iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 11 **Issue:** VII **Month of publication:** July 2023

DOI: https://doi.org/10.22214/ijraset.2023.54793

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue VII Jul 2023- Available at www.ijraset.com

Innovative Approach to Air Quality Management Using Pollution Cleaner Tower

Samruddhi S Patil[1], Sneha M Patil[2], Tejas R Patil[3], Tejas B Kamble[4], Dr. Shridhar S Kumbhar[5]
[1, 2, 3, 4]*Student, B.E. Civil Engineering Department, Rajarambapu Institute of Technology, Rajaramnagar*
[5]*Prof, Civil Engineering Department, Rajarambapu Institute of Technology, Rajaramnagar*

Abstract: ***Development activities like urbanization, transportation, industrialization and infrastructure development etc. has caused drawbacks to the environment. It has badly affected air quality. So, the problem statement of this project is "Development of modified wet scrubber to remove air pollutants at ambient condition." A community was identified by using the Air Quality Data available on Central Pollution Control Boards website. It was found that Pune is the most polluted city in Maharashtra and Revenue Colony-Shivajinagar, Pune -IITM is the most polluted area of Pune city which we have identified using different sources.***

Data of concentration of air pollutants was presented on graph and compared with standard guidelines given by pollution control board. After comparing the data with the guidelines, we got to know that the concentrations of pollutants were beyond the limits set by the pollution control board.

Then different alternatives were found to address this problem and from the available alternatives the best one which was chosen that was "Wet scrubber" which has the ability to remove gaseous pollutants as well as particulate matters. To improve the air quality, we designed a pollution cleaner tower which allow people to breathe and experience clean air for free. We implemented this project in the campus of Rajarambapu institute of technology, Rajaramnagar and got the good results with many advantages. And finally, from the tests conducted we concluded that the Pollution Cleaner Tower is able to trap pollutants effectively.

The main objective of this project was the goals which were not achieved even after applying many government policies but it will be achieved with the help this pollution cleaner tower.

I. INTRODUCTION

A. Air Pollution

Air pollution is the contamination of air due to the presence of substances in the atmosphere that are harmful to the health of humans and other living beings, or cause damage to the climate or to materials. It is also the contamination of indoor or outdoor surrounding either by chemical activities, physical or biological agents that alters the natural features of the atmosphere.

B. Air Pollutants

Classification of Pollutants

Particulate Pollutants	Gaseous Pollutants
1. Lead 2. Fly Ash 3. Metallic Oxides 4. Nanoparticles	1. Carbon monoxide (CO) 2. Carbon dioxide (CO2) 3. Chlorofluorocarbon bons (CFCs) 4. Ozone (O3) 5. Nitrogen oxide (NOx) 6. Sulphur dioxide (SO2)

C. Sources of Air Pollution

Pollution enters the Earth's atmosphere in many different ways. Most air pollution is created by people, taking the form of emissions from factories, cars, planes, or aerosol cans. Second- hand cigarette smoke is also considered air pollution. These man-made sources of pollution are called anthropogenic sources.

Some types of air pollution, such as smoke from wildfires or ash from volcanoes, occur naturally. These are called natural sources. Air pollution is most common in large cities where emissions from many different sources are concentrated. Sometimes, mountains or tall buildings prevent air pollution from spreading out. This air pollution often appears as a cloud making the air murky. It is called smog. The word "smog" comes from combining the words "smoke" and "fog."

(Source: https://education.nationalgeographic.org/resource/air-pollution)

D. New Guidelines by World Health Organization (WHO)

The new recommendations slash in half the WHO limits for a measure called PM2.5, which stands for particulate matter smaller than 2.5 micrometers or less than one-thirtieth the width of a human hair. That is small enough to travel deep into the lungs and even enter the bloodstream. According to the new limits, average annual PM2.5 concentrations should be no higher than five micrograms per cubic meter. The old recommendations set the average annual limit at 10. But scientists have determined that long-term exposure to concentrations even that low still contributed to heart and lung diseases, stroke and other negative health impacts. Announcing the new guidelines, the WHO said that "almost 80% of deaths related to PM2.5 could be avoided in the world if the current air pollution levels were reduced."

