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Particulate Matter Management Plan for Prayagraj City Based Upon Emissions

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Abstract: ***Air Pollution has become one of the significant factors behind the increase in world-wide mortality rate. There are several reasons behind this increased rate such as rapid growth of industrialization, vehicular pollution accompanied by increase in urbanisation and burning of fossil fuels. This paper presents the proper management and mitigation plan (action plan) of air pollution scenario for the city Prayagraj based upon emissions. Some major air pollutants under consideration in the city of Prayagraj are Particulate Matter (PM10) and particulate matter (PM2.5). There are several prominent sources within and outside prayagraj contributing to PM10 and PM2.5 ambient air; these pollutants can be taken as surrogate of other pollutants also, as most of the pollutants coexist and have common sources. Several major sources of pollution in the city have been noted such as from Domestic, Vehicular Pollution, Road dust, Municipal solid waste (MSW) and Brick kiln. Based upon emissions calculated from these major sources a proper mitigation and management plan has been prepared for the city.***
Keywords: Air pollution, Particulate Matter, Prayagraj city, Action Plan, Emissions.

I. INTRODUCTION

Today, it is increasingly recognized that air pollution has become the leading risk factors behind the human health issues and rise in world-wide mortality rate. Air pollution is the main responsible for environmental quality worsening in many cities all over the world, with adverse outcomes on people's health (Choudhary 2020). According to the last World Health Organization (WHO)report, more than 80% of people living in the urban context are subjected to air quality levels above the emission limits regarding air pollution.

The increase in emission amounts of these pollutants is due to the rapid industrialization and urbanization of developing countries (sofia *e.t.al 2020*).

As per global ranking of risk -factors causing deaths, Air pollution is the fifth leading risk factor for world – wide mortality. The worsening of air quality in urban environments has considerable interest in the scientific community and public opinion due to the strong relationship between air pollution exposure and increased harmful short- and long-term effects on human health (Choudhary 2020).

The pollution occurring depends not only on the pollutant concentration but also on the ability of atmosphere to either disperse or absorb those pollutants. Air quality can be described in a way to report the concentrations of all the air pollutants with standard acceptable limits.

Focusing on the severity of air pollution and its corresponding impact on health, this paper studies major air pollutants such as Particulate Matter (PM) in Prayagraj city. When discussing particulate matter, the two subcategories you've likely heard of before are PM10 and PM2.5.

The main difference between PM2.5 and PM10 is size. When discussing particulate matter, the number to the right of the 'PM' indicates the aerodynamic diameter of the particles. So, PM10 refers to particles with an aerodynamic diameter smaller than 10 μm, and PM2.5 refers to particles with an aerodynamic diameter smaller than 2.5 μm. We also know that PM10 called coarse dust and PM2.5 called fine dust.

Particulate matter can include organic matter, like dander and spores, and inorganic matter, like dust. While other pollutants are identified through chemical makeup, PM is an umbrella term for all airborne particles, regardless of molecular composition. Primary sources of particulate matter (PM) include various sources such as Construction sites, Mining activities, Unpaved road dust ,Natural dust, Vehicle emissions, Wildfires, Slash-and-burn agricultural, Other fuel-burning activities. Therefore, an integrated pollution control approach in the region can only improve the air quality of the prayagraj city.

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II. MATERIALS AND METHOD

A. Study Area

The city of Prayagraj is situated in the state of uttar Pradesh, north India. Prayagraj is also known as judicial capital of the uttar Pradesh and it is among the largest cities of Uttar Pradesh with an area of 5,482 sq. km. Prayagraj city is localized around the convergence of three rivers –– the Ganga, the Yamuna and the invisible "Saraswati" is considered holy by hindus. Prayagraj is the state's sixth most populous city, with a population of 11.43 lakh people. Prayagraj may be found at 25.45°N 81.84°E.

For calculation of emissions, the whole city of prayagraj is divided in the no. of grids so that there would be a full coverage area of city. The entire study area is shown into the grid form as shown in the figure no. 1.

