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A Review: Dust Removal on Road by Different Techniques

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ABSTRACT: In our day and age, burning fossil fuels is one of the leading causes of global air pollution. Due to human activity, dust discharge from heavy urban construction and off-road vehicle use has increased rapidly in the last decade as urban expansion has increased. The global agitation over urban air pollution triggered by increasing dust remains unclear. According to the WHO 2020–21 published index, India is indeed the fifth most polluted country in the world, out of 117 nations and regions. This review article examines a variety of research paper styles. Out of all the research publications that discuss various techniques used to regulate and reduce dust on roadways, two have been chosen for further consideration.

I. INTRODUCTION

In our era's burning fossil fuels are the main causes of air pollution in the world. With increasing urbanization in the last few decades, anthropogenic dust discharge due to heavy urban construction and off-road vehicle use is increasing rapidly. Rapid economic growth in the last two decades has turned many sub-urban areas into businesses it is which created unpredictable urbanization effects. Couple with Global climate change causing the increase in air pollution also. Industrialization of the cities requires an extension of the road traffic system and urbanization. The increasing amount of road dust in urban areas is a consequence of industrialization. Air pollution and cities are a global important health issue that is especially pronounced for the increasing population as children attending school close to major road or pedestrian near road junction we are waiting time constitute a significant exposure hazard. Children and those living in economically depressed regions near main roadways are disproportionately targeted by urban air pollution. They concluded the most affected sector was about 0.2 to 0.3 mile (300 to 500 metres) from the highway. The health consequences of vehicle-generated air pollution are severe and cause serious side effects. The dust particles present on the road are dangerous to road safety such as these particles mixing with the fog and forming smog, leading to decreasing visibility on road and causing fatal accidents. The tire surfaces reduce in presence of dust particles on the road and cause skidding while turning, it also enters in driver's eyes which cause discomfort and irritation facing critical problems.

Different Ways are used the moment to reduce dust pollutants in the atmosphere caused by air pollution. Some styles are used to control gassy adulterants, which are mentioned then. When hazards are in the organic form of smog, this approach is applied. During honey combustion or the catalytic process, these organic adulterants are converted into water vapor and fairly lower dangerous products, similar to CO₂. absorption. This fashion passes gassy effluents through scrubbers or absorb. These incorporate a compatible liquid spongy that excerpts or modifies one or other influent products in gassy backwaters. Adsorption the gassy backwaters are passed through previous, solid adsorbents in suitable holders. The organic and inorganic ingredients of the effluent feasts are trapped at the interface between the solid adsorbent and the physical adsorbent. Managing air pollution involves reducing or excluding the emigration of adulterants that might damage mortal or environmental health. One of the main areas of pollution control, along with wastewater treatment, solid waste operation, and dangerous waste operation, is the control of air pollution. The most

effective way to protect air quality is to reduce pollutant emissions by switching to cleaner fuels and processes. Pollutants not eliminated in this way must be collected or trapped by appropriate air-cleaning devices as they are generated before they can escape into the atmosphere. The porous concrete acts as a pollution reducer. After causing accidents, the porous concrete divider also reduces. Walls are effective in deflecting particulate matter, but adding shaping either at the design stage or as a retrofit improve performance. previous concrete subject to dust blocking, which discusses the blocking status and changes in permeability due to natural dust fall and clump dust fall. Elements present in concrete interact with and eliminate sulphur and nitrogen oxides in the air. Although the capacity of concrete to absorb hydrogen sulphide diminishes over time, researchers have found that the new surfaces provided by crushing concrete may improve its pollution-removing properties. Because of its flexibility, concrete is an outstanding construction material for a wide variety of functions. It can be reshaped in an infinite number of ways without preserving its toughness, allowing designers to exploit it for a variety of applications. Concrete is a locally sourced raw material. Cement's main constituent (around 10-15% of concrete by weight) is lime, which is widely and freely accessible. Because the material does not need to be transferred across vast distances, considerable carbon savings in transportation can be realized. In terms of climate change, the cement and concrete industries have been working for many years to minimize CO₂ emissions. Concrete has good sustainability characteristics, and the industry has made tremendous progress in lowering CO₂ emissions from cement production. Since 1990, the cement sector has reduced its carbon emissions by 19%. Climate ambition is also being launched by the industry to offer society carbon-neutral concrete by 2050, in line with international climate commitments. The effective use of materials, together with the comprehension of the carbon techniques that concrete incorporates, serve to permanently deposit CO₂ in dwellings. Concrete can also be reused and is 100% recyclable at the end of its life. The industrialization of society requires an extension of the road traffic system and urbanization. Modernization has led to an increase in fine particulate matter in urban areas. Fewer researches have evaluated the consequences of street dust on human and animal health, despite the fact that many have looked at the geochemical constitution of road dust. Transportation is also a major source of dust pollution, which includes the transportation of loaded as well as empty vehicles and the transportation of bags or containers with powdered materials. Road traffic and unpaved road sides are also responsible for dust emissions. The different sizes of dust particles, mainly suspended particles, i.e., suspended particulate matter (SPM), flow in the air for varying time periods, which depend on their sizes and weights.

