AIR POLLUTION

A Social Relevance Project Report submitted

in partial fulfillment of the requirements for the award of the

Degree of

Bachelor of Technology

during 2nd Year 2nd Semester

In

COMPUTER SCIENCE AND ENGINEERING

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SAGI RAMAKRISHNAM RAJU ENGINEERING COLLEGE (A)

Approved by AICTE, New Delhi & Affiliated to JNTUK, Kakinada

Chinna Amiram, Bhimavaram, West Godhvari Dt. A.P.

2020 - 2021

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Certificate

This is to certify that the project Report entitled **"AIR POLLUTION"** is the bonafide work carried out by CH S N MANIKANTA (19B91A0535) , C VINAY BABU (19B91A0539) who carried out the project work under my guidance and supervision vision in partial fulfillment of the requirements for the award of the degree of **Bachelor of Technology during 2nd year 2nd semester** in **Computer Science and Engineering.**

Internal guide

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CHAPTER 2
AIR POLLUTION

2.1 INTRODUCTION

Air pollution refers to any physical, chemical or biological change in the air. It is the contamination of air by harmful gases, dust and smoke which affects plants, animals and humans drastically.

There is a certain percentage of gases present in the atmosphere. An increase or decrease in the composition of these gases is harmful to survival. This imbalance in the gaseous composition has resulted in an increase in earth's temperature, which is known as global warming. But, due to increasing industrialization and concentration of poisonous gases in the environment the air is getting more and more toxic day by day. Also, these gases are the cause of many respiratory and other diseases. Moreover, the rapidly increasing human activities like the burning of fossil fuels, deforestation is the major cause of air pollution [1].

2.2 TYPES

1) **Primary :** Pollutants that are formed and emitted directly from particular sources. Examples are particulates, carbon monoxide, nitrogen oxide, and sulfur oxide.

2) **Secondary :** Pollutants that are formed in the lower atmosphere by chemical reactions. The two examples are ozone and secondary organic aerosol [2].

Fig.2.1: Air Pollution

2.3 CAUSES

Following are the important causes of air pollution:

2.3.1 BURNING OF FOSSIL FUELS

The combustion of fossil fuels emits a large amount of sulphur dioxide. Carbon monoxide released by incomplete combustion of fossil fuels also results in air pollution.

2.3.2 AUTOMOBILES

The gases emitted from vehicles such as jeeps, trucks, cars, buses, etc. pollute the environment. These are the major sources of greenhouse gases and also result in diseases among individuals.

2.3.3 AGRICULTURAL ACTIVITIES

Ammonia is one of the most hazardous gases emitted during agricultural activities. The insecticides, pesticides and fertilizers emit harmful chemicals in the atmosphere and contaminate it.

2.3.4 FACTORIES AND INDUSTRIES

Factories and industries are the main source of carbon monoxide, organic compounds, hydrocarbons and chemicals. These are released into the air, degrading its quality.

2.3.5 MINING ACTIVITIES

In the mining process, the minerals below the earth are extracted using large pieces of equipment. The dust and chemicals released during the process not only pollute the air, but also deteriorate the health of the workers and people living in the nearby areas.

2.3.6 DOMESTIC SOURCES

The household cleaning products and paints contain toxic chemicals that are released in the air. The smell from the newly painted walls is the smell of the chemicals present in the paints. It not only pollutes the air but also affects breathing [1].

2.4 EFFECTS

The hazardous effects of air pollution on the environment include:

2.4.1 DISEASES

Air pollution has resulted in several respiratory disorders and heart diseases among humans. The cases of lung cancer have increased in the last few decades. Children living near polluted areas are more prone to pneumonia and asthma. Many people die every year due to the direct or indirect effects of air pollution.

2.4.2 GLOBAL WARMING

Due to the emission of greenhouse gases, there is an imbalance in the gaseous composition of the air. This has led to an increase in the temperature of the earth. This increase in earth's temperature is known as global warming. This has resulted in the melting of glaciers and an increase in sea levels. Many areas are submerged underwater.