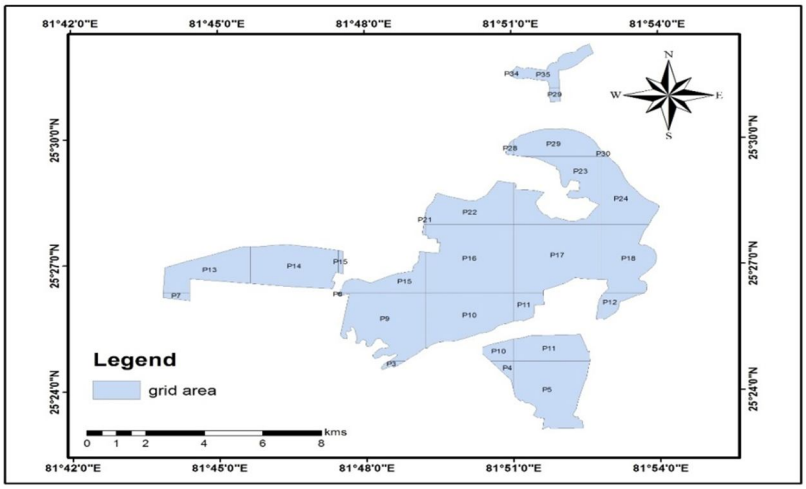

Fig no.1: Grid Wise Distribution of Praygraj city for study

B. Sites Under Consideration

The city of Prayagraj is divided into 36 no. grids in order to maintain the accuracy of the emissions calculated. The grids are selected on the basis of the type of the area they contain. Grids divided are of uniform size that is of 3*3 km^2. Table no.1 shows several grids number with their names.

S.no.	Grid no.	Grid Name
1	P4	A.D.A Naini and Mewalal Bagiya Chauraha
2	P5	A.D.A Naini and Mewalal Bagiya Chauraha
3	P8	A.D.A Naini and Mewalal Bagiya Chauraha
4	P9	A.D.A Naini and Mewalal Bagiya Chauraha
5	P10	Post Office barron
6	P11	Naini Bridge Police Booth
7	P12	Aadya Hospital
8	P13	Dhoomanganj
9	P14	Dhoomanganj
10	P15	Dhoomanganj
11	P16	Prayag Hotel and Mayohall Chauraha and Hanuman Chowk
12	P17	Prayag Hotel and Mayohall Chauraha and Hanuman Chowk
13	P18	Prayag Hotel and Mayohall Chauraha and Hanuman Chowk
14	P21	Prayag Hotel and Mayohall Chauraha and Hanuman Chowk
15	P22	Rajapur Civil Line
16	P23	Bank Road Fountain and old Khatra chowk
17	P24	Bank Road Fountain and old Khatra chowk
18	P28	Bank Road Fountain and old Khatra chowk
19	P29	Teliarganj
20	P35	Teliarganj

C. Methodology

For the calculation of emissions from different sources (Vehicular ,Domestic cooking ,Road dust, brick kiln ,municipal solid waste), proper survey has been performed over the whole city for the duration of four months to collect the data .

After calculating the emissions by applying suitable emission factors (which are generally taken from the CPCB report) to the grid wise distributed area, certain results from different sources have been derived.

These emissions from different sources are calculated in Kg/day.

III. RESULTS AND DISCUSSIONS

As per the existing calculated value of emissions from vehicular and road dust, these calculated values are grid wise distributed over the whole the prayagraj city area. These values of existing emissions from vehicular and road dust sources are controlled by applying different methods for different sources of pollution as shown in below represented figures.

From figure no. 2 to figure no. 6 shows the comparative values of road dust emissions which are distributed grid wise. Different controlled options are adopted for the management of PM10 and PM2.5 in different grids which can be easily inferenced from the bar char results which are shown below.

From figure no. 7 to figure no. 9 shows the comparative values of vehicular emissions which are distributed grid wise. Different controlled options are adopted for the management of PM10 and PM2.5 in different grids which can be easily inferenced from the bar char results which are shown below.