II. LITERATURE REVIEW

Qijian Lin and Ling Choufu studied “An analogue experiment of pervious concrete” subject to the call blocking. The study and to discuss clogging as a result of a dust and subsequent changes at the permeability function after rainfall. This research adopted the 2011 average monthly dust fall in Ping tongue country and magnified it by 10 and 20 times. Because asphalt has a shorter lifespan, Lian and Zhuge created an experiment with permeable concrete with increased strength. The accumulation of sediments inside the internal pores of the porous concrete is known as "clogging" and is one of the main phenomena that decrease the hydraulic performance of porous concrete. This reduction is given by the partial or total clogging of the interconnected pores, leading to large variations in permeability. In some cases, the accumulation of sediment can be so high that it reduces the permeability of the material by up to 95%, causing porous concrete to no longer be considered a permeable material according to the minimum values of the standards. Winston evaluated eight small-scale and full-scale maintenance techniques in red dressing that remove the top 2 cm of fill material where Brunetti designed a high pavement system. They used fine aggregates of 12.5, 9.5, 6.35, 4.75, 2.36, 1.88, and 0.6 mm. Clay was used to stimulate the dust fall, which represented airborne dust particles from 0.22 to 0.15 mm passing through a 100-seat sieve. Water is provided on a testing area of 0.819 liters each time using a pressure sprayer. Then I dried the specimen for 1 hour and noted the readings were about average at 3.67 g. To determine the monthly average dust fall, the procedure is repeated 20 times.

Wolfersberger, C. has studied “Environmental Benefits of Pervious Concrete”. When it's time to tear down a concrete building or sidewalk, the materials don't have to be squandered. It can be crushed and used as aggregate, base material, or paving material. Even steel might well be reused, and while it is broken, the carbon dioxide is being collected. The maximum amount of oil and grease is stored in driveways, ride-away lanes, service stations, and parking spaces. Roads are next. Pervious concrete reduces stormwater runoff, which replenishes water tables and aquifers. It does away with expensive detention ponds used in watershed management techniques. also allows for environmentally friendly land development. It keeps warm, contaminated water from entering streams. Additionally, they gather hazardous elements from pneumatic tyres as well as trace metals from machines and exhaust systems. When it rains, they become large

polluters. When the time comes to demolish a concrete structure or pavement, the material does not need to be wasted. It can be crushed and used as aggregate, base material, or paving material. Even rebar can be recycled. Additionally, as it has been broken, CO₂ is being absorbed. Concrete can be made porous. To obtain optimum resilience, this is done by extracting sand and particles from the mixture and modifying the concrete mixture with cementitious materials. The base and the pervious concrete mix are made of sustainable materials.