2.4.3 ACID RAIN

The burning of fossil fuels releases harmful gases such as nitrogen oxides and sulphur oxides in the air. The water droplets combine with these pollutants, become acidic and fall as acid rain which damages human, animal and plant life.

2.4.4 OZONE LAYER DEPLETION

The release of chlorofluorocarbons, halons, and hydro chlorofluorocarbons in the atmosphere is the major cause of depletion of the ozone layer. The depleting ozone layer does not prevent the harmful ultraviolet rays coming from the sun and causes skin diseases and eye problems among individuals.

2.4.5 EFFECT ON ANIMALS

The air pollutants suspend on the water bodies and affect the aquatic life. Pollution also compels the animals to leave their habitat and shift to a new place. This renders them stray and has also led to the extinction of a large number of animal species[1].

Fig.2.2: Climate change due to Air Pollution

2.5 PREVENTION

Prevention of air pollutions can be taken place by using the following methods

2.5.1 USING PUBLIC TRANSPORTS

Using public transport is a sure short way of contributing to less air pollution as it provides with less gas and energy, even carpools contribute to it.

2.5.2 TURNOFF LIGHTS WHEN NOT IN USE

The energy that the lights take also contribute to air pollution, thus less consumption of electricity can save energy. Use energy saving fluorescent lights to help the environment.

2.5.3 RECYCLE AND REUSE

The concept of recycle and reuse is not just conserve resources and use them judicially but also is helpful for air pollution as it helps in reducing pollution emissions. The recycled products also take less power to make other products.

2.5.4 REDUCTION OF FOREST FIRES AND SMOKING

The collecting of garbage and getting it on fire in dry seasons or dry leaves catching fires is a huge factor for causing air pollution, moreover smoking also causes air pollution and causes the air quality to worsen along with obviously damaging one’s health.

2.5.5 AVOID USAGE OF CRACKERS

The use of crackers during festivals and weddings is sadly one of the biggest contributors to air pollution, leading to a layer of smog which is extremely harmful for health. So, practice of no crackers should be implemented[1].

2.6 CASE STUDY

Fig.2.3: Air Pollution in Delhi

2.6.1 ABOUT AIR POLLUTION IN DELHI

It is to be noted that the capital is the highest cluster of small –scale industry setups constituting the other twelve per cent of overall pollution.

Besides, Delhi is home to more than 167.5 lakh people . While air pollution is a standard feature for a metropolitan city across the world, the capital of India(delhi) has it in the worst way.According to this report,vehicular pollution contributed to more than sixty per cent,and coal-based thermal power plants partook in twelve per cent of the pollution.Till 1997 ,a steep increase in vehicular pollution can be noticed as the city expands and becomes a major industrial hub.The records of Departement of Tansport ,Government of NCT, Delhi suggests that the vehicular population in Delhi is more than 3.4 mllion and is growing at the rate of seven per annual.

2.6.2 EFFECTS

Older people, kids and patients with pre-existing respiratory ailments such as lung inflammation, influenza and asthma are susceptible to the particular matter suspended in the air. And it is not just outdoor air pollution. The suspended particulates make way to indoor air in homes and stay there as well.
Besides this, another study establishes that Delhi air pollution causes nearly 10,000 to 30,000 deaths in the city. In other words, the eighty lives are lost every day because of the PM2.5 level. The effect of pollution often appears as a secondary ailment. The deaths occur from strokes and heart attacks and respiratory ailments.

2.6.3 CONTROL MEASURES

1)Lower emission vehicles and implementation of several stringent measures have resulted in some improvement and relief from Delhi air pollution.

2)The government and other authority figures need to deploy war-like measures to ensure the well-being and health of the citizens.

3)Using the metro and public transport can reduce vehicular transmission.