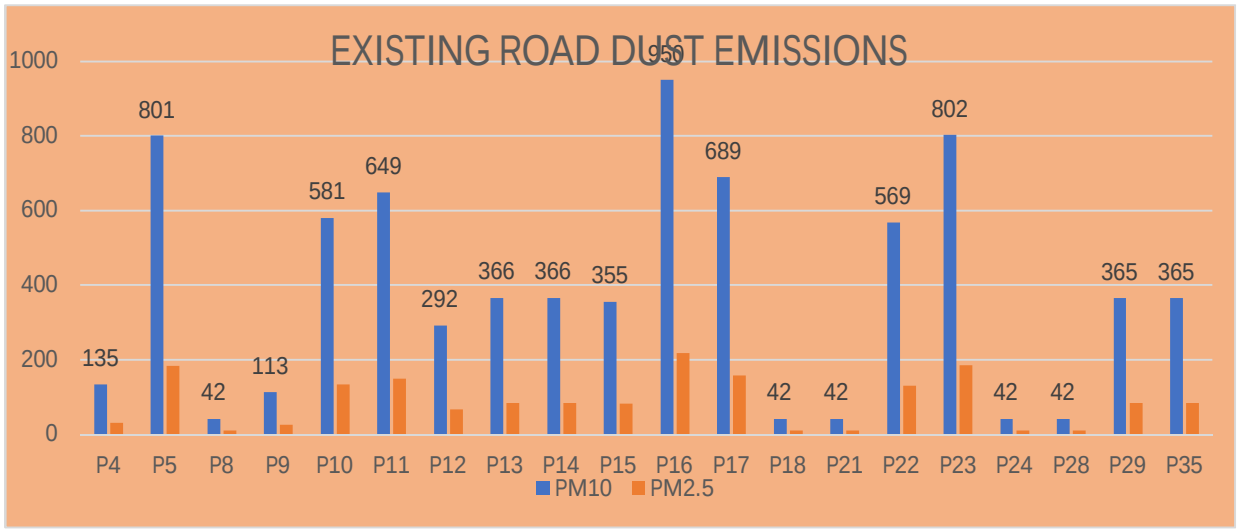

Fig no.2 showing grid wise distribution of existing road dust emissions

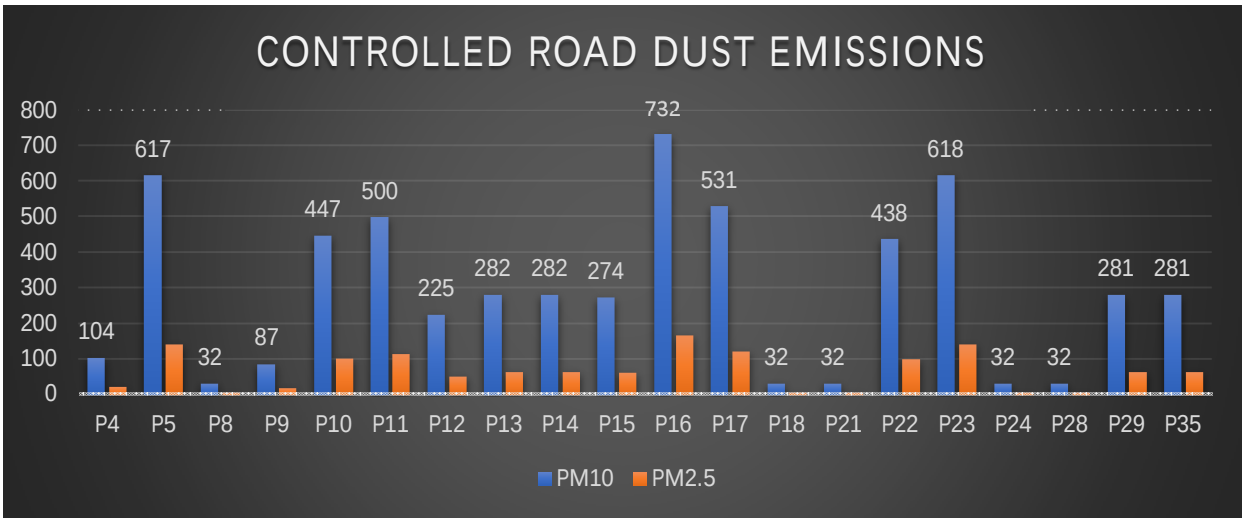

Fig no.3 CRDE due to mechanical sweeping with water wash 2 times/month

*CRDE (Controlled road dust emissions)

