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Study on Ambient Air Quality Monitoring of MSIL MPT Engine Plant

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Abstract

The project investigates the concentration of the pollutants Sulphur dioxide, Nitrogen oxides, Ozone, Particulate Matter ($PM_{10,}$ $PM_{2.5}$), and ammonia generated from various sources like automobiles, industries over the ambient air quality of the MPT engine plant, Gurugram, Haryana. As such Haryana is a big city and it is not possible to measure the concentration of these major pollutants in all areas, so we have restricted our study to only 7 parameters. The major pollutants as suggested by the Central pollution control board (CPCB) in an industrial and commercial area are Sulphur dioxide, oxides of Nitrogen (NO_X), ozone, Particulate matter ($PM_{10,}$ $PM_{2.5}$), ammonia and lead.

The many laboratory methods for concentration of all these gases in the ambient air –1-West and Gaeke method for determination of $_{SO2}$ in air, (b) Modified Jacob and Hochheiser methodology for determination of nitrogen oxides(**NO**) in air, (c) Chemical method for determination of Ozone in ambient air. (d) Gravimetric Method for the measurement of$PM_{10,}$ $PM_{2.5}$ in ambient air (e) Indophenols method for determination of ammonia in ambient air.

Keywords: MSIL , Sulphur dioxide, Nitrogen oxides, Ozone, Particulate Matter (PM 10, PM 2.5), and ammonia.

Introduction

Air is available in abundance in the surface of the earth. Numerous of gases are released into the atmosphere through natural activity. The tiny particles of solid, liquid are distributed throughout the air by winds, volcanic eruptions and similar other natural resources. By human activities many pollutants resulting from chemical and biological processes are also released into the atmosphere.

Aim of the study- Monitoring of Air Quality.

Review of Literature

Reviewed on urban air pollution and respiratory infections that Public awareness of the impact of air quality on health is increasing worldwide. Indoor and outdoor air pollutants impair children's growing lungs, and increase the risk of respiratory infections. In many cities, children face indoor air pollution from fuels used for cooking and heating, as well as outdoor pollution from vehicle exhausts(Rossa Brugha **,** Jonathan Grigg **(2012).**

To examine the effect of ambient air pollution at the district level on adolescent. Happiness and their change in happiness over time in a cohort sample from Taiwan. Higher concentration levels of each of the three air pollutants measured were associated with adolescent happiness such that a higher level of concentration was related to lower levels of adolescents' happiness, Wen-Hsu Lin **,** Wen-Chi Pan **,** Chin-Chun Yi **(2019)**

demonstrated the association between air pollution and different medical conditions including respiratory and cardiovascular diseases. Air pollutants might have a role also in the etiology of mental disorders in the light of their toxicity on central nervous system. Purpose of the present manuscript was to review and summarize available data about an association between psychiatric disorders and air pollution, Massimiliano Buoli **,** Silvia Grassi **,** Alice Caldiroli **,** Greta Silvia Carnevali **,** Francesco Mucci **,** Simona Iodice **,** Laura Cantone **,** Laura Pergoli **,** Valentina Bollati **(2018)**

Angelica I Tiotiu **,** Plamena Novakova **,** Denislava Nedeva **,** Herberto Jose Chong-Neto **,** Silviya Novakova **,** Paschalis Steiropoulos **,** Krzysztof Kowal **(2020)** find out impact of air pollution on Respiratory problem . The Asthma is a chronic respiratory disease characterized by variable air flow obstruction, and wind pipe inflammation.

H Orru **,** K L Ebi **,** B Forsberg **(2017)** modelled future ozone and particulate matter concentrations and calculated the resulting health impacts under different climate scenarios.

Seema tiwari, I.P. Tripathi, H.L. tiwari (2013) reviewed effects of lead on environment and concluded, lead is a soft metal that has known many applications over the years. Lead has wide applications in metal products, cables and pipelines, paints and pesticides. Foods such as fruits, vegetables meat, seafood soft drink and wine may contain significant amount of lead**Seema tiwari, I.P. Tripathi, H.L.**

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Material and Methods

The material and methods include the following aspects:

1) Description of sampling and collection of samples
2) Physico-chemical properties parameters

A) Description of sampling and collection of samples- Site for the collection of air sample was MSIL Manesar MPT engine plant, Plot No 1, Phase 3A, IMT Manesar, Gurgaon, Haryana, India. Air sample was collected in the month of February, 2021.

B) Physico-chemical properties- A total of 7 parameters viz. S02, NO2, Ozone, PM10, PM2.5, lead and ammonia were analyzed by following methodology and protocols as per **under the provisions of the Air (Prevention & Control of Pollution) Act, 1981.** The methods prescribed in the notification for respective parameters are the combination of physical method, wet-chemical method and continuous on-line method.

Improved West And Gaeke Method For Measurement Of Sulphur Dioxide

Principle : Sulphur dioxide from air is absorbed in a solution of potassium tetrachloromercurate (TCM). A dichlorosulphitomercurate complex, which resists oxidation by the oxygen in the air, is formed. The complex is made to react with pararosaniline and formaldehyde to form the intensely coloured pararosaniline methanesulfonic acid. The absorbance of the solution is measured by means of a suitable spectrophotometer.