4)The citizens should comply with the emission mandates and get their vehicles checked regularly for pollution.
5)They should turn off the engines while waiting at the traffic signals.
6)The community should plant more trees and proactively get air-purifying plants to ensure the elimination of indoor pollutants[3].

REFERENCES :

1) https://byjus.com/biology/air-pollution-control/
2) https://pollution.ucr.edu/primary-vs-secondary
3) https://www.cidm.co.in/delhi-air-pollution-case-study/

CHAPTER 3
AIR POLLUTION CONTROL

3.1 PRECIPITATION ON AIR POLLUTION

The best way to protect air quality is to reduce the emission of pollutants by changing to cleaner fuels and processes. Pollutants that are not eliminated in this way must be collected or trapped by appropriate air-cleaning devices as they are generated and before they can escape into the atmosphere.

Particulate matter can be human-made or naturally occuring(dust,ash). Particulate Matter(including soot) is emitted during the combustion of solid and liquid fuels.

BINARY FORMAT

PM(2.5) level is considered to be high if concentration of particulate matter is greater than 115 micrograms per cubic meter.
PM(2.5) level is considered to be low if concentration of particulate matter is less than 115 micrograms per cubic meter.

Machine Learning models to detect and predict PM(2.5) levels based on a data set consisting of atmospheric conditions in a specific region.

1. Detects the levels of PM2.5 based on given atmospheric values.
2. Predicts the level of PM2.5 for a particular date.

Logistic regression is employed to detect whether a data sample is either polluted or not polluted.
Auto regression is employed to predict future values of PM2.5 based on the previous PM2.5 readings.

Training phase: The system is trained by using the data in the data set and fits a model (line/curve) based on the algorithm chosen accordingly.

Testing phase: The system is provided with the inputs and is tested for its working. The accuracy is checked.

DATA SET

1.Wind Speed
2.Atmospheric Pressure
3.Dewpoint

4.PM(2.5) concentration
5.Result

All the features in the data set that are considered for the prediction are correlated and thus can be considered to train the model.

ODDS IN FAVOUR

Odds in favor is given by number of possibilities that are in favor divided by number of possibilities that are not in favor.

Odds from probabilities: (probability of winning)/(1-probability of winning)

Odds classification: 1. 0 to 1
2. 1 to infinite

SYMMETRICITY:

log((probability of winning)/(1-probability of winning))

Log(odds) useful for solving certain statistical problems specifically ones where we are trying to determine probabilities about win/loose, true/false, yes/no (here whether air is polluted/not polluted)

Logit Function: The log of the ratio of probabilities is called logit function and forms the basis for **LOGISTIC REGRESSION**.

LOGISTIC REGRESSION

* Our independent variables are wind speed, atmospheric pressure, temperature, gravity.
* Our dependent variable is Binary (polluted or not polluted).

To tie together our linear combination of independent variables in essence with the dependent variable we need a function that links them together, or maps the linear combination of independent variables that could result in any value onto the probability distribution with a domai ranging from 0 to 1. The natural log of odds ratio ,THE LOGIT is that link function.