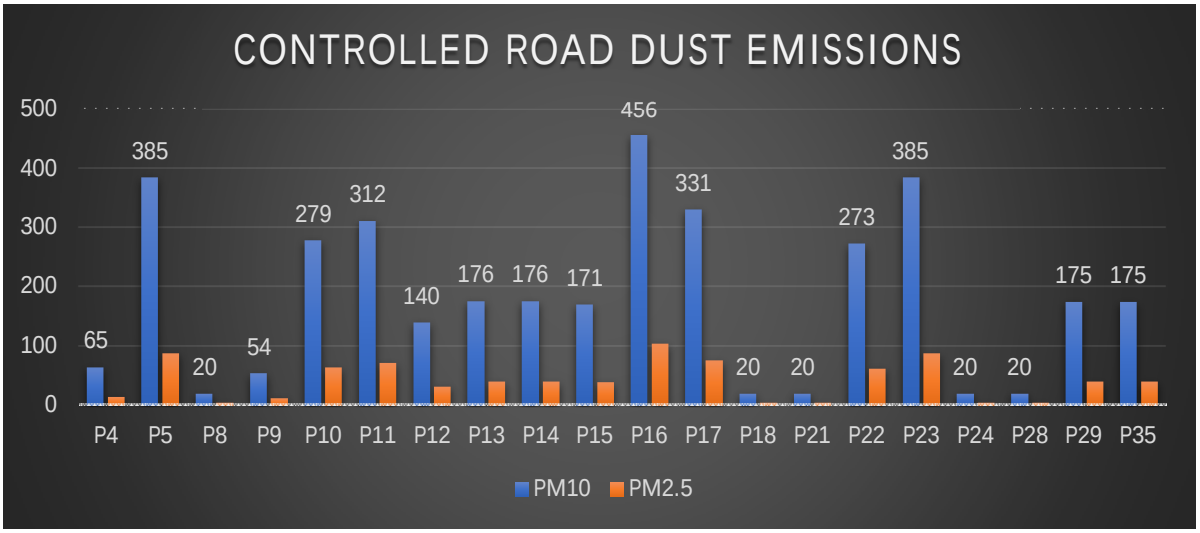

Fig No.4 CRDE due to mechanical sweeping with water wash 4 times /month

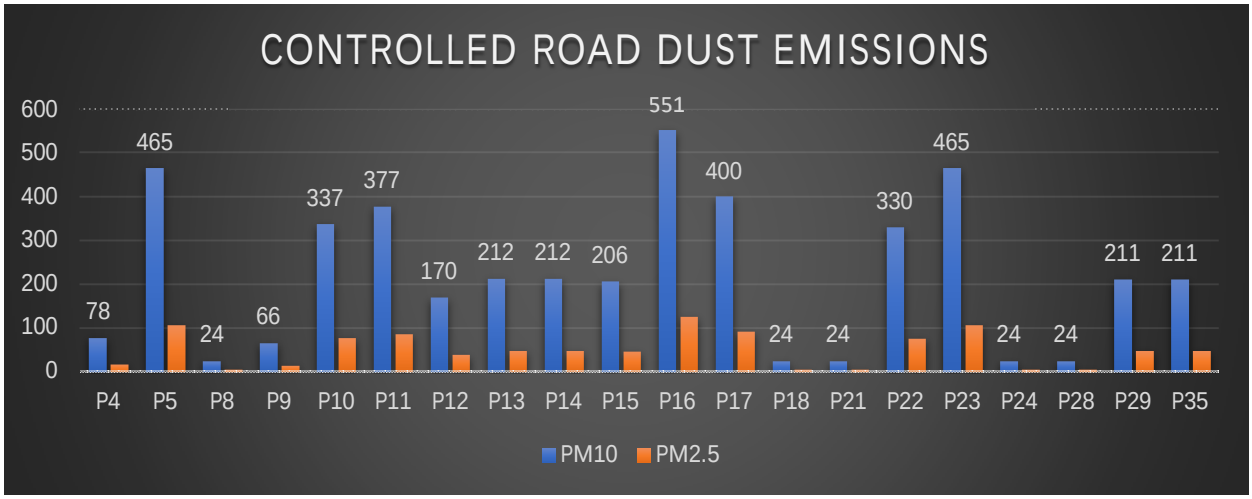

Fig No. 5 CRDE due to vacuum sweeping 2 times /month

