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ECO-SOCIAL PAVEMENT

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ABSTRACT

Due to the increasing population and its large use of vehicles the pollution and its effects on human being is increasing in the urban cities and hence this gave the idea of Eco-Social pavement to come into existence. In this project an experimental study is carried out for reducing vehicular pollution and storm water disposal. This study includes the step wise procedure for construction of Eco Social pavement. The field survey consist the material selection for making of pavement and collecting samples for testing. The lab work consist testing ofcollected samples for proper selection of material for work as per the standard maintained in IS code. The constructed pervious concrete block of sizes 38cm×25cm×8cm by using aggregate of sizes 10mm, 6.3mm, and 4.75mm with TiO2 coat on surface of pavement for making of Eco Social pavement. Three previous block of each aggregate is used for testing strength, infiltration rate and pollution control test.

KEYWORDS : Pavement, Eco-Friendly

INTRODUCTION

Today is the era of industrialization, globalization, and modernization. Due to this 3 "inaction" the nature in 21 century is turning towards devastation. The green cover of earth is reducing hence the problems like global warming is arising. But it is not harmful yet. However in upcoming years these problems may arise more, hence proper steps need to be taken today. Some ecological and social problems in any metropolitan city are,

1. Increasing population.
2. Traffic and industrial pollution.
3. Storm water and drainage problems.
4. Road accident.
5. Health condition.

These are just the highlighted problems which are creating a negative impact on urban cities. The people from cities are now migrating towards the safe areas where pollution will be minimum as well as less disturbance. But there migration is also increasing new load on new areas where they are supposed to live. This cycle is going on increasing day by day. And it is sure that, "that day is no long when we will be the killer of ourselves". These problems are arising due to vehicular pollution and ineffective storm water disposal. For that reason the road system is partly responsible for pollution because the road surface does not contribute to control the pollution that's why the exhaust system of vehicles directly emits the pollution in to the atmosphere. Most of the pavements are impermeable

So there are no attempts made by vehicular industry to make their exhaust downward. Because there is no medium (pavement) underneath that can absorb and reduce the pollution. It is true that the new innovation of "Catalytic converter" in vehicular industry helps to minimize the pollution, But as vehicles becomes old the efficiency of catalytic converter decreases. Hence our attempt is to make "ECO-SOCIAL Pavement".

Literature Review

General:

This project is an innovative attempt to reduce vehicular pollution and storm water disposal on roads in metropolitan cities. Many attempts were carried out by various authors and researchers in the field of environment, vehicular industry, and construction of pavement to minimize the vehicular pollution and storm water disposal. For the purpose of this study, the literature related to the various application of

titanium dioxide, photocatalytic reaction of TiO_2, design of pervious pavement, mix design etc. are studied. Out of vast literature survey that has been referred, few important ones are noted below which are worth in the project.

Maria Burton *et.al.*(2011)[1], Presented that the titanium dioxide (TiO_2) is used to reduce harmful emissions at street level and benefit a cleaner living environment for the public. Unlike traditional non-pervious pavements, the high porosity and surface roughness of pervious concrete pavement allow more TiO_2 particles to have direct contact with UV lights and thus improve removal efficiency. The open pore structure of pervious concrete might also protect TiO_2 particles from traffic loading and environmental weathering. In addition to being a sustainable transportation facility for storm water runoff management, pervious concrete pavement, when coated with TiO_2 and widely implemented in urban roads and highway shoulders, may result in improved air quality and thus a multi-phase cleaner transportation environment for future generations.

`Luigi Cassar *et.al.*(2014)[2], Presented the dual effect of the cement, an invaluable contribution to the quality of life in the world's cities and an extremely attractive product for future construction and modernization projects as well as reducing the visible effects of environmental pollution, it helps to ensure cleaner, more breathable air. According to a study, walls that are coated with the product from Italian cement reduce nitrogen oxide content in the surrounding air by approximately 70 percent.`

Objectives:

1. The objective of this study is to evaluate the effectiveness of TiO_2 treated pervious concrete for their capability of pollutant reduction, maintaining the infiltrating characteristic of the pervious concrete, and withstanding environmental damage.

2. TiO_2 distribution for each application method was analyzed using a setup to evaluate the pollutant removal efficiency due to the photocatalytic effect of the TiO_2.

3. Because a major focus of this application is in the transportation environment, three different gaseous pollutants that are present in automobile exhaust were tested the pervious concrete. And NO. Infiltration was tested to ensure the surface.

MATERIALS & METHODS

A. Materials

Following materials are used for making Concrete:

a) Cement – Ordinary Portland cement of 53 grade is used. The cement has been tested for various properties has been tested for various properties as per IS 4031-1988 & formed to be confirming to various specification of IS: 12269-1987 having specific gravity of 3.0.

b) Coarse Aggregate – Hard granite broken stones of size 10, 6.3, 4.75mm were used as coarse agg. (Sp.gravity-2.75).

c) Water – Locally available portable water confirming to IS 456 is used.

d) Titanium dioxide (TiO_2)

Methodology adopted for Eco-Social Pavement:

This paper involves evaluating the environmental effectiveness of a variety of TiO2 surface treatments on pervious concrete pavement. The goal is to find the effectiveness of Eco-Social pavement in a real traffic environment for controlling vehicular pollution and effective storm water disposal. To achieve the project goal, a four-step project procedure is followed:

1) Mix design and sample preparation.
2) Measurement of porosity.
3) Measurement of infiltration rate.
4) Pollution control test.

