

Literature review on use of nanotechnology in flexible pavement construction

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Abstract—We know that waterlogging damages the pavement heavily. Use of Nanotechnology in waterlogging area to make soil water proof, results in increment of CBR under wet condition and reduces the damages. The other benefits achieved are likely negligible maintenance and increase in overall life span of road. As the thickness of pavement decreases, material requirement reduces ultimately which is an added advantage. This paper discusses the recent developments in use of nanotechnology in pavement construction.

Keywords— Nanotechnology, Flexible Pavement Design, Improving C.B.R in wet conditions, Vehicle damaging factor

I. LITERATURE SEARCH

Syed Sabihuddin (2015) has done a work use of nanotechnology in Road materials on behalf of a range of civil engineering mechanism is discussed. In view of the fact that the use of nanotechnology controls the topic at the minute level, the properties of matter are sincerely affected. Strength, durability and other properties of materials are dramatically affected under a scale of nano meter(10-9m). The properties like self-sensing, self-rehabilitation, self-structural health monitoring, self-vibration damping, self-cleaning and self-healing are studied. Nanotechnology offer infinite amounts of improvement in the civil engineering field. It has help improve the quality of and solved many issue with building materials such as concrete and steel. The use of nanotechnology has also helped formed more efficient also sustainable materials such as self-cleaning and self-repairing concrete and window.

Abdullaha et al. (2015) have done improvement in the performance of asphalt mixture; the virgin asphalt binder needs to be modified with suitable modifiers. There are various types of modifiers available in market and it is clearly stated and established in most of pavement standard specification. Nowadays, pavement technologist and researchers had put their interests on nanotechnology and they had found that polymeric Nano composites have shown its effectiveness through the modification of virgin asphalt binder with certain portion of nanomaterial. In addition, many studies have demonstrated that nanomaterial have significant effects in improving the engineering properties of asphalt binder and mixture. Nanotechnology has the potential for improvements in the field of pavement material and construction in future. In flexible pavement application, researchers focused on the modification of binder using nanoclay, nano-hydrated lime and carbon nanoparticles. In general, all nanomaterials have stable in storage and can be effectively used as a modifier to improve the physical and rheological properties of virgin asphalt binders.

Faruqi et al. (2015) have done a work in this paper reviews Nanotechnology is the understanding and control of matter at the nanoscale of dimensions between approximately 1 and 100 nanometers, where unique phenomena enable novel applications. The article is organized into six sections, namely: applications of nanotechnology in concrete pavements, application of nanotechnology in asphalt pavements, application of nanotechnology in soils, cost-benefit, challenges, and trends to the future. It is observed from this review that nanoscience can help improve the performance of transportation construction materials and this may eventually lead to the extension of their life cycle.

Kaizar Hossain and Shaik Rameeja(2015) researched on Nanotechnology is an extremely wide term, the definition of which varies from field to field. Most commonly, nanotechnology is defined as “the understanding, control, and restructuring of matter on the order of nanometres to create materials with fundamentally new properties and functions”. Nanotechnology refers to the manipulation of individual atoms and molecules, by engineering matter at the atomic level. At the Nano scale, familiar materials can have dramatically different properties: changes can affect colour, elasticity, strength, conductivity, and other properties. Nanoparticles also have an increased surface area relative to their volume, making them especially reactive and useful in energy storage, for making composite materials.

Saurav(2014) has done a work on the Application of nanotechnology in pavement materials for various civil engineering works is discussed. Since the use of nanotechnology controls the matter at the atomic level, the properties of matter are seriously affected. Strength, durability and other properties of materials are dramatically affected under a scale of nano meter(10-9m).This paper also reveals how the use of nano technology makes concrete more stronger, durable and more easily placed. Different types of nano materials used are discussed with its wide applications.

Zhu et al. (2014) said that it is summary of the state-of-the-art report on Application of Nanotechnology in Construction, which is one of the main tasks of a European project – Towards the setting up of a Network of Excellence in Nanotechnology in Construction (NANOCONEX). The paper first presents background information and current developments of nanotechnology in general. Then, the current activities and awareness of nanotechnology in the construction industry are examined by analysing results of a survey of construction professionals and leading researchers in the field.

Zala et al. (2013) have done a work on Benefits of using Nano technology to make soil water proof are like increment in California Bearing Ratio (C.B.R) results in wet conditions, decrement in maintenance or negligible maintenance, increase in life span of road, less materials required for construction of road because reduction in thickness required of pavement.

II. CONCLUSION

As we know pavement based design and thickness of sub- base depends upon CBR value so increment in CBR value results in reduction of thickness of sub-base, which means materials require for sub-base are having less quantity.

Conventional method of pavement making is having less initial cost but it requires the high maintenance costs. Roads are very susceptible to water hazards every year, which is a huge headache to all contractors and developers, on the other hand pavement making using nano technology may have high initial cost but it has nearly no maintenance costs which will affect the economy of road long-time.

Durability As we know the conventionally made roads are not very long lasting, they hardly remain in good conditions for 10 years. But having Nano-technology as all problems due to water are eliminated, the roads life for good conditions increases up to 20-25 years.

REFERENCES

- [1] A. Paul Alivisatos, Charles M. Lieber, Heather L. Tierney, 2014, “Nanoscience and Nanotechnology”.
- [2] A Saurav, 2012, “Application of Nanotechnology in Construction”.
- [3] Ali Akbar Firoozi, Mohd Raihan Taha, Ali Asghar Firoozi, 2014, “ Nanotechnology in Civil Engineering”, EJGE.
- [4] Amit Srivastava and Kirti Singh, 2011, “Nanotechnology in Civil Engineering and Construction”.
- [5] B. BHUVANESHWARIS, SAPTARSHI SASMAL, NAGESH R. IYER, Nanoscience to Nanotechnology for Civil Engineering – Proof of Concepts
- [6] Dr. L. B. Zala, Prof. Jayeshkumar Pitroda and Mr. Pushpak Luhana, jan 2013, “Nanotechnology in Flexible Pavement”, International Journal of Scientific Research.
- [7] Faruqi M., Castillo L. and Sai J., 2015, “States-of-the-Art Review of the Applications of Nanotechnology in Pavement Materials”, Journal of Civil Engineering Research 2015
- [8] Heather L. Tierney, 2011, “Nano Waterproofing”.
- [9] Jun Yang and Susan Tighe, 2013, “A review of advances of Nanotechnology in asphalt mixtures”, Journal of Civil Engineering Research 2013
- [10] Kaizar Hossain and Shaik Rameeja, 2015, “Importance of Nanotechnology in Civil Engineering”.
- [11] Mohd Ezree Abdullaha, Kemas Ahmad Zamharia, Rosnawati Buharia, Nurul Hidayah Mohd Kamaruddina and Nafarizal Nayanb, 2015, “The Exploration of Nanomaterials Application in Pavement Engineering”.
- [12] Perumalsamy Balaguru and Ken Chong, 2006, “Nanotechnology Asphalt: Research Opportunitie”.
- [13] Somnath Ganguli, Manoj Nallanathel and S. Needhidasan , “Nanotechnology in Civil Engineering Present Scenario with Practical Application”.
- [14] Syed Sabihuddin, 2015, “Application of Nanotechnology in Civil Engineering”.
- [15] W. Zhu1, P.J.M. Bartos1 and A. Porro, Oct 2014, “Application of nanotechnology in construction”.