EMERGING OF NEW TECHNOLOGY INROAD CONSTRUCTIONS: NANO TECHNOLOGY

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ABSTRACT

This paper addresses the current developments regarding use of Nano-materials in construction industry.Nanomaterials as a field can be defined as a study of materials with morphological features on the nanoscale, especially those that have special properties stemming from the nanoscale dimensions. Carbon nanotubes, Titanium Dioxide Nanoparticles, Silicon Dioxide Nanoparticles, Zinc Oxide Nanoparticles, and many more nanomaterials are used in Constructions and all other major fields under Civil Engineering.

This efficient method is used in Highways that means Road constructions it the optimization of behaviour and significantly improves mechanical properties of pavements like durability, skid resistance, etc., It also gives good aesthetic and self-cleaning glasses.Furthermore, Nano-cement and Nano-paint are introduced as the outstanding representations. The main advantage of nanomaterials in Civil Engineering is the Eco-friendly, the cement and concrete reduces the emission of Carbon Dioxide. So that the Global Warming is minimized.

Keywords: **Nano Technology, Nano Particles, Nano Tubes, Asphalt. Etc.**

I. INTRODUCTION

The "Nano" prefix derives from the Greek noun Nanos, meaning dwarf. A nanometre (nm) is one billionth (1 x 10-9) of a meter: the length of about ten atoms placed side-by-side, or 1/80,000th of the thickness of a human hair. The term nanotechnology is an umbrella term that encompasses a vast range of technologies across a number of disciplines involving the manipulation and application of matter, based on its properties at the atomic scal

"Concerning the usual corrosion problems in concrete products,nanotechnology can offer smart solutions providing coatings that 'respond' to external agents with a 'response' that can repair or prevent damage"

1.1 The Area of nanotechnology are used

1. Construction
2. Medicine
3. Chemistry and Environment
4. Energy
5. Automobile Industries

ISBN: 978-81-932074-1-3

6. Agriculture
7. Information and Communication
8. Heavy Industries
9. Consumer Goods
10. Telecommunication etc..,

1.2 In Civil Engineering

Civil engineers deals with designing, building and maintaining the various structures that make civilization function. Roads, bridges, canals, tunnels, traffic systems, public transportation and other structures that operate on a large scale are subject to special considerations that require engineers to account for earthquakes, winds, massive public movement and even military strikes. The special requirements give multiple applications for nanotechnology, from earthquake – resistant building materials to graffiti – resistant subways.

1.3 Nanomaterials

Nanomaterial's as a field can be defined as a study of materials with morphological features on the nanoscale, especially those that have special properties stemming from the nanoscale dimensions. Nanomaterials are classified into two types: Fullerenes, Nanoparticles

1.4 Nanomaterial'swhich are used in Civil Engineering

1. Carbon Nanotubes
2. Titanium Dioxide Nanoparticles
3. Silicon Dioxide Nanoparticles
4. Zinc Oxide Nanoparticles
5. Silver Nanoparticles
6. Aluminium Oxide Nanoparticles
7. Zirconium Oxide Nanoparticles
8. Wolfram Oxide Nanoparticles
9. Iron Nanoparticles

1.5 Carbon Nanotubes

Nanotubes are members of the fullerene structural family and exhibit extraordinary strength and unique electrical properties, being efficient thermal conductors. The expected benefits of carbon nanotubes are mechanical durability and Crack prevention in concrete, Enhanced mechanical and thermal properties in ceramics, Real- time structural health monitoring capacity. They have five times the Young's modulus and eight times (theoretically 100 times) the strength of steel, whilst being 1/6th the density.

1.6 Titanium Dioxide Nanoparticles

It is a white pigment that can used as an additive to cement, paint, concrete, glass windows due to its Sterilizing properties. The abrasion resistance of concrete containing nano-TiO2 is better than that containing the same amount of nano-SiO2. Being hydrophilic gives self cleaning properties to surfaces to which it is applied,

ISBN: 978-81-932074-1-3

because the rain water is attracted to the surface and form sheets which collect the pollutants and dirt particles previously broken down and washes them off. The resulting concrete surface has a white colour that retains its whiteness very effectively.