(Source: https://www.indiatoday.in/science/story/who-air-quality-guidelines-India-climate-change-pollution-emissions-1856111-2021-09-23)

E. Problem Statement

"Development of modified wet scrubber to remove air pollutants at ambient condition."

World is facing problem with bad air quality which leads to lot of problems to human health as well as to environment, in severe condition it also leads to death. From various newspapers and literatures, it was found that this is the major issue faced by the world. By taking above points into consideration, it was decided to develop modified wet scrubber to remove air pollutants at ambient condition.

F. How the Community is Identified

This project will be carried out at Revenue Colony

1) Shivajinagar, Pune, Maharashtra. Reasons

Pune is among 16 cities from central and western India that have shown a stable trend in air pollution.

Pune has 4 times more polluted air than the standards set by world health organization.

On January 24, 2022, Pune's air quality was worse than Delhi's, dust storm.

2) Objectives

a) To analyze ambient air quality for Pune City.
b) To identify pollution sources for Pune City.
c) Design of Pollution Cleaner Tower.

G. Scope of Project Work

1) This Pollution Cleaner Tower will allow people to breathe and experience clean air for free.
2) The Pollution Cleaner Tower has the ability to remove both gases pollutants and particulate matters.
3) Purification of ambient air with respect to standard norms given by CPCB.
4) Reduction of adverse effects on plants and animals.
5) Reduction of bad effects on human health.
6) Reduction of harmful effects on structures.
7) Purification of the ambient air will result in clear vision and reduce number of accidents.
8) The goals which were not achieved even after applying many government policies will be achieved with the help of this pollution cleaner tower.

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue VII Jul 2023- Available at www.ijraset.com

II. LITERATURE REVIEW

In this chapter different research papers are studied. Here we referred about air pollution and wet scrubber their design, working and efficiency.

1) *Akshey Bhargava, Department of Civil Engineering, Global Institute of Engineering and Technology, Hyderabad, India (2016), "Wet Scrubbers – Design of Spray Tower to Control Air Pollutants", International Journal of Environmental Planning and Development, Volume 2, Issue 1.*

Wet scrubbers are compatible and effective air pollution control devices to arrest particulate matters and polluting gases coming out of industrial processes as air polluting emissions

There are various types of wet scrubbers but the present paper deals with Spray Towers and its design. The author of the present paper designed the Spray Tower for a 100 TPD cement plant based on Vertical Shaft Technology (VSK) after monitoring the air emissions in regard to designed parameters under variable conditions on a time scale. Such Spray Towers can be designed and installed in VSK based mini cement plants to control particulate matter with in the permissible norms.

2) *Amir Hossein Matin and Ali Reza Rahmati 2019), "Industrial Air Pollution Control", Book: Air pollution – Monitoring, Qualification and Removal of Gases and Particles, Chapter 9.*

Ambient air contaminants have different adverse effects on human health, environment, and structures. Some pollutions are more toxic and have unfavorable effects on workers and public health, for example, cyanide/isocyanide vapor produced in some processes or in burning of polyurethane compounds, which is a toxic gas that can kill or cause harms impossible to reverse. It is so necessary that air pollutants will be controlled and treatment will be provided for the workers and public who are exposed or exhausted to the environment. Industrial ventilation (general ventilation, dilution ventilation, and local exhaust ventilation) is an appropriate system to control indoor air pollutions. Local exhaust ventilation (LEV) has different segments such as hoods, fittings, collectors (air cleaners), stacks, and fans that could collect and treat indoor and outdoor air contaminants. Each well-designed segment of a local exhaust ventilation is a vital subject that can cause an appropriate and inappropriate performance of systems. A well-designed LEV can lead to obtain a high efficiency level of pollution removal and minimum exposure (workers, public, and environment) to pollutants and save costs and energy.

3) *Dr. Kamal Jyoti Maji (2016), "Research and evidence for developing the Pune air information & response (air) plan", By Indian Institute of Tropical Meteorology, Centre for Environment and Education, Indian Institute of Public Health-Gandhinagar, Natural Resources Défense Council.*

Transportation sector was responsible for almost half of primary emissions, the air pollution emitted directly from combustion or other sources. Rapid urbanization, Industrialization and the key results from Pune's emissions inventory for fine particles (PM2.5) indicate that, during2015, the infrastructural development has badly affected on air quality as it. produces large amount of particulate matter. The other contributors to airborne PM2.5 were resuspended dust (29%), industrial operations (17%), and solid fuel combustion (5%).