Infiltration Test

Pervious concrete allows water to infiltrate completely through it. The infiltration characteristics of the pervious concrete were determined before and after the surface coating applications. The test followed the ASTM Standard C1701 (2009), but was applied to the smaller scale samples by using a smaller 4-inch diameter pipe. The pipe was attached to the sample surface using plumber's putty at two locations, centered at 3 inches (76.2 mm) from the left and right sides of the sample. **2000 mL** of water was poured through the pipe and timed. Each side (left and right) of each sample was tested 3 times, and the overall average infiltration rate for each sample was calculated. The infiltration rate was calculated as shown in Equation below, where d is the diameter of the pipe and t is the infiltration time.

The infiltration rates of the 10mm samples were acceptable, with fast rates ranging from **17.37-26.86 mm/s.** The infiltration rates of the **4.75mm** samples were not so fast, with rates ranging from **3-8.55 mm/s.** It is possible that the two samples with the same porosity had different infiltration rates because of differences in connectivity of the voids within the internal structure of the samples. The high degree of variability in infiltration exists because the void connectivity variability is not accounted for by porosity.

Pollution control Test:

This test was conducted to check the efficiency of Eco-Social pavement to absorb vehicular pollution. A was made to make test sample similar to the vehicular condition on the roads. For testing the absorbing capacity of vehicular pollution of pervious pavement we have made a glass box of size 40cm×40cm×40cm. The round hole is left for inserting the

pipe from tail end of vehicle exhaust to few centimeters above the pavement. The setup of the concept of the test procedure on pollution control. The above set up is made similar to the practical working of pavement on the pavement. The test procedure adopted for the above set up consists; PUC reading of vehicle is taken prior to emission of pollution in to the glass box. The exhaust from vehicle is then emitted on the pavement which is kept in closed glass container. The sufficient time is given to accumulate the pollution in the glass container. The emission of pollution is stopped and the entry whole is sealed with sticker to prevent the escape of pollution. Then pavement is kept in sun light for photo catalytic reaction and the readings of PUC are taken at successive interval **of 2 sec, 5 sec, 10 sec, 15 sec, 20sec, and 30 sec respectively.** The test sample is carried for three or more time and the average reading is analyzed.

Relevance to the Field:

This research will be helpful in solving the vehicular pollution and storm water problem in metropolitan cities (Delhi, Pune, Mumbai, Chennai, Kolkata, etc.) The following relevant areas would be the key application of ECI-SOCIAL PAVEMENT.

1. Traffic Signals- In traffic areas vehicle stops for waiting for signals, during this period all the vehicles are in ON condition and maximum pollution come from exhaust due to improper combustion of fuel, hence implementation of pervious concrete made with 10mm uniform graded aggregate and surface TiO_2 helps to neutralize the hazardous gases and compounds (NO_2, VOCS, CH_4, NH_3) and the same pavement also reduces the storm water accumulation. This pavement also helps to rain water harvesting by road pavement.

2. Toll plazas- On toll plazas vehicles stops for giving toll hence here also chances of concentration of pollutants from vehicles. Thus by implementing this pavement Eco-social zones are created.

3. Parking areas- In parking areas the issues are accumulation of rain water and pollution by vehicles. These problems are controlled by application of eco-social pavement.

4. Foot path- Walk way in garden, open impervious areas around buildings- the valuable rain water runs off on impervious area and results in wilting of surrounding greenery, but pervious pavement allows water to percolate to ground and makes rejuvenation of ground water table and greenery.```

CONCLUSION

Because pavement has large surface area that is in contact with polluted air, treating pavements with TiO_2 reduces harmful emissions at street level and benefit a cleaner living environment for the public. Unlike traditional non-pervious pavements, the high porosity and surface roughness of pervious concrete pavement allow more TiO_2 particles to have direct contact with UV lights and thus improve removal efficiency. The open pore structure of pervious concrete also protects TiO_2 particles from traffic loading and environmental weathering. In addition to being a sustainable transportation facility for storm water runoff management, pervious concrete pavement, when coated with TiO_2 and widely implemented in urban roads and highway shoulders, results in improved air quality and thus a multi-phase cleaner transportation environment for future generations.

The test conclude that there is 84 % of CO removal and near about more than 50% nitrogen removal in the various form. The particulate matter and carbon ash settles on the surface of the pavement.

This project provides base for future ecofriendly environment in urban areas. There is need of constructing the flexible exhaust system of vehicles so as to take dual advantages of pavement and vehicle. There are certain advantages and disadvantages with the construction of Eco-Social pavement.

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