

A Research Study on Nano Technology for Highway Infrastructure

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Abstract: *Nanotechnologies are a quickly extending territory of research in highway infrastructure. This is due to self cleaning, self vibration damping, and structural health monitoring and self healing properties of it. This paper focuses on the advancement of important nanotechnology and its effect on roadway designing practice is presented for widening vision and inspiring the creativity of highway engineering keeping in viewpoint safety, durability, financial aspects and maintainability of the transportation framework of India is considered.*

Keywords: Nanotechnology, Infrastructure, Health, Highway.

Introduction:

Nanotechnology has changed and will seek after to change our observation, desires and capacities to control the materials world. Many orders of Civil disciplines, in conjunction with plan and development procedures can be profited from this innovation. This paper investigates the vision in making the roadway structure with the assistance of nanotechnology material. The investigation of about nano science and different nano particles potential points of interest of Nano silica, smaller scale silica, carbon nano tubes, Nano TiO₂, Nano phosphorus and their execution in transportation field are shown in this paper. The article additionally accentuates on the modern request and utilization of nanotechnology for comprehensions moving toward transportation structure challenges is prescribed. Transportation arranging concentrates on the techniques required to give, work and manage the obliged infrastructure to allow vehicles to travel. The objectives of transportation designing can be portrayed as the supply of a protected, toughness, productive and reasonable facility for the improvement of goods and people. In whatever is left of this paper the investigation and potential usages of nanotechnology in transportation infrastructure are discussed around these limits. TRG demonstrated that it is basic to in like manner fulfill the vision of feasible and facilitated multi-particular transportation foundation for the country. At this moment, there is no legitimate stage in India for specialists over all techniques for transport, to get together and exchange thoughts and data. In like manner, there is no normal road in India at present to order and distribute the examination writing over all transportation parts and modes for better between

modular comprehensions. TRG wishes to expansion this opening by giving such a phase/road in India and get the opportunity to be assistant in the general advancement of the India.

Research Study of Nano Materials Application:

The frames part of the supply of a concrete transportation infrastructure facility as far as enhancing the inside material properties. Transportation goals safety, durability, economics and sustainability can be upgraded utilizing nanotechnology and Nano materials.

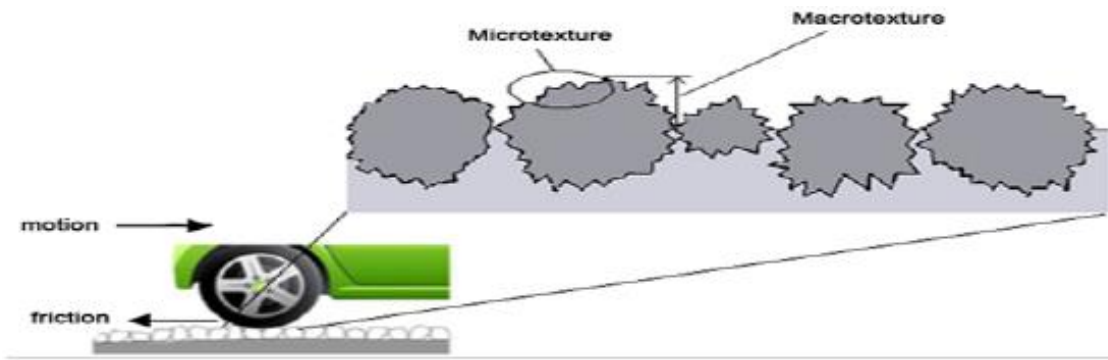
Safety: Driving safety is of importance in the transportation infrastructures. Skid resistance has for some time been perceived as the most vital parameter in diminishing highway user crashes particularly in wet conditions. The learning of the friction coefficient and skid resistance is incredibly huge information for safety redesign of roads. Some Expressway failed to control accidents as tyre blowouts continue to cause accidents. Information of the most recent eight months, since the expressway was thrown open, demonstrates that almost 40% of the 20 accidents, which left 10 people dead and a few others harmed, have been because of tyre blasts. A RTI answer has uncovered that over speeding has been the primary driver of accidents in larger than 700 cases out of 2905 accidents. In larger part of 320 cases trust burst brought about accidents. Upwards of 427 individuals have lost their lives, RTI additionally uncovered. Main reasons is to excessive heating of tyre which is beyond their designed rating due to increased friction, high speed driving and frequent braking which finally result in tyre bursting. From the writing study we can state as indicated by NCHRP many components influence friction of pavements, including micro texture, macro texture, materials properties, and ecological conditions, for example, temperature, water, and snow. The American Concrete Institute reported that previous attempts to increase pavement friction primarily focused on creating different surface textures or macro texture. As per Paine, macro texture can lessen the likelihood of vehicle hydroplaning by expanding the frictional qualities of wet pavement. Vehicle crashes on wet pavements are 3.9 to 4.5 circumstances as likely as in dry conditions. Macro texture is useful in lessening vehicle crashes in wet conditions.