Reagents: Distilled water ,Mercuric chloride ,Potassium chloride / Sodium chloride ,EDTA , Absorbing Reagent 0.04 M Potassium Tetrachloro mercurate (TCM),Sulphamic Acid (0.6%) ,Formaldehyde (0.2%) ,Purified Pararosaniline Stock Solution,Pararosaniline Working Solution ,Stock Iodine Solution ,Iodine Solution,Starch Indicator Solution,Potassium iodate,Stock Sodium Thiosulfate Solution

Procedure

· Insert a midget impinge into the sampling system. Add 10 ml TCM solution to the impinger. Suck out the air at 1 or 0.5 l/m. During and after the sampling shield the absorbing reagent from the direct sunlight.
· Add 1 ml Sulphamic acid. Keep it 10 minutes.
· Add 2 ml formaldehyde.
· Add 2 ml working PRA Make up to mark (25 ml.) with distilled water.
· Keep it 30 minutes for reaction Set.
· Zero of spectrophotometer with Distilled water.
· Measure absorbance at 560 nm.

Calculations

Concentration of sulphite solution:

$$C = \frac{(V1-V2) \times N \times K}{V}$$

Where, C = SO concentration in µg/ml
V1 = Volume of thiosulfate for blank, ml
V2 = Volume of thiosulfate for sample, ml
N = Normality of thiosulfate
K = 32000 (Milliequivalent weight SO2/µg)
V = Volume of standard sulphite solution, ml

$$C\ (SO2\ \mu g/m) = (As - Ab) \times CF \times Vs / Va \times Vt$$

Where, C SO2 = Concentration of Sulphur dioxide, µg/m
As = Absorbance of sample
Ab= Absorbance of reagent blank
C = Calibration factor F
Va= Volume of air sampled, m
Vs= Volume of sample, ml
Vf = Volume of aliquot taken for analysis

1) Jacob And Hochheiser Modified Method For Determination Of Nitrogen Dioxide (Sodium Arsenite Method)

Principle : Ambient (NO_2) is picked by bubbling air by a solution of 2 sodium hydroxide and sodium arsenite .The amount of nitrite ion produced during sampling is find out colorimetrically by reacting the nitrite ion with phosphoric acid, sulfanilamide, and (NEDA) and measuring the absorbance of the highly colored azo-dye at 540 nm.

Reagents : Distilled water , Sodium hydroxide,Sodium Arsenite ,Absorbing solution (Dissolve 4.0 g of sodium hydroxide in distilled water, add 1.0 g of sodium Arsenite, and dilute to 1,000 ml with distilled water). N-(1-Naphthyl) ethylenediamine Di-hydrochloride (NEDA),Hydrogen Peroxide - 30% , Phosphoric Acid - 85% ,Sulphanilamide Solution,Hydrogen Peroxide Solution,Sodium nitrite , Sodium Nitrite stock solution (1000 µg NO /ml) , Sodium Nitrite solution (10 µg NO /ml.) ,Sodium Nitrite working solution.

Procedure

1. Place 30 ml of absorbing media in an impinger.
2. Connect it to the gas sampling manifold of gas sampling device (RDS/HVS).
3. Draw air at a sampling rate of 1 lpm for four hours
4. Check the volume of sample at the end of sampling and record it
5. Transfer the exposed samples in storage bottle and preserve
6. Take 10 ml. of unexposed sample in 50 ml. Vol. Flask (blank).
7. Add 1 ml hydrogen peroxide.
8. Add 10 ml sulphanilamide.
9. Add 1.4 ml NEDA Make up to mark (50 ml.) with distilled water.
10. Keep it 10 minutes for reaction Set Zero of spectrophotometer with Distilled water Measure absorbance at 540 nm**.**

Calculations

C (NO2 µg/m) = (As - Ab) x CF x Vs/ Va x Vt x 0.82

Where, C NO2 = Concentration of Nitrogen dioxide, µg/m

As = Absorbance of sample

Ab = Absorbance of reagent blank

CF = Calibration factor

Va = Volume of air sampled, m

V = Volume of sample, ml

Vs = Volume of aliquot taken for analysis, ml

0.82 Sampling efficiency

2) Buffered Ki Method For Measurement Of Ozone Principle

To determine the oxidizing substances in the atmosphere- Micro-amount of Ozone and its oxidants which liberate iodine when absorbed in 1% solution of potassium iodine which buffered at the pH of 6.8±0.2.The stoichiometry is as by the following reaction:

O**3**+ 3 KI + H**2**O KI**3**+ 2 KOH + O**2**

Reagents

1. Distilled water
2. Absorbing Solution (1% KI in 0.1 m Phosphate Buffer).
3. Stock Solution 0.025 M I (0.05N).
4. M I2 Solution Procedure
5. Place10 ml of absorbing media in an impinger.
6. Connect it to the gas sampling manifold of gas sampling device (RDS/HVS).
7. Draw air at a sampling rate of 1 lpm for 60 minutes.
8. Do not expose the absorbing reagent to direct sunlight.
9. Add de ionized water to make up the evaporation loss during sampling and bring the volume to 10 ml.
10. Prepare calibration graph as recommended in method.
11. Within 30 to 60 minutes after sample collection, read the absorbance in a cuvette at 352 nm against a reference cuvette containing de ionized.