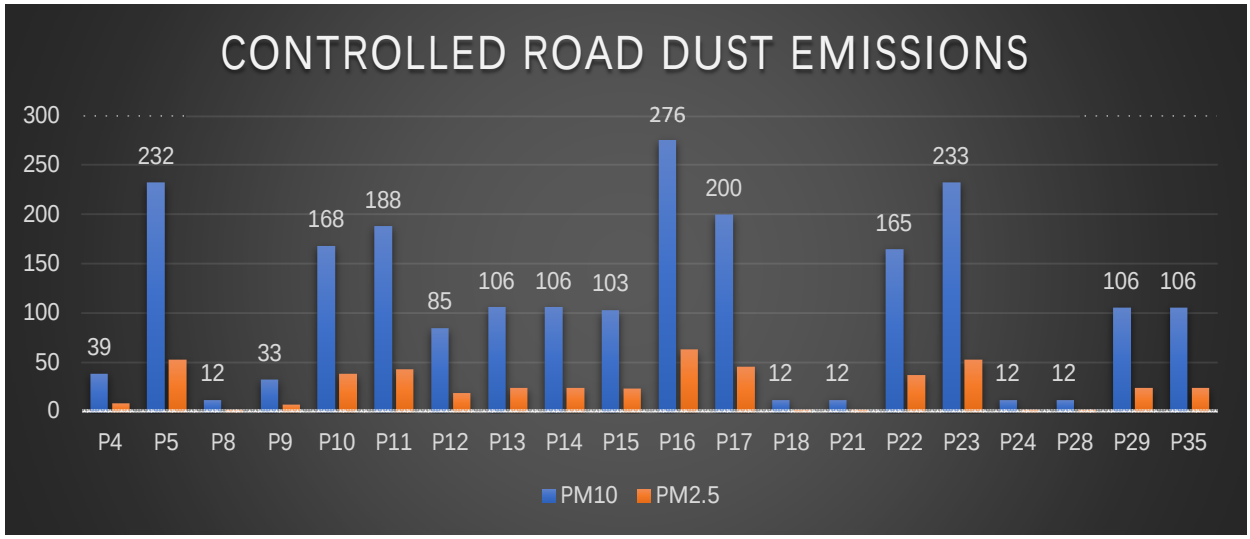

Fig No. 6 CRDE due to vacuum sweeping 4 times /month

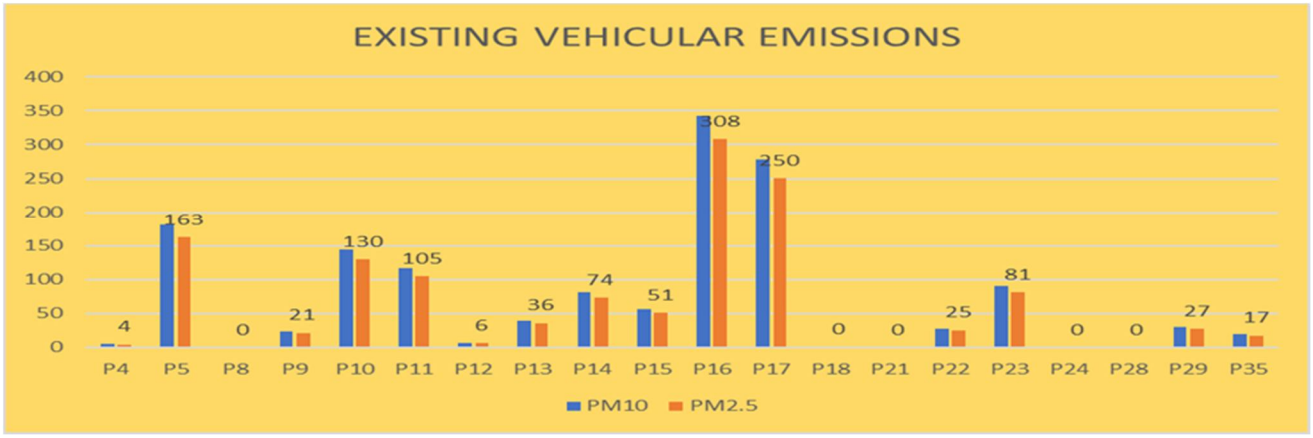