Enhancing Road Safety using Nano Material:

The next generation concrete surface is the first new concrete pavement texture introduced in the last 20 to 30 years in the United States. This next generation surface likewise has the quietest texture developed, for the most part through macro texture modification, for routine concrete pavements. Pavement surface, portrayed by micro texture, macro texture, and mega texture, is a property used to show the practical state of roads and can be characterized as the deviations of the pavement surface from a planar surface as shown in figure. These deviations happen at three levels that rely on upon the wavelength (λ) and the peak to peak amplitude (A). Micro texture, macro texture, and mega texture are characterized as takes after:

- Micro texture: $\lambda < 0.5$ mm and $A = 1$ to 500 μm ,

- Macro texture: $\lambda = 0.5$ to 50 mm and $A = 0.1$ to 20 mm, and
- Mega texture: $\lambda = 50$ to 500 mm and $A = 0.1$ to 50 mm.



Micro texture and Macro texture

Micro texture can be enhanced by utilizing nano materials, which consists of particles at scales underneath 100 nm. The utilization of nano materials could be a promising and progressive device for engineering applications. The writing overview uncovers that nano silica, Nano lotus leaf, and nano fibers can be connected in concrete pavements. As indicated by Flores et al., nano silica enhances the compressive quality of Portland cement mortar. The principle helpful impacts of nano silica on the microstructure and on the execution of concrete based material incorporate a change in the aggregate mortar contact zone that outcomes in a better bond, a reduction in segregation, an acceleration of the hydration process, and the creation of small size crystals and clusters of calcium silicate hydrate (C-S-H) during pozzolanic reaction.

Night Visibility:

Since most accidents happen during the night on account of lessened visibility, the traffic designer must endeavor to enhance night visibility all around. A critical component is the measure of light which is reflected by the road surface to the drivers' eyes. Glare brought about by the impression of approaching vehicles is unimportant on a dry pavement however a vital component is when the pavement is wet. Poor visibility can be enhanced by utilizing Nano phosphorous material to exploit road markings and additionally right and left edges of the road to manage the vehicle. The potential usage of nano phosphors with road surfacing materials or paints for this aim was evaluated at CSIR. Nano phosphors are Nano scale crystalline structures with a size depend band gap that can be adjusted to change the shade of light. On the off chance that the road can go about as the wellspring of the light is made luminescent it can assume a part in enhancing road safety as the source of the light won't be subject to outer power and the utilization of a mechanized vehicle any majority.

Durability:

The present situation of India is not really 2 percent of the country's road length developed from concrete; there is great degree for enhancing the life of pavement and quality of roads through concretization as it offers a few particular points of interest over streets with bituminous surfaces. We

proposed utilizing cement for road development in light of the fact that it is far durable and less expensive to keep up than bitumen despite the fact that it is generally costly at the start. The thought is that utilizing cement will cut down the cost of upkeep fundamentally.



India to stop paving any more roads with Bitumen Roads

Bitumen can at present be utilized, yet just if detailed project study propose that clearing with cement is excessively difficult or would be additionally 20% costly than bitumen.

Economical:

The customer for most transportation designing facilities is the overall population, and in this manner the greater part of these tasks are subsidized through citizen cash or if nothing else facility client cash. It is along these lines required to ensure that the course of action of transportation facilities is also done in the most saving way possible. Both beginning advancement and ceaseless upkeep costs along these lines ought to be surveyed. Starting cost of development is higher when Nano materials are utilized as a part of pavement yet it increment durability and decrease overall life time maintenance cost. Nano scale sensors and gadgets may give practical consistent checking of the structural honesty and execution of bridges, tunnels, rails, parking structures and pavements asphalts after some time. Nanos cale sensors, particular gadgets, and diverse improvements contributed by Nano electronics can in like manner support a redesigned transportation foundation that can talk with vehicle based frameworks to help drivers keep up path position, avoid crashes, conform fly out courses to stay away from blockage, and upgrade drivers' interfaces to locally accessible gadgets. Nano and Micro scale electrical mechanical foundations sensors have been made and used as a piece of improvement to screen or possibly control the earth conditions (e.g. temperature, clamminess, smoke, hullabaloo, etc.) and the materials/structure execution (e.g. push, strain, vibration, breaking, disintegration, etc.) in the midst of the structure's life. Nano sensor ranges from 10-9m to 10-5 m which could be embedded into the structure in the midst of the advancement methodology. The general organization life of foundation can be extended through the change of the resistance of the infrastructure to ecological impacts.