In 2016, Dr. Kamal Jyoti Maji, a scholar at the Indian Institute of Technology-Bombay, led a health risk assessment on the effects of NO2, SO2 and PM based on data from 2005-2013 from monitoring stations operated by the CPCB in Pune. This study estimated 733 excess deaths per million people in Pune due to cardiovascular diseases from air pollution exposures (PM10 and SO2) each year. The author team estimated 901 annual hospital admissions for respiratory disease per million people in the city due to polluted air, and 348 excess hospital admissions for cardiovascular disease per million people.

4) *13- Gas-cleaning technology petri Sjoholm, Derek b. Ingham, Matti Lehtimak, Leena Perttu-Roiha, Howard goodfellow, Heikki Torvela.*

The collection efficiency of wet scrubbers is dependent on parameters such as the size and quantity of liquid droplets, the liquid/gas ratio, high water-to-particle relative velocity, wettability of dust, particle density, gas viscosity, etc. For any specific application, the design procedure is to review operating data available from the technical literature or from manufacturers for similar applications. If data are not available, it may be necessary to perform pilot scale tests, which can be used for scale-up purposes.

5) *Shubham V Surwase, Nishant R Magar, Akshay B Surwase, Abhishek S Palkar, Prof. Aparna Ghadge (2020), "Smog depleting tower-a review", International Journal of Advance Scientific Research and Engineering Trends, Volume 5, Issue 7, Page No.74.*

Smog Free Tower is 23-feettall tower that vacuum in the smog particles It is a 7.0 × 3.5 m modular system, energy- friendly and patented ionization technology, lightweight construction with LEDs. The tower sucks in dirty air like a giant vacuum cleaner. Iontechnology then filters it, before returning smog-free air through the tower's vents. By creating field of ions, all the particles on the nano scale gets positively charged, therefore when the ground is negatively charged, you can drag them to the ground, and purify the air – 80 percent cleaner. The great thing about the technology is that is safe and to have 30,000 cubic meters of clean air purified, it takes an hour and only uses about 30watts, which is like a light bulb, says Daan Roosegarde.

6) *S. Laxmipriya, A. Ajay Kumar, S. Aravinthan, N. Arunachalam, "Reduction of air pollution using Smog- free-tower a review paper", International Research Journal in Advanced Engineering and Technology (IRJAET), Vol 4 Issue 2, Page 2.*

The working of the Smog Free Tower had been validated by Professor "Dr. Bert Blocken" of the Eindhoven University of Technology and was successfully implemented in China and Poland. The only limitation is that this tower can treat only small areas covered up to certain radius. Smog free project is a series of urban innovations to reduce pollution and provide an inspirational experience of a clean future. Smog free tower, Smog free ring and Smog free bicycle provide a local solution of clean air in public spaces. Air filters use fine sieves that filter particles with air circulation. This filter exchanges the air in the room by using a fan to draw the air through the purifier. The impurities remain on the filter leaving pure air to continue on through the machine and re-enter the room. As air flows into the purifier, the finer the sieve is, the smaller the particles it can trap onto the filter. HEPA air filters are made from very tiny glass fibers that are made into a tightly woven paper. They are guaranteed to trap 99.97% of airborne particles above 0.3 microns.

III. METHODOLOGY

In this chapter all the procedure carried out to achieve the objectives of the project are explained.

1) Problem identification
2) Primary data collection
3) Secondary data collection
4) Identification of alternatives to the addresses problem
5) Identification of relevant alternative
6) Model designing to designed alternative
7) Design of model
8) Fabrication of model
9) Execution of model
10) Result and Conclusion

A. *Primary Data Collection*

In primary data collection a community was identified by using the Air Quality Data available on Central Pollution Control Boards website. It was found that Pune is the most polluted city in Maharashtra and Shivajinagar area of Pune is most polluted community.