Fig no. 7 showing grid wise distribution of existing vehicular emissions

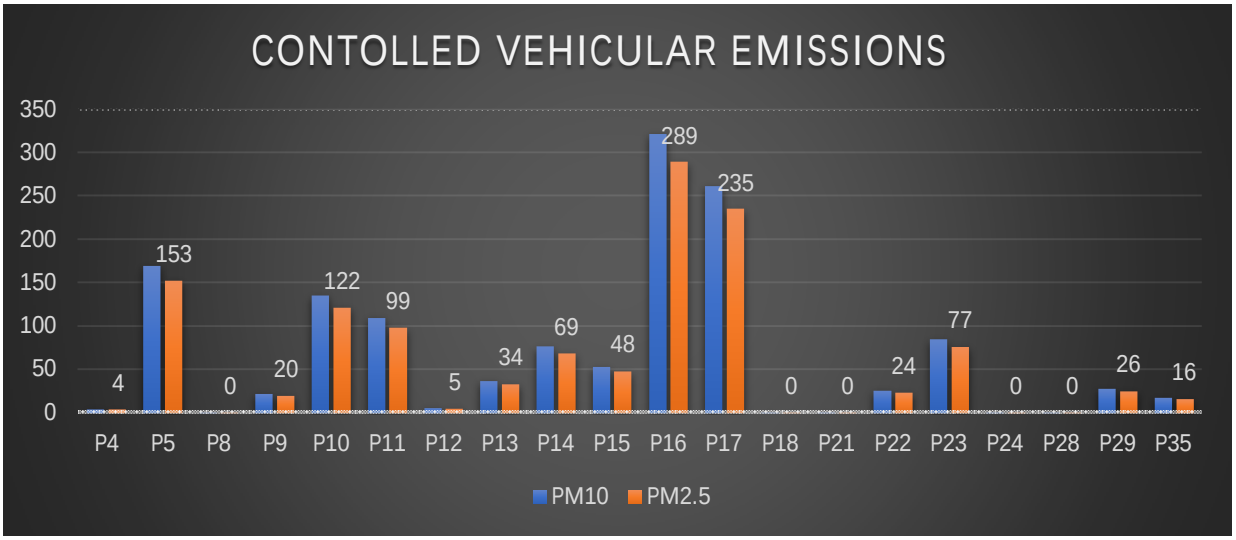

Fig No..8 CVE due to use of ultra-low sulphur fuel
*CVE (Controlled vehicular emission)