S.Gulia, P. Goyal, S.K. Goyal, R. Kumar et al (2018) "Re Suspension of Road Dust" In these literature discussed that significant fraction of urban PM₁₀ and PM_{2.5} concentrations is due to non-exhaust traffic emissions such as road dust re-suspension, brake wear and tyre wear. Where PM₁₀ represents means particles less than 10 µm in diameter and PM_{2.5} represents means particles less than 2.5 µm in diameter. Icholson (1988) described the process of particle resuspension and the parameters that influence it. A wide variety of industrial and ecological operations, from fresh air innovation to dirt removal, involve the resuspension of tiny droplets from a plane normal to a turbulent boundary layer storms and the spreading of crop diseases by fungal spores. An analysis must take into account the transmission of chaotic offshore wind to interface molecules to produce an accurate image of dilution. Cleaver and Yates (1973) were the first to quantify the impact of wall induced shear on particle resuspension. They concluded that lifting, dragging, and twisting, both of which have an impact on a molecule on the ground, are caused by viscous forces. Cleaver and Yates' hypothesis that coherent structures near the wall contribute significantly to particle resuspension has since been confirmed by experiments such as Kaftori et al., 1995; Rashidi et al., 1990; Braaten et al., 1990; Yung et al., 1989; and theoretical calculations such as Soltani and Ahmadi, 1995a; Pedinotti et al., 1992; Wen and Kasper 1989. Silt loading on the road, vehicle types, tyre types (studded and non-studded), pavement type, vehicle speed, and nearby land use type are the main factors influencing road dust emission.

Rihan k. khan (2018) et al carried out the study on "Road Dust and Its Effect on Human Health". In this literature review was carried out to summarise the present understanding of the scientific community about the impacts of road dust on human and other living being's health, a literature study was conducted. The human body's respiratory system was shown to be the most negatively affected by air pollution and increasing dust, according to researchers at the University of Bristol. The Platinum Group element lead, as well as the metals aluminium, zinc, and vanadium, were most frequently mentioned in the articles and case studies we reviewed. Aluminium has been long recognised for its detrimental effects on numerous major organs. Long-term exposure to aluminium was found to be associated with Alzheimer's disease. Aluminium was found to be associated with respiratory allergies such as asthma in aluminium industry workers. The accumulation of aluminium can cause cardiac hypertrophy, leading to cardiac failure. Hepatocellular system dysfunction has been linked to aluminium accumulation in the body. Aluminium was also found to be associated with anaemia and a low reproductive rate in rats. They reported that palladium was more soluble than other platinum group elements, thus causing a potential health risk to humans. Some researchers found a higher rate of inhaler usage due Youngsters with asthma who have been exposed to tiny road dust particles experience worse problems. Some laboratory experiments on non-human subjects have provided evidence regarding the mutagenicity of some palladium and rhodium salts Palladium was found to cause allergies at a very low dose among miners, dental technicians, and chemical plant workers. The human body was discovered to be negatively impacted by road dust, particularly the respiratory system.

Shubham Thakur, Rakshit Jain, AnuragJohari et al (2017) "Roadside Dust Cleaning System". The literature review carried out for this work deals with the minimization of dust particles on roadsides by designing a portable highway wind turbine. We can eradicate this problem by applying manual labour or any other non-renewable technology, which can be costly. Therefore, to suppress this problem, we initiate a project that uses a renewable source of energy, i.e., wind energy. Wind energy is a rapidly growing, environmentally friendly, dependable, and cost-effective source of energy. As these problems are fatal and life-threatening, the results are taken when implementing the project on a highway, so when vehicles pass on the road, this causes rotation in the blades of turbines. The energy generated by the system is sufficient to drive the vacuum pump. The dust particles on the roads are easily removed.