Revenue Colony-Shivajinagar, Pune -IITM is the most polluted area of Pune city which we have identified using different sources.

B. *Secondary Data Collection*

From the CPCB website's the data of various pollutants like PM2.5, PM10, SO_2, and their guidelines, it is observed that the concentrations of pollutants were beyond the limits set by the pollution control concentration was collected.

AQI values at or below 100 are considered satisfactory. If the value exceeds 100 then air qualities unhealthy. In this table the figures highlighted exceed the moderate value of AQI thus showing unhealthy air quality.

Impact of AQI whose value exceeds 100 which are as follows:

1) *Moderately polluted (101–200):* May cause breathing difficulties in people with lung disease like asthma, and discomfort to people with heart disease, children and older adults.
2) *Poor (201–300):* May cause breathing difficulties in people on prolonged exposure, and discomfort to people with heart disease
3) *Very Poor (301–400):* May cause respiratory illness in people on prolonged exposure. Effect may be more pronounced in people with lung and heart diseases.
4) *Severe (401-500):* May cause respiratory issues in healthy people, and serious health issues in people with lung/heart disease

(Source: https://www.business-standard.com)

C. Identification Of Alternatives To Adress The Problem

There were various alternatives available to solve this problem with their pros and cons.
Alternatives to address the problem:
Cyclonic spray scrubber (90% efficient) Dry Scrubber (Greater than 95) % Wet scrubber (80-95% efficiency) Fabric Filters (Greater than 99%) Electrostatic Precipitators (99% for PM only)

D. Identification Of Relevant Alternative

There are some reasons of selecting wet scrubber from the available alternative control devices which are as follows:
Small Space requirement: Scrubbers reduce the temperature and volume of the unsaturated exhaust stream. Therefore, vessel sizes, including fans and ducts downstream, are smaller than those of other control devices. Smaller sizes result in lower capital costs and more flexibility in site location of the scrubber.
No secondary dust sources once particulate matter is collected, it cannot escape from hoppers or during transport.
Handles high-temperature, high-humidity gas streams No temperature limits or condensation problems can occur as in baghouses or ESPs.
Minimal fire and explosion hazard various dry dusts are flammable. Using water eliminates the possibility of explosions.
Ability to collect both gases and particulate matter. Wet scrubbers can neutralize corrosive gases.

E. Model Designing Of The Selected Alternative (Pollutioncleaner Tower)

The Pollution Cleaner Tower will come with a Wet Scrubber installed in it. The design of wet scrubbers depends on the nature of the air pollutants involved.
Scrubbers are designed to collect particulate matter and/or gaseous pollutants.
Wet scrubbers remove dust particles by capturing them in liquid droplets. The droplets are then collected, the liquid dissolving or absorbing the pollutant gases.
Solvents Used in Wet Scrubbers: - Water (H2O)
In wet scrubbers we need water for the treatment of polluted air. The water used in PCT can be cleaned using OHM and recirculated in tower. OHM (Oleophilic Hydrophobic Multi- Functional Media) will be used as a filter media at the outlet through which the particle liquid slurry will pass. This media lowers the water filtration cost by reducing resources required to clean water. OHM media is low in cost, efficient, environmentally friendly. The additional advantage of this filter media is its reusability. It can be reused 10-30 times depending on the mechanical strength of pad/sponge material. Cost of the sponge is Rs.1241.52. ($15).

Materials used

1) Galvanized iron Sheets (GI Sheets):
2) Angle
3) Air Blower
4) Pipes
5) Filter media

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue VII Jul 2023- Available at www.ijraset.com

IV. EXECUTION OF MODEL

The model was tested at Campus of Rajarambapu Institute of Technology, Sakhrale. The water connection was provided to the sprinkler system also water collectors were placed at outlet from where slurry will pass out of the tower.

A. Setting up of Model

For artificially blowing the air blower was used. For getting the results firstly soil sample was taken and which was blown using air blower at the same time water connection was started. The pollutants passed through the inlet of the tower which was then absorbed by the water droplets which were sprinkled by sprinkler system.

Burning of waste papers and bagasse.