1.7 Silica Dioxide Nanoparticles

Nano- Silica could significantly increase the compressive strength of concretes containing large fly ash volume at early age, by filling the pores between large fly ash and cement particles. Nano-Silica decreases the setting time of mortar when compared with silica fume (micro silica) and reduces bleeding and segregation by the improvement of the cohesiveness.

1.8 Zinc Oxide Nanoparticles

Zinc Oxide is a unique material that exhibits semiconducting and piezoelectric dual properties. It is added into various materials and products, including plastics, ceramics, glass, cement, rubber, points, adhesive, sealants, pigments and fire retardants. When used for concrete manufacturing, ZnO improves the processing time and the resistance of concrete against water.

1.9 Silver Nanoparticles

The Silver nanoparticles are coated on the surface of any materials, the surface area increases several million times than the normal silver foil. The Nano-silver will affect, in contact with bacteria viruses and fungi, the cellular metabolism and inhibit cells growth. The growth of bacteria and fungi, which causes infection, odour, itchiness and sores.

1.10 Aluminium oxideNanoparticles

The addition of nano-Al2O3 of high purity improves the characteristic of concretes, in terms of higher split tensile and flexural strength. The rate of the pezzolanic reaction is proportional to the amount of surface area available for reaction. The cement could be advantageously replaced in the concrete mixture with nano-Al2O3 particles up to maximum limit of 2.0% with average particle size of 15 nm, the optimal level of nano-Al2O3 particles content being achieved with 1.0% replacement.

1.11 Zirconium Oxide Nanoparticles

Zirconium oxide (or Zirconia) Nano powder or Nano particles are white high surface area particles with typical dimension of 5 to 100 nanometers and specific surface area in the 25to 50 m2/g range. Nano Zirconium shows good aesthetics (Translucency), Superior Physical resistance (hardness, flexibility, durability), Chemical resistance (practically inert) and is very good insulator.

1.12 Wolfram Trioxide Nanoparticles

In recent years, tungsten trioxide has been employed in the production of electro chromic windows or smart windows. These windows are electrically switchable glass that change light transmission properties with an applied voltage. This allows the user to tint or light passing through.

ISBN: 978-81-932074-1-3

1.13 Iron Nanoparticles

Zero valent Iron (ZVI) nanoparticles can be used for environmental remediation of contaminants. They can be used for environmental remediation of contaminants. They can be used for degradation of various organic Contaminants' such as chlorinated organic solvents, organochlorine pesticides, Polychlorinated biphenyls (PCBS) and organic dyes.

1.14 Nanotechnology for Civil Engineering

Nanotechnology can be adopted for several materials and techniques in Civil Engineering to enhance their performance, which includes

- Concrete
- Steel
- Wood and its Products ,
- Glass Coating ,
- Thermal Insulator ,
- Fire protections ,
- Structural Monitoring

II. CONCRETE DEFINITION OF NANO-CONCRETE

Nano-concrete is defined as a concrete made with portland cement particles that are less than 500 nano-meters as the cementing agent. Currently cement particle sizes range from a few nano-meters to a maximum of about100 micro meters. In the case of micro-cement the average particle size is reduced to 5 micro meters. An order of magnitude reduction is needed to produce nano-cement.

Nano-silica for improved compressive strength reducing calcium leaching, water penetration and thus enhancing durability of concrete. Carbon-Nano tubes increase the compressive strength properties which can be used for health monitoring and damage detection. The addition of small amounts of carbon nanotubes can improve the mechanical properties of mixture samples of Portland cement and water.

2.1 Steel

The addition of copper nanoparticles reduces the surface uneven of steel which then limits the number of stress and hence fatigue cracking, leading to increased safety, less need for monitoring and more efficient material use. Vanadium and molybdenum nanoparticles improve the delayed fracture problems associated with high strength bolts, reducing the effects of hydrogen embrittlemant and improving the steel micro-structure. The addition of nanoparticles of magnesium and calcium leads to an increase in weld toughness.

2.2 Wood and its products

Highly water repellent coatings incorporating Silica and alumina nanoparticles and hydrophobic polymers are proper to be used for wood.

2.3 Glass

ISBN: 978-81-932074-1-3

The use of TiO2 nanoparticles to glasses leads to so- called Self cleaning Technology. Fireproductive glass is obtained using fumed silica (SiO2) nanoparticles as a clear interlayer sandwiched between two glass panels which turns into a rigid and opaque fire shield when heated. Tungsten Trioxide can be used for electro chromic window panes.