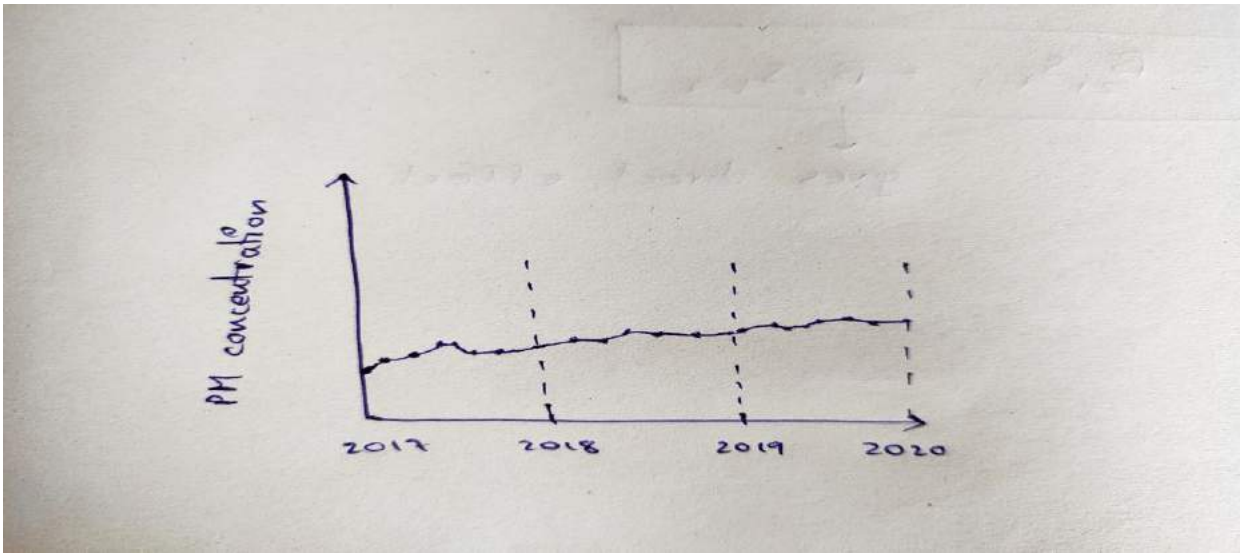
Limit : We have to specify the range of things to be considered for the model on which whether the values taken from the data set needs to be considered as polluted or not polluted (for example particulate matter concentration greater than 115 micro grams per cubic meter is taken as polluted).