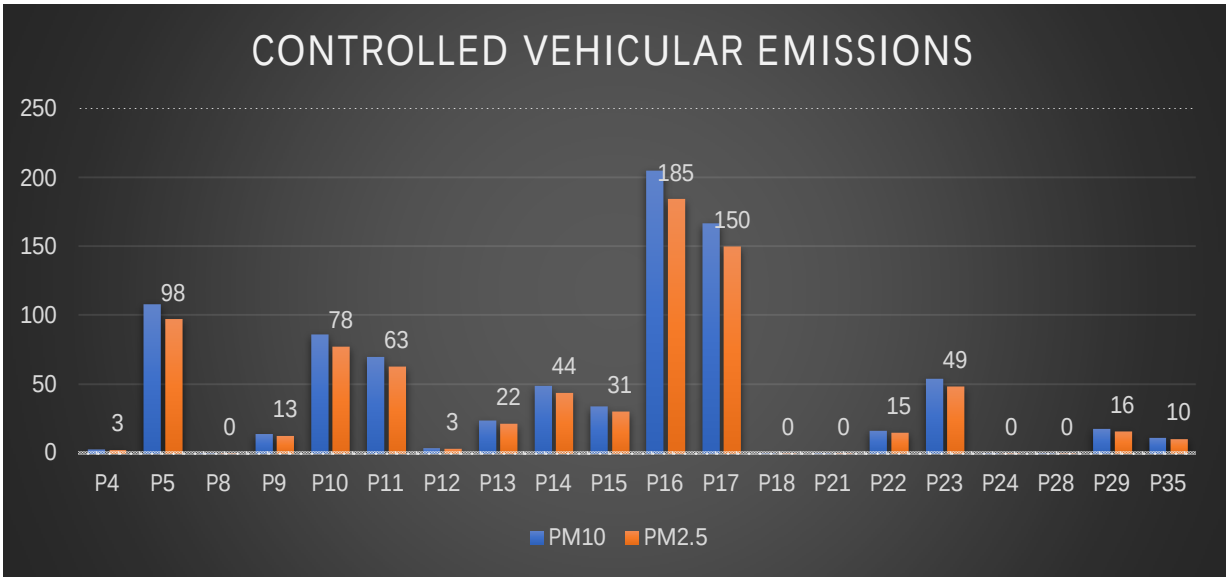

Fig No.8 CVE due to use of Retrofitment of diesel particulate filter

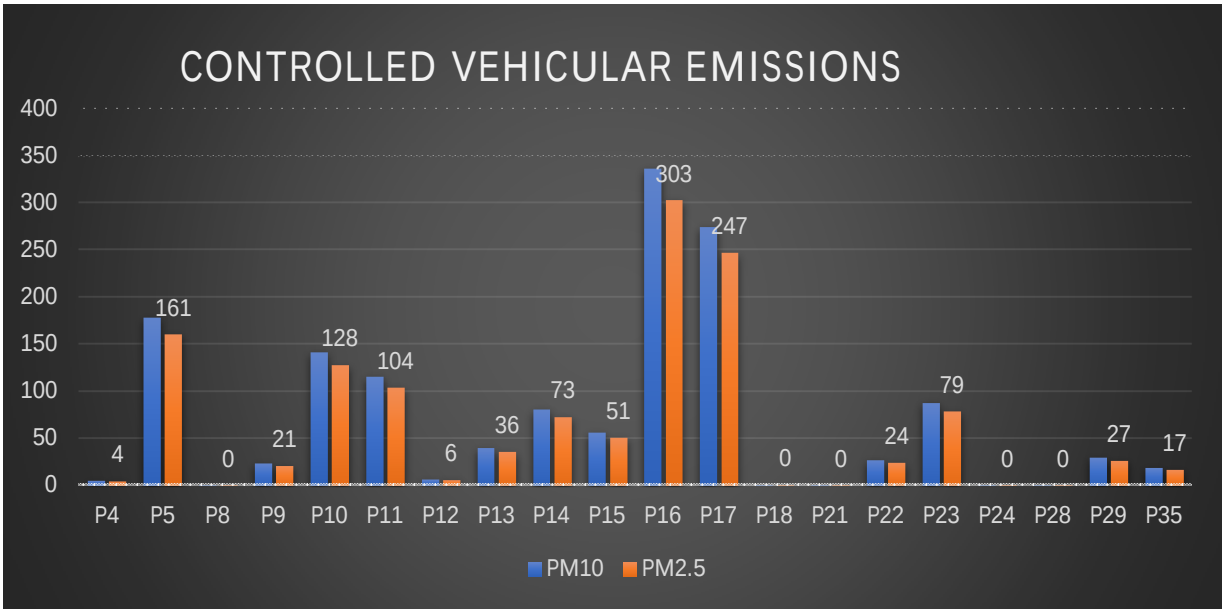

Fig no.9 CVE due to conversion of diesel vehicles into electric vehicles

IV CONCLUSION

Analysing the above results for distribution of emissions from vehicular and road dust in different grids following conclusion can be withdrawn for particulate matter which are as follows-

1) Existing values of road dust emissions for PM10 are very high in grid no. P5, P16 and P23, so the most preferrable method for controlling these emissions was vacuum sweeping of roads with a frequency of 4times/ month.