V. AIR QUALITY TESTS

A. Determination of Total Solids and Suspended Solids

Aim: - To determine the different types of Solids present in a given sample.

Apparatus: - Oven, Muffle furnace, balance, Crucible etc.

1) Determination of Total Solids

a) The weight of crucible up to an accuracy of three decimal was taken-(W1)-

b) 100ml of Slurry sample in crucible was taken.

c) It was kept in oven at 105-degree Celsius for 24hrs.

d) After evaporation of liquid, weight of residue + weight of crucible (W2) was taken. Thus, we got total solids present in a given sample as, Total solids = [(W2-W1) x1000]/ (ml. of sample taken) mg/lit.

2) Determination of Suspended Solids

a) A filter paper (Whatman filter paper No.44) and its weight(w3) was taken.

b) 100ml of slurry sample was taken and filtered by using filter.

c) After that filter paper was dried and again weight of that filter paper was taken (W4). (i.e., weight of filter paper + weight of sup. Solids)

d) Difference of these two weights has given suspended solids present in a given sample, Suspended solids = [(W4-W3) x1000]/ (ml. of sample filtered) mg/lit.

B. Observation Table

Observations for dust particles present in slurry

Sr. No.	Observations (For Dust)	Weight (in g)
1.	Initial wt. of filter crucible, W1	63.554
2.	Final wt. of filter crucible, W2	63.972
3.	Initial wt. of filter paper, W3	1.066
4.	Final wt. of filter paper, w4	1.196

Observations for Ash present in slurry

Sr. No.	Observations (For Ash)	Weight (in g)
1.	Initial wt. of crucible, W1	65.202
2.	Final wt. of crucible, W2	65.210
3.	Initial wt. of filter paper, W3	1.806
4.	Final wt. of filter paper, W4	1.838

C. For Dust

- *For Total Solid*

➢ Weight of crucible = W1 = 63.554 gms.

➢ Weight of crucible + Solid = W2 = 63.972 gms. Total solids = [(W2-W1) x1000]/ (ml. of sample taken)

= [(63.972-63.554) x1000]/ 100

= 4.18 mg/lit

- *For Suspended Solid*

➢ Weight of Filter paper = W3 = 1.066gms.

➢ Weight of Filter paper + Suspended Solid = W4 = 1.196gms. Suspended solids = [(W4-W3) x1000]/ (ml. of sample filtered)

= [(1.196-1.066) x1000]/ 100

= 1.3 mg/lit.

- *For Total Solid*

➢ Weight of crucible = W1 = 65.202 gms.

➢ Weight of crucible + Solid = W2 =65.210 gms. Total solids = [(W2-W1) x1000]/ (ml. of sample taken)

= [65.210-65.202) x1000]/ 100

= 0.08 mg/lit

- *For Suspended Solid*

➢ Weight of Filter paper = W3 =1.806 gms.

➢ Weight of Filter paper + Suspended Solid = W4 =1.838 gms. Suspended solids = [(W4-W3) x1000]/ (ml. of sample filtered)

= [(1.838-1.806) x1000]/ 100

= 0.032 mg/lit.

This test is performed to experimentally prove that PCT can actually trap Particulate matter.

Performing of TSS Test

VI. RESULTS

1) The test gives result for 100 ml slurry of dust particles the amount of total solids found 4.18 mg/lit and suspended solid 1.3 mg/lit.
2) For 100 ml slurry of ash particles the amount of total solids found0.08 mg/lit and suspended solid 0.032 mg/lit.
3) There is no clogging during the gas movement.
4) Water droplets fall under the force of gravity.

A. Percentage of PM10 & PM2.5 Emissions in Pune City

1) The table above shows the percentage of PM10 and PM2.5 emissons in Pune City caused by various sectors.
2) Transportation Sector: This sector is a significant contributor to global warming and this creates particulates.
3) Industrial Sector: The smoke that the industry emits in the air contributes a lot to ozone depletion, health problems to both animals and humans, and global warming.
4) By using Pollution Cleaner Tower this problem can be solved.