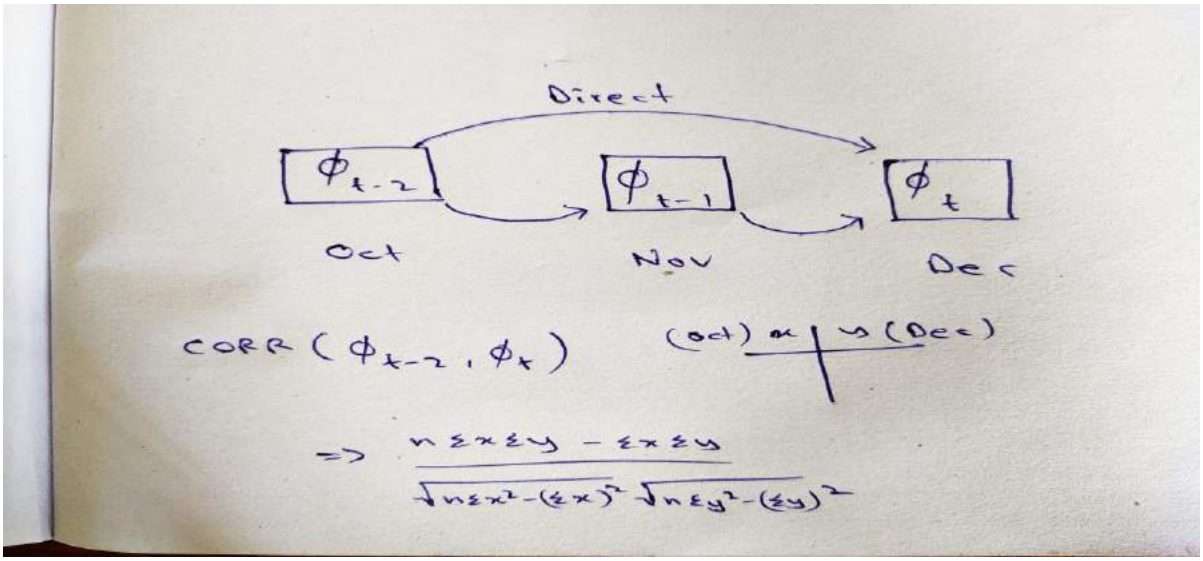
AUTO REGRESSION

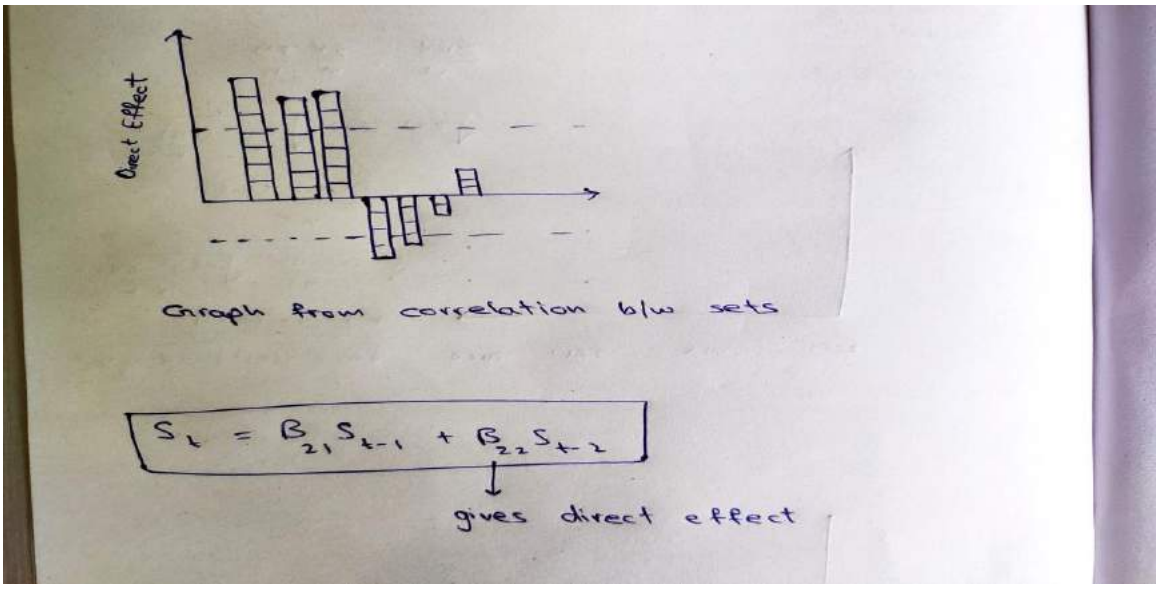
An autoregressive (AR) model considers observations from previous time steps as input to predict the value at the next time step.

The measurement of some value at a time period depends on the measurement of that value at the previous time period at the time period before that one and so on.

There may be positive correlation or negative correlation effect between two sets. We consider direct effect instead of all the possible indirect effects on others.







CONTROLLING POLLUTION USING REGRESSION MODELS

Pollutants can be in the form of solid particles, liquid droplets, or gases. In addition, they may be natural or man-made. Pollutants can be classified as primary or secondary. Usually, primary pollutants are directly emitted from a process, such as ash from a volcanic eruption, the carbon monoxide gas from a motor vehicle exhaust or sulfur dioxide released from factories.

Secondary pollutants are not emitted directly. Rather, they form in the air when primary pollutants react or interact.

Sulfur oxides (SOx) - especially sulfur dioxide, a chemical compound with the formula SO2. SO2 is produced by volcanoes and in various industrial processes. Further oxidation of SO2, usually in the presence of a catalyst such as NO2, forms H2SO4, and thus acid rain.

Carbon monoxide - is a colorless, odorless, non-irritating but very poisonous gas. It is a product by incomplete combustion of fuel such as natural gas, coal or wood.