Calculations

C (O3 µg/m) = (As - Ab) x CF x 1.962/ Va

Where, C O3= Concentration of Ozone in µg/m

As = Absorbance of sample

Ab = Absorbance of reagent blank

CF = Calibration factor

Va = Volume of air sampled in m 1.962

Conversion factor, µl to µg

1) **Cyclonic Flow Technique For Measurement Of Suspended Particulate Matter (Pm10 And Pm2.5)**

Principle :
The Air is distorted by a size-selective pipe(Inlet). These Particles with aerodynamic diameter less than the cut-point of the pipe(inlet) are amalgamation by the filter. The mass of these particles is find out by the difference in filter weights prior to and after sampling.
Reagents: Filter Media A glass fiber filter of 20.3× 25.4cm (8×10in)size.
Procedure

1. Check the filter for any physical damages.
2. Mark identification number on the filter.
3. Condition the filter in desiccator for 24 hours.
4. Record initial weight.
5. Place the filter on the sampler.
6. Run the sampler for eight hours.
7. Record the flow rate on hourly basis.
8. Remove the filter from the sampler.
9. Keep the exposed filter in a proper container.
10. Record the total time of sampling & average flow rate.
11. Again condition the filter in desiccator for 24 hours.
12. ·Record final weight.

PM10/PM2.5FINE PARTICULATE SAMPLER ECOTECH (FPS)
The main component of FPS PM10/PM2.5 sampler is two impactors which are fitted in series in the sampler for PM2.5 measurement. PM10 impactor removes all particles from air stream having size greater than 10 microns while 2ndimpactor named as WINS impactor (due to its shape of well) greater than 2.5 microns. Both these impactor are modular in design very easily can be stacked together or detached as per requirement. Impactor can be configured either for PM10 sampling or for PM2.5 sampling.
Design of the FPS sampler has been made such that suction pump assembly heat do not influence the temperature of filter on which PM2.5 dust is accumulated. To make unit compact and easy to transport impactor assembly and dry gas meter has been fitted in parallel. Two cabinets have been made one for pump unit where timer is fitted to automatic operation of sampler at decided time and another cabinet hold DGM (Digital Gas Meter) and Impactor assembly. Further to give actual on time ofthe sampler a time totalizer has been incorporate in circuit.
circular omni directional inlet has been designed and fitted on top of the PM10 impactor. Design of inlet has been made simpler such that ambient dust reaching to PM10 impactor without hitting any surfaces of sampler in flow stream.
Installation Method
Setting up FPS for Measurement of PM 2.5 Dust, FPS is supplied in dissemble from where following major component are available in sample boxes

1. Impactor Assembly
2. DGM (Digital Gas Meter) and Impactor holding box
3. Inlet of PM2.5 Sampler

All above components are modular in design can be fitted together by pushing of pipes where ‘O’ rings are provided. Now push PM10 impactor pipe on WINS which must be tightened by circular holding clamp of DGM box so that it becomes stable and straight. Connect PU pipe in orifice of the DGM Box and far end of pipe is required to be fitted on nozzle of pump. Tight brass nut at both end DGM. Box need to keep on pump cabinet and raise the four sliding side clamp so that DGM box is fixed on it. Mains cord need to connect to pump and check that pump is in working condition. Also see that DGM digital start moving. This confirms that sampler is in working condition and ready to be used.
Calculation

C PM10 µg/m = (Wf - Wi) x 10 / V

Where, C PM10 = Concentration of PM10, µg/m

Wf = Initial weight of filter in g

Wi = Initial weight of filter in g

10 = Conversion of g to µg

V = Volume of air sampled

Results and Discussions

This dissertation report summaries the sampling, analyses and monitoring of 7 identified health based parameters. The methods used for respective parameters are the combination of physical method, wet-chemical method and continuous on-line method. The experiment was done at the FARE labs, gurugram, Haryana. The air sample was collected in February 2021. The air sample was collected from the MSIL manesar MPT engine plant. The result of the present investigation showed that there were:-

Conclusion

Air quality testing is the methodology of testing the air quality of your residence ,office area , school, transport facility, a shopping centre, hospital or child day care spaces.. The legal implications of poor air quality in workplace or place of business are becoming a critical issue for facility managers, business managers, employers, engineers and HVAC (heating, ventilation, and air conditioning) companies.Ambient air quality was assessed using inside MSIL MPT engine plant; the studies have clearly revealed the levels of air pollutants for PM_{10}, $PM_{2.5,}$ $NO_{2,}$ O_3, SO_2 and NH3.The values of particulates are observed to be very much high. This increase in AQI at this site is probably due to the increased transportation on the road in front of it. The air quality is giving the holistic view of air pollution levels. So from the result, it is evident that for the time being, the ambient air inside MPT engine plant, Haryana campus need many attention to control the increasing air pollution level.

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