Sustainability:

In India, roads give access to business, method for transporting agricultural deliver and access to human services and social administrations. The roads that are being built now will be ready for maintenance and rehabilitation in the next five to ten years. To the extent the potential effect of nanotechnology on transport foundation the fixation would be thusly again lies in the zone of alteration of existing materials, their general application in the framework, or through their creation or isolating them from the earth regardless. Materials can be adjusted to empower improvement at lower vitality levels (i.e. cut down temperatures) to cut down the vitality necessities for the advancement methodology.

Conclusion:

In view of the data examined in this paper, the going with conclusions are drawn that nanotechnology is a rapidly augmenting region of research where novel properties of materials fabricated on the nano scale can be utilized for the merit of transportation infrastructure. Despite the fact that the cost of nanotechnology-empowered materials and gadgets may prevent their across the board application for interstate infrastructure at the present stage, their cost is relied upon to drop sooner rather than later. What's additional, the advantages from nanotechnology's application could legitimize the extra cost. In any case, the helpful changes that nanotechnology may convey to parkway foundation could be minimized if interstate infrastructure experts need proper vision and attention to potential nanotechnology applications for roadway designing.

References:

1. Abdullah M E, Zamhari K A, Buhari R, Kamaruddin N H M, Nayan N, Hainin M R, Hassan N A, "A review on the exploration of nanomaterials application in pavement engineering" 2015. Vol. 73 pp 69–76.
2. Al-Jumaily I A S, Naji N and Kareem Q "An overview on the Influence of Nano Materials on Properties of Concrete" Int. J. Innov. Res. Sci. Eng. Technol. 4, 2015 pp 81–92.
3. Anon "India moving towards rigid pavement" - India first NewsPortal on Projects 2017.
4. Anon, Mohammad Alauddin "Safe , Quiet and Durable Pavement Surfaces" 2009 Author's Declaration [5] Chithra S, Senthil Kumar S R and Chinnaraju K "The effect of Colloidal Nano-silica on workability, mechanical and durability properties of High Performance Concrete with Copper slag as partial fine aggregate" 2016 Constr. Build. Mater. 113 pp 794–804.
5. Du H, Du S and Liu X "Durability performances of concrete with nano-silica" 2016 Constr. Build. Mater. 73 pp 705–12.
6. Faruqi M, Castillo L and Sai J "State-of-the-art review of the applications of nanotechnology in pavement materials" 2014 J. Civ. Eng. Res. 5 59.

7. Gonzalez M, de Oliveira Lima A and Tighe S L "Nanoconcrete for Rigid Pavements: Abrasion Response and Impact on Friction" 2014 Transp. Res. Rec. J. Transp. Res. Board 3745 pp 28–37.
8. Gonzalez M, Cao J and Tighe S, "Sound Absorption and Friction Properties of Nano-Lotus Leaf Coated Concrete for Rigid Pavement" 2016 Vol 22 pp 445–450
9. Ganesh V K "Nanotechnology in Civil Engineering" 1857 8 pp 96–109.
10. Kurapati Srinivas "Nanomaterials for Concrete Technology" 2014 Int. J. Civil, Struct. Environ. Infrastruct. Eng.Res. Dev. 4 pp 79–90.
11. Mehta P K and Monteiro P J M 2006 Concrete: microstructure, properties, and materials.
12. Mataei B, Zakeri H, Zahedi M and Nejad F M "Pavement Friction and Skid Resistance Measurement Methods: A Literature Review" 2016 Open J. Civ. Eng. 6 pp 537–65.
13. Mohan D, Tiwari G and Bhalla K "Road safety in India status report 93" 2015.
14. Nili M, Ehsani A and Shabani K "Influence of Nano-SiO₂ and Microsilica on Concrete Performance" 2014 Proc. Second Int. Conf. Sustain. Constr. Mater. Technol. 7.
15. Smith, K L, J.W. Hall L T-G "Guide for Pavement Friction Contract" 2009 Final Rep. NCHRP Proj. 01-43 1-65-91.
16. Saloma, Nasution A, Imran I and Abdullah M "Improvement of concrete durability by nanomaterials" 2015 Procedia Eng. pp 125 608–12.