METHODS OF CONTROL OF GASEOUS POLLUTANTS:

ABSORPTION:

In this process effluent gases are passed through the absorbers which contain liquid absorbents that remove the one or more of the gaseous air pollutants in the gas stream

Absorbing solutions that are used in removing different gaseous pollutants from gas stream are:
SO2: Ammonium sulphate, Sodium sulphite, Alkaline water
H2S: Sodium alamine, Sodium Hydroxide
HF: Water, Sodium hydroxide

FACTORS:
1. Amount of surface contact between gas and liquid
2. Contact time
3. Concentration of absorbing medium
4. Speed of the reaction between absorbents and gases.

ADSORPTION:

In this process the effluent gases are passed through adsorber which contains the solids of porous structure. The commonly used adsorbers are activated carbons, silica gel, activated alumina.

FACTORS:
1. Contact of gaseous pollutants with solid adsorbent.
2. Seperation of gaseous pollutants from adsorbent by reaplacement of adsorbent.
3. Recovery of gases for final disposal.

COMBUSTION:

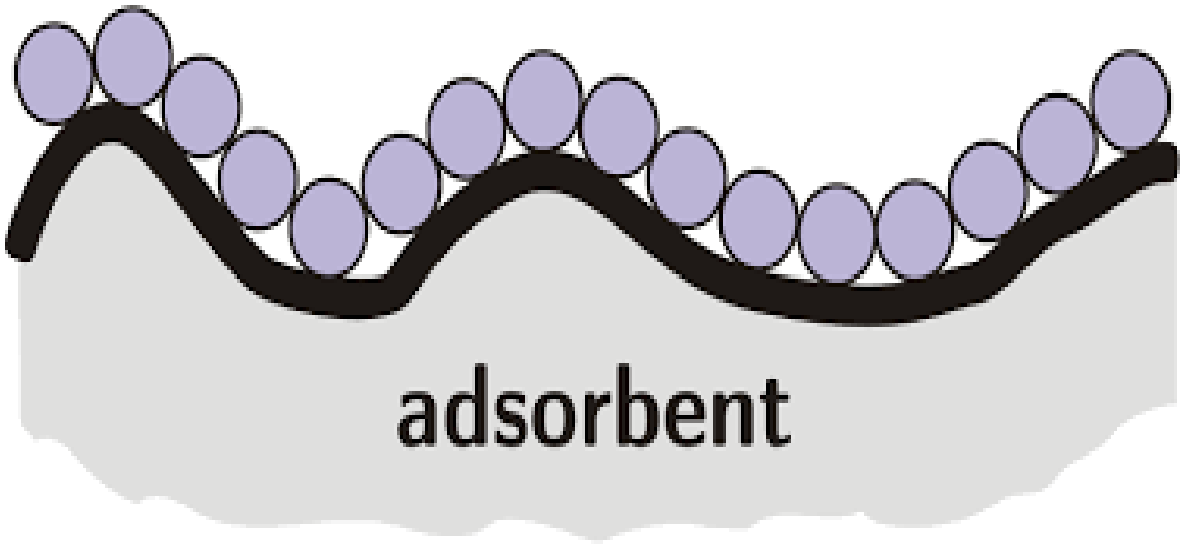
Combustion is mostly used to control the emission of organic compounds from process industries. This control technique refers to the rapid oxidation. When combustion is complete, the gaseous stream is converted to carbon dioxide and water vapour.

AID OF MACHINE LEARNING

Using regression models we can calculate the effectiveness of the method used for reducing the pollution effectively by considering every possible aspect used in the method we chosen to reduce pollution(that can be absorption, adsorption, condensation, combustion).