2) As per the comparative values of PM2.5 for vehicular emissions in different grids, we conclude that in grid no. P5, P16 and P17 emissions were very high, so the most preferrable method for controlling them is the retro fitment of direct particulate filter in vehicles.

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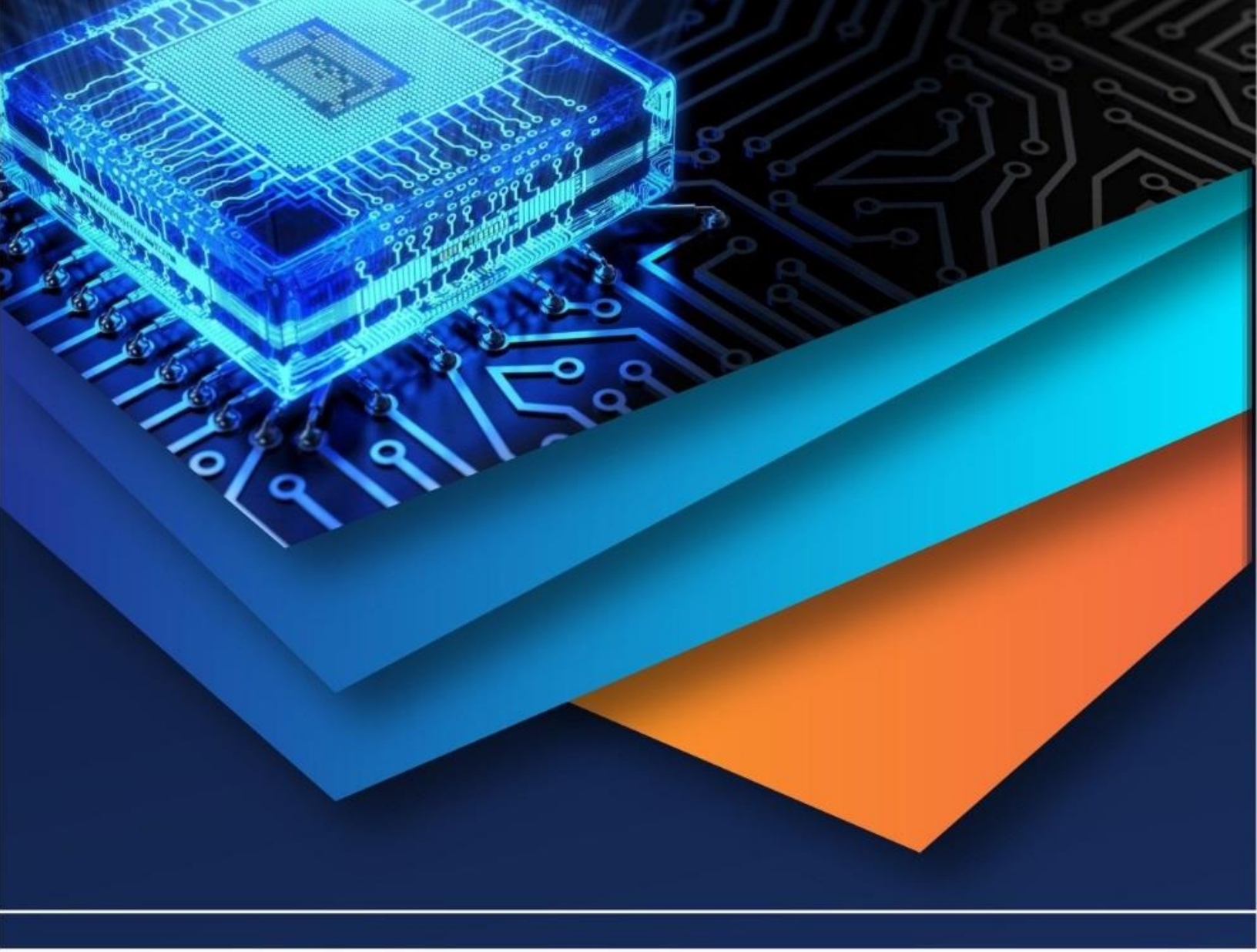

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