AN INTRODUCTION OF NANOMATERIALS OF CONSTRUCTION

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ABSTRACT

In this we are presenting an introduction of nanomaterials of constructions. It has been demonstrated that nanotechnology generated products have many unique characteristics, and can significantly fix current construction problems, and may change the requirement and organization of construction process. This would significantly help the readers such as civil engineers, architects, contractors for quickly getting an idea of the availability of the nanomaterials that can be considered in the design of sustainable and durable structures. Nanotechnology concerns with the usage of materials falling in range of few to less than 100 nanometers. Nanomaterials offer many improved performance properties for adhesives, concrete, coatings, flooring, glass, lighting equipment,plumbing fixtures and other construction products.

Keyword : - *Nanotechnology, Nanomaterials, Construction, Process, Strucures etc.*

1. INTRODUCTION

Construction Industry has undergone tremendous change in the past two centuries. What affected it most was the industrial revolution and its resultant outcome in terms of steel, cement and other building materials. The twentieth century saw further refinement in the same with even more sophisticated techniques and devices. Now, it has to move in the next phase where inputs are less and lighter, they are smooth and sturdier; they are cost effective, cleaner and sustainable. It has to move towards more sophistication with the help of emerging technologies like the Nanotechnology. While nanotechnology based construction products provide many advantages to the design and construction process, the production of these products, however, require a lot of energy. Also, the nanotubes might cause a lung problem to construction workers. In other words, it creates an environmental challenge to the construction industry as well. Sustainability and environmental issues caused by growing economic development has gained intensive statewide and worldwide attention. Since the construction industry is heavily involved in the economic development and consumes great amount of resources and energy, its impact on environment is significant. Therefore, it is necessary and urgent to regulate the construction and its related performance to sustainable manners. The nanotechnolgy becomes a double-edge sword to the construction industry. More research and practice efforts are needed with smart design and planning, construction projects can be made sustainable and therefore save energy, reduce resource usage, and avoid damages to environment. It is necessary to establish a system to identify the environmentally friendly and sustainable of construction nanomaterials and to avoid the use of harmful materials in the future.

1.1 MATERIALS

Considering the aspects mentioned before, the following sections summarize the evolution of the market and scientific research on the issues accessed in this dissertation, namely focused on materials for structural applications: (i) cement and concrete, (ii) polymers, and (iii) ceramics.

2. VARIOUS NANOMATERIALS IN BUILDING MATERIALS

The main Nanomaterials which could be used in Construction materials are:

2.1 NANO SILICA (SiO2)

Nano Silica mixed in Concrete can improve:
Mechanical Properties Can Control the degradation of the fundamental C-S-H (Calcium-Silicate-Hydrate) reaction of concrete. Can block water penetration and therefore lead to improvements in durability. They also increase strength as well as offering the benefit of monitoring stress levels through the measurement of section electrical resistance.

2.2 TITANIUM DIOXIDE (TiO2)

Titanium Dioxide Nanopowder added to concrete can give:
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. TiO2 is a white pigment and can be used as an excellent reflective coating. It is incorporated, in sun-block to block UV light and it is added to paints, cements and windows for its sterilizing properties since TiO2 breaks down organic pollutants, volatile organic compounds, and bacterial membranes through powerful catalytic reactions. It gives self cleaning properties to surfaces to which it is applied.

2.3 CARBON NANOTUBES (CNT)

Carbon Nanotube addition to concrete can give the benefits like:
CNT is used to strengthen and monitor concrete. The addition of small amounts (1% wt) of CNT's can improve the mechanical properties of samples. Oxidized multi-walled nanotubes (MWNT's) show the best improvements both in compressive strength (+ 25 N/mm2) and flexural strength (+ 8N/mm2).

2.4 OTHER NANOMATERIALS

Other Nanomaterials we have:

- Carbon Nanotubes
- Nanodiamonds
- Nanoceramics
- Quantum Dots
- Nanometals
- Fullerenes
- Nanowires
- Nano and Micro Salts
- Tectomers
- PEG Derivatives
- Phosphonic Acid Derivatives

3. NANOCOATINGS: FOR PROTECTION & HEAT INSULATION

Coatings are expected to constitute the largest application for nanomaterials in construction. Architectural paints, water sealers and deck treatments, and treatments applied during fabrication, such as scratch-resistant coatings on vinyl or wood flooring are meant for protection.
Various Nanocoatings can provide:
Fire Protection
Heat Insulation
Corrosion Protection

4. NANOSENSORS

Nano and microelectrical mechanical systems (MEMS) sensors have been developed and used in construction to monitor and/or control the environment condition and the materials/structure performance. One advantage of these sensors is their dimension. Nanosensor ranges from 10-9 m to 10-5m. The micro sensor ranges from 10-4 to 10-2 m. These sensors could be embedded into the structure during the construction process. 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 and early age strength development. The sensors can also be used to monitor concrete corrosion and cracking. The smart aggregate can also be used for structure health monitoring. The disclosed system can monitor internal stresses, cracks and other physical forces in the structures during the structures' life. It is capable of providing an early indication of the health of the structure before a failure of the structure can occur.

5. NANOTECHNOLOGY BASIC

The new features of construction materials and elements accordingly change the material usage and force and resistance calculations of project design and its related field construction operation and management. This is because the development and application of nanotechnology are relying on the development of other related science and technology such as physics and chemistry that are commonly new to break through at that time. Most promising developments of nanotechnology are fullerene (a new form of carbon, C60) and carbon nanotubes.

5.1 APPLICATION OF NANOTECHNOLOGY IN CONSTRUCTION

Nanotechnology can be used for design and construction processes in many areas since nanotechnology generated products have many unique characteristics. These characteristics can, again, significantly fix current construction problems, and may change the requirement and organization of construction process. These include products that are for:

- Lighter and stronger structural composites
- Low maintenance coating
- Improving pipe joining materials and techniques.
- Better properties of cementitious materials
- Reducing the thermal transfer rate of fire retardant and insulation
- Increasing the sound absorption of acoustic absorber
- Increasing the reflectivity of glass

6. CONCLUSIONS

This would significantly help the readers such as civil engineers, architects, contractors for quickly getting an idea of the availability of the nanomaterials that can be considered in the design of sustainable and durable structures. The coatings incorporating certain nanoparticles or nanolalyers have been developed for certain purpose. It is one of the major applications of nanotechnology in construction. Nanotechnology is the creation of materials and devices by controlling of matter at the levels of atoms, molecules, and supramolecular (nanoscale) structures . In other words, it is the use of very small particles of materials to create new large scale materials . Although more thorough definitions were used by some researchers as well, the key is the size of particles because the properties of materials are dramatically affected under a scale of the nanometer (nm), 10^{-9} meter (m).

7. REFERENCES

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