ADSORPTION:

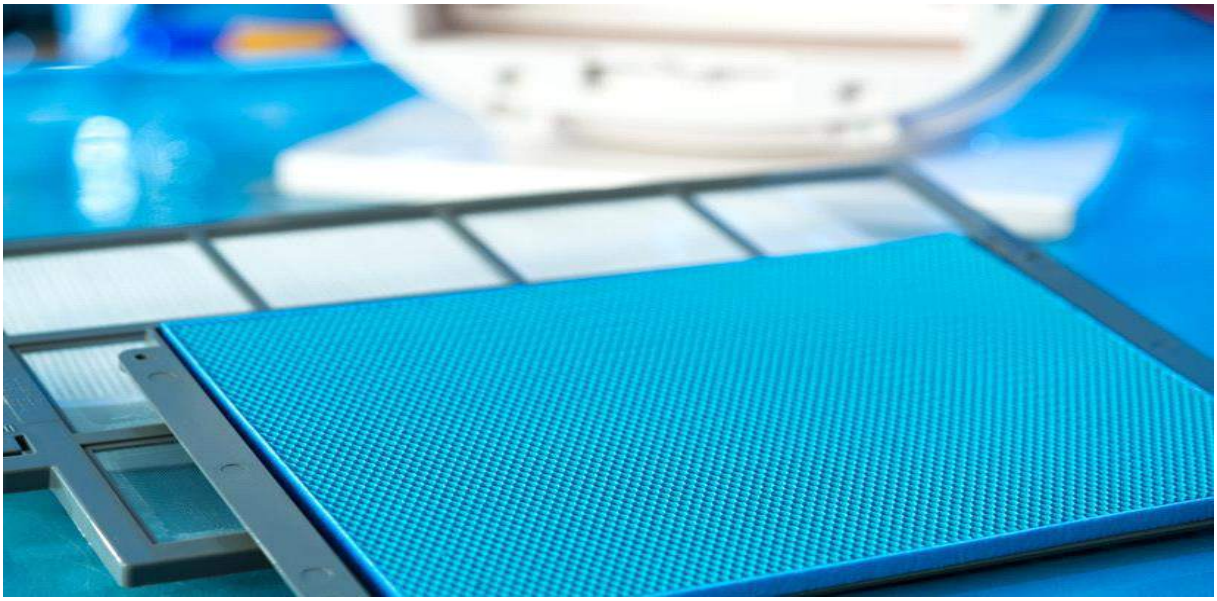
In Adsorption process we have a solid substance which adheres gaseous pollutants. We can perform various methods like movement of the solid substance(up, down, left, right), speed with which it's moving, time it's taking to cover one cubic meter with respect to the shape, properties and characteristics of the solid substance used to remove pollutant particles.



AIR FILTERS

Air Filters are devices used to control air pollution which employ a specific type of filtration media—e.g., fabric, sintered metal, ceramic, etc.—to collect and remove dry particulates and contaminants, such as dust, pollen, microbes, chemicals, etc. from air passing through them. These devices are utilized in residential, commercial, and industrial applications to remove pollutants from exhaust air and improve the air

quality within the work environment. For industrial applications, there are several types of air filters available, including HEPA filters, fabric filters, and cartridge dust collectors.

