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## A REVIEW ON NANOTECHNOLOGY IN CIVIL ENGINEERING CONSTRUCTION

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### ABSTRACT

Nanotechnology has vast future. Nanotechnology is a broad term that covers many areas of science, research and technology. Nanotechnology involves understanding matter at the “nano” scale.

Many research works are done in soil improvement and nano materials for soil improvement is very promising and enhances our understanding of relationship between Nano Technology and Geotechnical engineering through latest nano approaches.

Any construction works needs to be carried out in planned way. The requirement of raw materials, labour tools and equipments are to be put together inspite of their shape and size, considering their characteristics we can utilize the effect in nano scale. The properties should remain the same for the nano material and shape the new construction in such way that it decay with the environment effects should be minimum. The Nano Technology can innovate the Civil Engineering construction works.

*Keywords- Characteristics, Nanotechnology durability.*

### I. INTRODUCTION

The increasing demands of technology to develop infrastructure to meet the need of mass in required time widen the vision of Civil Engineering Nano Technology. Nanotechnology control and manipulate the matter at the level of individual atoms and molecules in the range of 0.1-100nm (less than 100nm). It creates the properties and functions of material device and system with new potential and vision.

Nanotechnology can be applied in many fields like imaging, measuring modeling and manipulating matter at this length scale. A nanometer is one-billionth of a meter.

Nanotechnology carries enhanced properties, low maintenance coatings, better properties of cementitious materials, reducing the thermal transfer rate of fire retardant and insulation, various nanosensor, smart materials, intelligent structure technology etc. The properties like self-sensing, self rehabilitation, structural health monitoring and self healing are the main features where nanotechnology are applied for. The gap between present construction technology and nanotechnology is to be bridged with research work considering economy as the main factor.

The use of nanotechnology towards development in Civil Engineering will give more economical infrastructure, low cost maintenance with longer durability.

### II. APPLICATIONS OF NANOTECHNOLOGY

The construction industry was the only industry to identify nanotechnology. Construction has lagged behind other industrial sectors where nanotechnology R&D has attracted significant interest and investment from large industrial corporation and venture capitalists. The nanotechnology characteristics can significantly fix current construction problems, and may change the requirement and organization of construction process. Nanotechnology is widely used in studying concrete properties like hydration reaction, alkali silicate reaction (ASR) and fly ash reactivity. Addition of Nano-silica leads to the densifying of the micro and nanostructure resulting in improved mechanical properties. With the addition of nano-SiO<sub>2</sub> part of the cement is replaced but the density and strength of the fly-ash concrete improves particularly in the early stages. The addition of small amount of carbon nanotube (1%) by weight could increase both compressive and flexural strength. Two nano-sized particles that stand out in their application to construction materials are titanium dioxide (TiO<sub>2</sub>) and carbon nanotubes (CNT's). The former is being used for its ability to break down dirt or pollution and then allow it to be washed off by rain water on everything from concrete to glass and the latter is being used to strengthen and monitor concrete.

Fire-protective glass is another application of nanotechnology. This is achieved by using a clear intumescent layer sandwiched between glass panels (an interlayer) formed of fumed silica (SiO<sub>2</sub>) nanoparticles which turns into a rigid and opaque shield when heated. Nanotechnology enabled sensors/devices also offer great potential for developing smart materials and structures which have ‘self-sensing’ and ‘self-actuating’ capability. Cyrano Sciences has developed electronic noses based on an array of different polymer nanometer-thin film sensors. Researchers employed plasm technology in order to transfer their properties to carbon fibre reinforced plastics since these micro- or nanoparticles must be highly homogeneous, and sometimes very closely bound to the polymer. Research into nano-cement (made of nano-sized particles) has the potential to create a new paradigm in this area of application of fire resistant materials.

In nutshell the following are the area where nanotechnology are in the stage of application:

- a) nanotechnology and concrete.
- b) nanotechnology and Steel
- c) nanotechnologies : water purification
- d) nanotechnologies and coating
- e) nanotechnology in glass
- f) nanotechnology in fire protection and detection
- g) nanotechnology in geotechnical engineering.
- h) nanotechnology in wood

### III. NANOTECHNOLOGY IMPACT ON CONSTRUCTION

#### ADVANTAGES:

- i) When nanotechnology is applied concrete cuts down construction schedules with reducing labour intensive (and expensive) tasks. It also reduce the cost of repair and maintenance.
- ii) The paint and coatings industry have four to six fold increase in wear resistance, with double toughness and bond strength.
- iii) The potential global market of nano composites is estimated to bounce in coming next two decades.
- iv) The market for the fire protection system is expected to grow by double.
- v) Nano agents for asphalt used as self repairing asphalt, healing and rejuvenating along with self assembling polymers improve asphalt mix.
- vi) Nano sensor for construction materials are available at minimum cost. These nano sensor are fully integrated and self powered which provides failure indication and are forecasting mechanism in high-capital infrastructures.

#### DISADVANTAGES

- i) Small production scale and higher cost are the main barriers to use nanotechnology in construction.
- ii) The type of workers who are employed in nanotechnology industries are new and they required to be acquainted with some field applications as well as research works.
- iii) Since the materials are of nanosize, nano particles negatively affects the respiratory and digestive systems and skin or eye surface of the workers.
- iv) Nanotechnology policies require cooperation between R&D Wings, Government agencies as well as construction industries.
- v) Commercialisation of any products take a long time for example a concrete without reinforcing bars are expected to be commercialize by 2020.

### IV. CONCLUSION

Presently nanotechnology is not a new application, but it is an extrapolation of current methods and techniques to a new scale. Nanotechnology is limited to it high cost and effects on environment as well as health. Still there is vast scope of research works in Civil Engineering are as of constructions and material development. Development of LED and OLED technology and progress in the insulating materials and smart glazing, the vision for buildings to meet their own energy requirement will became a reality in near future. Nanoparticles might also be engineered to act as functional nanosensors and devices that can be extensively mixed in the soil mass or used as smart tracers for in situ chemical analysis, characterization of groundwater flow, and determination of fracture connectivity, among other field applications.

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