2.4 Coatings

Nanotechnology is applied to points in order to assume corrosion protection under insulation since it is hydrophobic and repels water from the metal pipe and can also protect metal from salt water attack. Titania Nanoparticles coating can enable self cleaning surfaces. They are also used to enhance the abrasion resistance of surface. Coatings are routinely used as protective barriers against abrasion, chemical attack,hydro-thermal variations and to improve aesthetics. Currently, most of these coatings are in the micrometer range. New materials and techniques are being developed to develop nano-meter thick coatings that are durable and generate less heat due to reduced friction.

2.5 Need of Coatings

- Coatings to reduce corrosion
- Coatings to reduce ingress of harmful chemicals
- Coating to change electrical property.

2.6 Thermal Insulation

Micro and Nanoporiues aerogel materials are appropriate for being core materials are appropriate for being core materials of vacuum insulation panels. Another application of aerigels is silica based products for transpired insulation.

2.7 Fire Production

Fire resistance of steel structures is often provided by a coating produced by a spray-on amentitious process. Nano-cements (made of nano sized particles) has the potential to create tough, durable, high temperature coating. This is achieved by the mixing of carbon nanotubes with the cementious material to fabricate fire composites.

2.8 Structural Monitoring

Nano and micro electrical mechanical system (MEMS) sensors have been developed and used in construction to monitor and / or control the environment conductor and the material / structure performance. Smart aggregate, a low cost piezoceramic based. Multi-functional device, has been applied to monitor early age concrete properties such as moisture, temperature, relative humidity, early age strength development, corrosion and cracking.

III. NANOHOUSE TO BLEND NANOTECHNOLOGY AND CONVENTIONAL MATERIALS IN THE BUILDING INDUSTRY

 ISBN: 978-81-932074-1-3

The Nano house is to represent best practice in sustainable and environmentally friendly housing, in concert with the most recently developed materials. The nanohouse initiative aims to design a new kind of energy in efficient domestic house.Some of the types of technologies under consideration for inclusion in the house include,

- ✓ Protective coatings for furniture effecting from UV protection .
- ✓ Bottles, food containers etc. with tuned optical properties for the enhancement of shelf life of both containers and contents .
- ✓ Self-cleaning TiO2 coated glass.
- ✓ Light coloured paints without glare and dark pigments for paints that do not retain heat.
- ✓ UV/IR filtering and reflecting windows for control of unwanted solar heat.
- ✓ Cold lighting systems for harvesting daylight during the day and use with ultra efficient bright white LED light sources .
- ✓ Water quality control systems that remove pollutants from water, and clean effluent water .
- ✓ Clothes and textiles with reduced need for washing with detergent.
- ✓ Cosmetics such as sunscreens that are transparent yet perform like those that are opaque.

IV. BENEFITS

Nano-particles are used to strengthen building materials and render them more flexible, thus resistant to shock and impact. Research is attempting to develop other applications.

Economical:

- ✓ Long life
- ✓ Maintenance Cost
- ✓ Less Labor
- ✓ Pricing and Profit
- ✓ Customer Satisfaction
- ✓ Market Value

Sustainability:

- ✓ Energy Efficiency
- ✓ Material Consumption
- ✓ Social and Ethical Benefits
- ✓ Reduced levels of several Environmental pollutants.

Why is Nano materials NOT in construction Underutilized?

- ✓ The use of nanomaterials in construction is reduce, mainly for the following reasons.
- ✓ The lack of Knowledge concerning the suitable nanomaterials for construction and their behavior.
- ✓ The reduce Portfolio of Nano products.
- ✓ The lack of details information's regarding the Nano products content.
- ✓ It is a High Costs.
- ✓ The Unknown health risks associated with nanomaterials.

V. CONCLUSIONS

The use of nano particles in cement and concrete reduces the emission of carbon-di-oxide, so that the Global Warming is minimized. The hydration rate for nano-cement components was higher than that of Portland cement. Current efforts are focused on understanding cement particle hydration, nano size silica and super plasticizer additions and sensors.There is also need to investigate other aspects including life cycle assessment of nanotechnology in general and nanomaterials in particular, before deploying the technology for large-scale industrial use in construction.

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