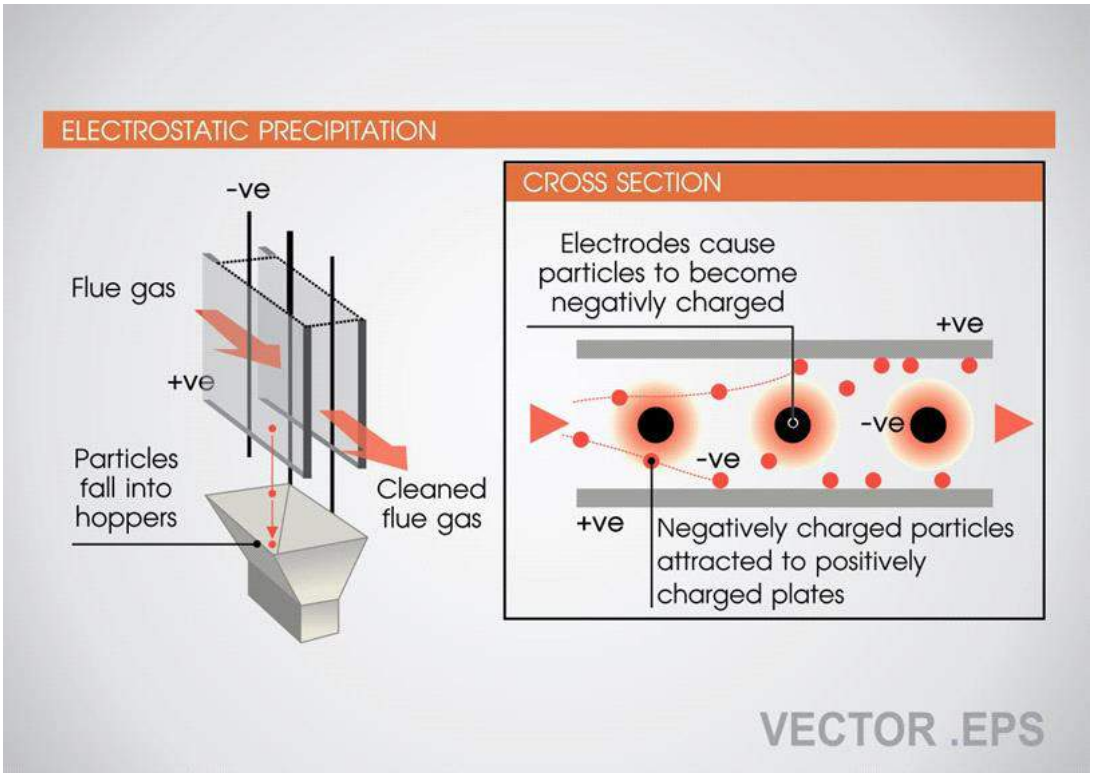


Industrial HEPA filters, are also known as high-efficiency particulate air filters, are a category of air filters which employ fiberglass filter mats to mechanically remove airborne particulates, such as pollen, smoke, dust, and bio-contaminants, from within the work environment. Typically the fiberglass filter mats have fibers ranging in size between 0.5 to 2 μm. When the blower component of the filtration system passes air through the HEPA filter, particulates adhere to or become embedded within the fibers. Additionally, particles passing through the filter collide with the gas contained within, which slows their velocity and increases their chance of becoming adhered to or embedded in the filter.

ELECTROSTATIC PRECIPITATORS

Electrostatic precipitators are air pollution control devices used to collect and remove particulate matter, such as dust, from industrial emissions and exhaust. ESPs employ transformers to create high static electrical potential difference between charging electrodes and collecting plates. As gas streams pass between the two components, an electrical charge is introduced to the particulates, which attracts the particulate matter to the collecting plates. Similarly to air filters, PM accumulation is periodically removed from the collecting plates and deposited in a collection hopper below, either

through mechanically dislodging the particulates or by introducing water to clean off the particulates. ESPs which employ the latter method are known as wet ESPs. As ESPs typically have multiple collection plates, their efficiencies often exceed 99%.



In case of electrostatic precipitators there will be different possibilities(electrodes properties, difference between the electrodes, solution properties etc) where we want to apply this method to remove air pollutants using regression techniques for certain atmospheric and properties of components we can measure the effectiveness of electrostatic precipitation method in removing pollutants.

CONDENSATION:

Condensation is the process of converting a gas or vapour to liquid. Any gas can be reduced to a liquid by lowering it's temperature and/or increasing it's pressure.In a contact condenser, the gas comes into contact with cold liquid.In a surface condenser, the gas contacts a cooled surface in which cooled liquid or gas is circulated, such as the outside of the tube. Removal efficiencies of condensers typically range from 50% to more than 95%, depending on design and applications.

Here under certain atmospheric temperature, pressure, wind speed, direction of wind are different variables needs to be taken into consideration for optimal reduction of gaseous air pollutants and this can be done from logit function and correlation function.

Using Logistic Regression we can calculate the effectiveness and decrease in concentration of particulate matter, and take appropriate measures to make the methods we use to reduce air pollution more efficient.