Leatal studied on "The Health Risk of Road Dust in Human Being". These studies found out different chemicals like lead chromium and copper in children living near Industrial Area and also near high traffic areas. Chromium is cariogenic, which causes birth defects in children and lung cancer in the human body. The experiment was done on animals rather than humans. In animals, barium causes cardiac arrest, renal failure, otoxity, hepatic failure, infertility, birth defects, and LBW; in humans, these toxic effects are found to occur through ingestion. Copper causes gastric

upset, nausea, and vomiting, and inhalation causes missing and pulmonary fibrosis, as well as genetic disease. There is proof of improved microcirculation of the nasal mucus layer in labourers treated with copper particles. Some infectious diseases can be transmitted by dust. In 50% of instances, meningococcal disease, a bacterium of the delicate tissue layer encasing the central nervous system, can cause hallucinations and, if left untreated, death. Finer dust particles have the potential to reach the circulation through the lower respiratory tract, where they can impact all internal organs and cause cardiovascular diseases. Wilson illness is a hereditary condition that causes copper to build up in the liver and cause abnormal liver and kidney failure. Wilson disease patients may experience a worsening of the illness's development with increased copper exposure. Animals that are exposed to aerial copper or consume water that has a lot of copper may develop immunological deficiencies.

III. METHODOLOGY

This research articles main goal is to present the architecture of the system for an urban roadside that would lessen environmental particulate matter. They utilised several engineering simulations models to reduce dust. In conclusion, different data are gathered by putting various systems in place on the road. However, they are not very cost-effective and take a lot of effort to maintain, so we developed our well-designed dividers to collect particulates (highway dust) with very little maintenance and that are more cost-effective than others. has features that are simple to use. Different techniques are used today for the reduction of dust pollutants in the atmosphere caused by air pollution. Some techniques are used to control dust particles, which are mentioned here.

The road sprinkler system: The roadside sprinkler method mentioned explains how the RASS can be integrated into existing civil infrastructure. Aside from the control system, there are only a few changes that need to be made to the current design. As a result, the operation's cost is reduced. Sprinkler devices are installed on the road striping area and curb trenches for the urban street canyon formed by high-rise buildings on both sides. The sprinkler system is powered by water feed and high-pressure water pumps. The sprinkling nozzle's adjustable arc and flow rate ensure that the generated stream or mist covers the entire space above the road. This system's water sources could come from the current municipal water supply system, the fire sprinkler system, or recycled water.

Roadside Dust Cleaning vacuum pump system: The work carried out deals with the minimization of dust particles on the roadside by designing a portable highway wind turbine. So the concept is to extract the maximum power from the tension column formed by vehicles as they go along roads and major highways. The pressure gradient is attributed to the high- and low-pressure bands formed by automotive motion. Air is flowing as a result. This wind generates enough electricity to power a vacuum pump due to the pressure differential. The pump periodically starts suction and removes dust from the road. Because these issues are fatal and life-threatening, we devise solutions. An approach to tackling this problem is to use highway submersible pumps operated by directional wind turbines. The VAWT is designed in such a way that its blades are vertically oriented toward the axis of rotation, so blades will always rotate in the same direction, regardless of the direction of the wind flow. The action of automobiles on roadways generates wind, which has always been guaranteed to persist in one location.

IV. RESULTS

The road dust vacuum system is used to gather a lot of dust. In order to drive the turbine blades as automobiles pass by, the project's vacuum pump road dust clearance technology is used while it is being implemented on a highway. The vacuum pump can be run on the energy that the system generates. The dust may easily be removed from the roads.

A sprinkler system is used to purify the air by washing away dust content and preventing particulate matter generation and resuspension caused by running vehicles, with an efficiency of 85%-100%, and to remove snow and ice from the road, with an efficiency of 95%-100%.

V. CONCLUSION

Vacuum pumps are used to remove dust and other particles from the air and roadways. Depending on the pressure, vacuum pumps come in a variety of designs. There are several types of pumps for high vacuum, including primary, booster, and secondary pumps. They are available in wet or dry versions, depending on what medium is being pumped through them. The dust-collection mechanism is quite good. In comparison to standard, manually controlled systems, the price is considerably expensive.



The water sprinkler system is mostly used in many nations to reduce dust. Sprinkler systems aid in the high-scale, 100% reduction of dust particles. For the machinery in this system to last a long time, it needs water of high quality. Vehicles for mechanical water cleansing are employed in this operation. Because automobiles are more expensive, they require more gasoline and oil to operate. The scale of the necessary water is expanding, which gradually raises its cost.

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