National Air Quality Index for Pune City on 27-03-2023 AQI: 106

B. Concentration of Pollutants

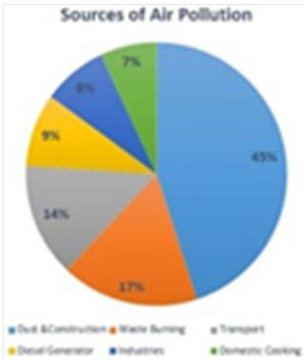
PM10: 140.74 µg/ m^3(Dominant Pollutant) PM2.5: 57.66 µg/ m^3 (Dominant Pollutant) NO2: 48.73 ppb
SO2: 2.16 ppb
O3: 24.75 ppb
CO: 1983.19 ppb
C6H6: 2.1 µg/ m3 NO: 12.11 ppb NOX: 43.2 ppb

From above data it is observed that PM2.5 and PM10 are dominant air pollutants in Pune City. These Pollutants affects on living as well as non-living organism. Air pollution can damage crops and trees in a variety of ways. It can poison wildlife through the disruption of endocrine function, organ injury, increased vulnerability to stresses and diseases and possible death. It also badly affects on human health it increases the risk of respiratory infections, heart disease and lung cancer. It damages buildings, monuments etc.

It is important to control these pollutants therefore these can be achieved using Wet scrubber which is installed in PCT. PCT can effectively remove these pollutants as ones these are trapped these cannot escape out.

VII. CONCLUSIONS

1) From the studies it was observed that Pune's ambient air quality is very poor.
2) From the CPCB's website data of concentration of PM2.5 and PM10 was found out to be very high
3) The various sources like transportation, industrialization and residential sectors are responsible for the poor air quality.



Above pie chart shows sources which are responsible for Pune's bad air quality and percentage of pollution caused by them.

4) Pollution Cleaner Tower has efficiency of about 95% The PCT was tested at the campus of Rajarambapu Institute of Technology (RIT). The waste slurry which was collected from the PCT was tested in RIT's Environmental Engineering Laboratory and good results were observed as mentioned in point no. 3.9. above which proved that the PCT is efficient to use.

REFERENCES

[1] Sirur, S. (2021, October 14) Delhi has two smog towers, but here's why they are unlikely to help fight Air Pollution. The Print. Retrieved from: https://theprint.in/india/delhi-has-two-smog-towers-but-heres- why-they-are- unlikely-to-help-fight-air-pollution/749815/

[2] Kumar, A. (1970, January 1). [how to] design a scrubber [packed column] (updated) as on 07.02.2020 . [How To] Design a Scrubber [Packed column] (UPDATED) as on 07.02.2020. Retrieved from : https://www.pharmacalculations.com/2018/03/how-to-design- scrubber-packed- column.html?m=1

[3] Aditi Rathor and Aparna Roy and Tanushree Chandra (2020, November 5), Finding solutions to air pollution in India: The role of policy, finance, and Communities. Retrieved from: https://www.orfonline.org/research/finding-solutions-to- air-pollution-in-india- the-role-of-policy-finance-and- communities-74311/

