27148619	41.92	Difenoconazole
18	32.602	405934	0.63	STIGMAST-5-EN-3-OL, OLEAT
19	32.934	2701564	4.17	HEXATRIACONTANE
20	35.080	2040519	3.15	HEXATRIACONTANE
21	35.327	24974	0.04	
22	37.693	2704817	4.18	TETRACONTANE
23	40.928	1048802	1.62	TETRAPENTACONTANE
24	44.938	572854	0.88	TETRAPENTACONTANE
		64765008	100.00	

Table 3 : Organic Compounds found in the sample

6.0 Discussion and Conclusion

After many concerted efforts, it can be concluded that there is still a long way to go before any significant improvements are made in mitigating industrial pollution. However slowly but surely some changes are visible in the form of reduction of industrial emissions, provision of stringent emission standards set by the air quality monitoring authority, use of better technology in machines which are more energy efficient and thus produce less residual smoke. The need of the hour is to further cut down on these industrial emissions so as to provide a safer working environment for the workers. At the same it is imperative to improve the air quality in the prevailing area as these toxic emissions can spread in the atmosphere thus affecting the entire city or town.

Even though industrialisation is only going to increase in developing countries like India, and the nuisance of air pollution is far from over, it is our fundamental duty as citizens of the country to get actively involved in such issues. The cooperation of industrialists is also very essential in achieving the required target levels of industrial air pollution. If priority is given to the environment and safety of workers over profits, then a tremendous progress is inevitable. Also at an individual level creating public awareness to increase the sensitivity of the problem at hand can go a long way to deal with the ever growing industrial emissions.

7.0 References

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