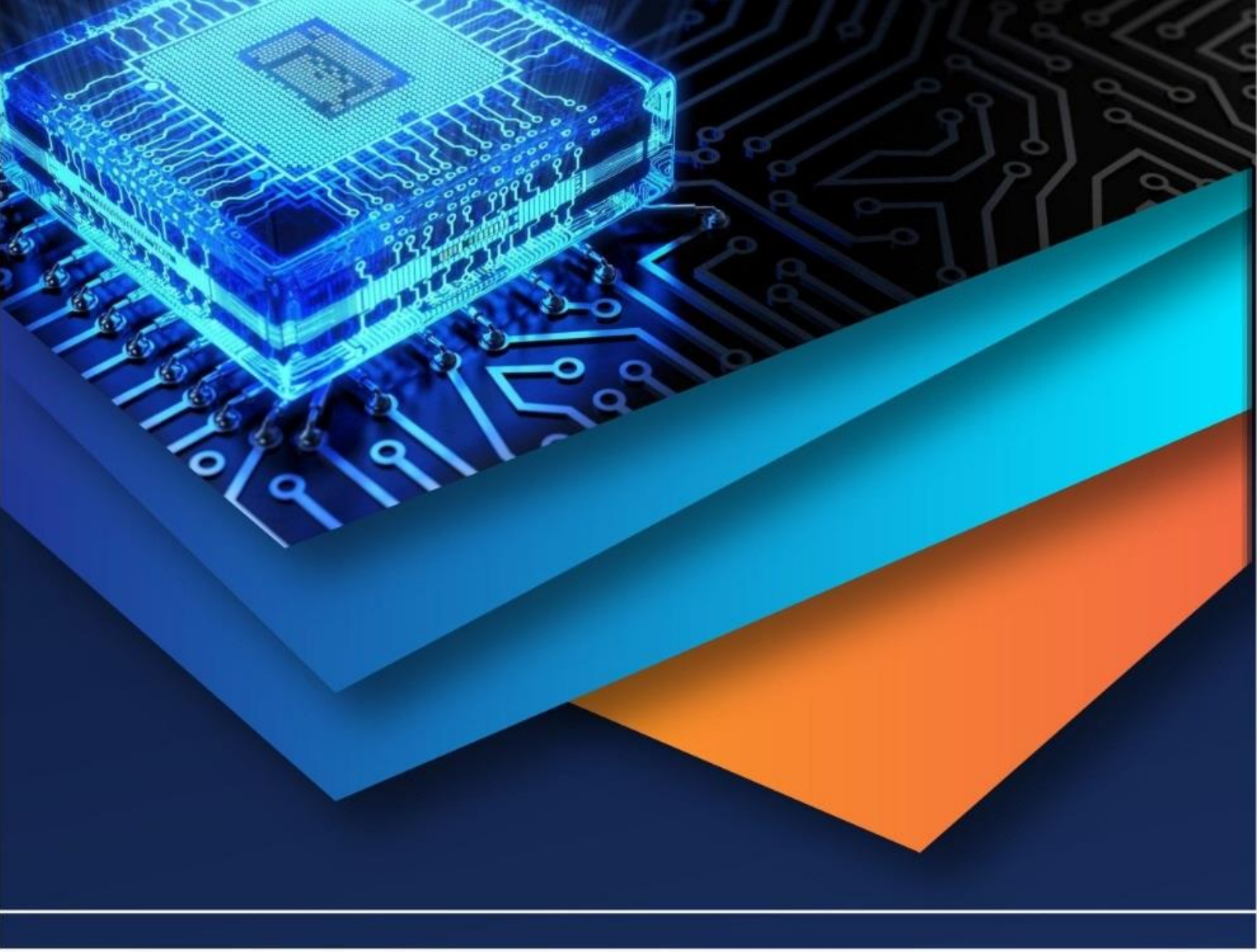
[4] Bharatraj, J., 2021, February 11, Location selection for smog towers using Zadeh's Z- numbers integrated with WASPAS. Intech Open. Retrieved, from: https://www.intechopen.com/chapters/75188

[5] CEMS and DAS Solutions for Clean Air Regulations. (2022, December 5). The definitive guide to air emissions regulations. ESC Spectrum. Retrieved from: https://escspectrum.com/home/learn-and- support/source-blog/the-definitive- guide-to-air- emissions-regulations/?gclid=CjwKCAiAhqCdBhB0EiwAH8M_GoCfEOuL6n7vJFPNHv GYr9c1JSRkkR7QfkcXtS2LBMPHe6HQ8mbmkBoCD 0IQAvD_BwE

[6] Studio Roosegarde, Smog free tower: Smog free project, Retrieved from: https://www.studioroosegaarde.net/project/smog-free- tower

[7] Bureau of Air Quality Control - Technical Services. Environmental Health Home Page. Retrieved from: http://www.houstontx.gov/health/Environmental/airqualitytechnical.html

[8] Wet scrubber / venturi scrubber / packed bed scrubber. Wet Scrubber-Venturi, Packed Bed, Tower, Cross Flow, Low Energy Scrubber. (n.d.). Retrieved from: https://techflow.net/wet_scrubber.html?gclid=CjwKCAi AhqCdBhB0EiwAH8MGjZ8xx8KuaoFgqXxcr9ov5hb7ggc8BMFdmYnQqzYa j8jf1n4EuIVVBoCAxIQAvD_BwE



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY