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Nanoparticles Used in Construction and Other Industries : a Review

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NANOPARTICLES USED IN CONSTRUCTION AND OTHER INDUSTRIES : A REVIEW

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Abstract:

The following study of Nano-particles has wide industrial as well as applicability in future and hence has received much attention. The purpose of the present paper is to provide and review some researches in this field. The topics are related to the particularity, utility, complexity and importance of nano- particles in various emerging fields now a days and also in the future. Nanotechnology plays important role in widening the civil engineering practices and revolutionize the current developments. This paper presents the current development and background information of nanotechnology in civil engineering. Finally this implies in future trend, potential and implications of nanotechnology development in civil engineering towards more economical infrastructure, low cost economic infrastructure construction and maintenance with longer durability.

Key words: Nano-particles, Nano-cement, Biomimetic, AB matter, Nanotubes, OLEDs, Nano fabric, Nano medicine, Vivo imaging, Tissue engineering

1. INTRODUCTION:

"Small is beautiful" is very famous statement of past but now it has to been modified to 'small is not only beautiful but powerful too'.

Engineering of tiny machines is called as Nanotechnology. Which may be achieved by controlling and restructuring of matters at dimensions of 1 to 100 nanometres (reducing a molecule to its 100 times)? A Nanometre is one billionth of a meter, roughly the width of three or four atoms. Nanotechnology is the design, and application of structures, devices, and characterization, production by controlled manipulation of size and shape at the nanometre scale that produces structures, devices, and systems with at least one novel or superior characteristics.

In this technology, only the properties of material like colour, abrasion, conductivity, etc. are changed by reducing its size without changing its chemical composition. Nanotechnology has drawn attention from all over the world by becoming a hottest field and has the ability to outdate most of the existing technologies present today. Because of its great application in future, chemists, physicists, biologist and all other scientist from renowned fields are putting their heads together, and targeting what promises to be a new Industrial Revolution. Here in this paper the background information and the recent developments in the field of nanotechnology has been described followed by the merits and demerits of their interdisciplinary approach. Further deals with application oriented nanotechnology-enabled materials and products that are either on the market or ready to be adopted in the industry.

Nanotechnology is not a new technology and it is not a new science either. It preferably an addition of the science and technology that have been already in development for many years. Here the particle size is the critical factor. At the Nano scale (anything from one hundred or more down to a few nanometres, or 10-9 m) material properties are altered from that of larger scales. Another important aspect is that, as Nano-sized particles are formed, the proportion of atoms on the surface increases relative to those inside which leads to novel properties [1].

1.1 Nanotechnology.

Nano came from the Greek word "Dwarf". Which indicates a billionth. Where One nanometre is a billionth of a meter. Definition of 'nanotechnology' varies generally but refers to understanding and manipulation of matter on the Nano scale, say, from 0.1nm to 100 nm. There are two ways to approach the Nano scale: shrinking from the top-down, or growing from the bottom-up. The 'top down' approach entails reducing the size of the smallest structures towards the Nano scale by machining and etching techniques, whereas the 'bottom up' approach, often referred to as molecular nanotechnology, which implies controlled or directed self-assembly of atoms and molecules to create structures.

2. Nanotechnology in construction

The construction industry was the only industry to identify nanotechnology as a promising emerging technology Furthermore, ready mix concrete and concrete products were identified as among the top 40 industrial sectors likely to be influenced by nanotechnology in 10-15 years [2]. Nanotechnology has the ability to make construction faster, cheaper, safer, and more varied. Automation in nanotechnology construction can allow for the creation of structures from advanced homes to massive skyscrapers much more quickly and at much lower cost. In the near future, Nanotechnology can be used to sense cracks in foundations of architecture and can send nabobs to repair them. If this technology is utilized in the construction of home and infrastructure, those structures will be more durable and stronger. If buildings will be stronger, then very few of them will require reconstruction and less waste will be produced.

In construction nanotechnology requires nanoparticles of alumina and silica. Manufacturers are also looking over the method of preparing nano-cement. If the cement having nano size particles can be processed, it will be very much helpful which will unfold a large number of scope in the field of ceramics, high strength concrete and applications in electronics field. Nanomaterial's still having a high cost relative to conventional materials, meaning that they are not likely to feature in high-volume building materials. The days are not far when this technology will reduce the use of structural steel.

2.1 Nanotechnology In Civil Engineering

Nanotechnology can be used for designing and constructing many products having many unique characteristics. These characteristics can, again, significantly fix current construction problems, and may change the requirement and organization of construction process.
Some of its applications are examined in details below:

2.1.1. CEMENT AND CONCRETE

Much analysis of concrete is being done at the Nano-level to understand its structure. Various techniques uses such analysis uses for studying at that scale such as Atomic Force Microscopy (AFM), Scanning Electron Microscopy (SEM) and Focused Ion Beam (FIB). After all, concrete is, a macro-material strongly influenced by its Nano properties and understanding it at this new level is yielding new avenues for improvement of strength, durability and monitoring as outlined in the following paragraphs. One of the most common and widely used construction materials is concrete. This technology is widely used to study the properties like alkali silicate reaction (ASR), hydration reaction and fly ash reactivity.[2]. Alkali silicate reaction is caused due to alkali content of cement and silica present in reactive aggregates like chart. Fly ash not only improves concrete durability and strength but also important for sustainability, reduces the requirement for cement, however, the curing process of such concrete is slowed down due to the addition of fly ash and early stage strength is low in comparison to normal concrete [3].

Silica (SiO_2) is present in conventional concrete as a part of the normal mix. Rather, an advancement made in the field of concrete by studying the nano scale property for silica particle packing may lead to a change in the micro and nanostructure resulting in improved mechanical properties. If Nano-silica is added to cement based materials, it can control the degradation of the fundamental C-S-H (calcium-silicate hydrate) reaction of concrete caused by calcium leaching in water and this also blocks the water penetration which leads to the improvement in durability.

If small amount of carbon nanotube (1%) by weight is added it can increase both compressive and flexural strength [4]. This may also improve the mechanical property of the samples comprising of the main Portland cement phase and water. Oxidized multi-walled nanotubes (MWNT's) show the best improvements both in compressive strength (+ 25 N/mm2) and flexural strength (+8 N/mm2) compared to the reference samples without the reinforcement.

2.1.2. STRUCTURAL COMPOSITES

Steel is a major construction material. FHWH along with US Navy and American Iron and Steel Institute developed new, low carbon, high-performance steel (HPS) for bridges in 1992 which is high corrosion-resistant and weld ability by incorporating copper nanoparticles at the steel grain boundaries [5]. Due to the changed nanostructure, MMFX steel possess extra ordinary mechanical properties, e.g. higher strength, ductility and fatigue resistance, over other high-strength steels. Thus these properties of materials can lead to the longer service life in the environment prone to corrosion with less construction cost. Carbon nanotubes are over 100 times stronger than steel and only one-sixth of the weight having high thermal and electrical conductivities. A CNT composite has been recently reported to be six times stronger than conventional carbon fibre composites [6].

2.1.3. COATINGS

Coatings containing Nano particles or Nano layers have been developed for certain purpose including: protective or anti-corrosion coatings for components, self-cleaning, thermal control, energy saving, anti-reflection coatings for glass/windows, easy-to-clean and antibacterial coatings for work surfaces, and more durable paints and anti-graffiti coating for buildings and structures. Example: Windows with self cleaning properties marketed by Pilkington have been prepared, St. Gobain Co., and others [7].

2.1.4. GLASS

Fumed silica (SiO2) nanoparticle which turns into a rigid and opaque fire shield when heated becomes fire-protective. This fire protective glass is another application of nanotechnology.TiO2 possess hydrophobic property, it can be applied in antifogging coatings or in self-cleaning windows. Sticking of pollutants can be prevented by applying nano-TiO_2 coatings to the exteriors and thus reduces the maintenance cost [8].

2.1.5. INSULATING MATERIALS

Nano Pore has developed bulk nonporous silica compounds with embedded organic molecules, which performs 10 times better than conventional insulating materials. The superior insulation characteristics of this low density, highly porous solids are due to the unique shape and small size (10-100 nm) of its large number of pores. So far this new insulating compound has been used in applications that require excellent thermal performance, optimum energy efficiency, or minimum insulation thickness.

2.1.6. PLASTICS

Carbon fibre reinforced plastics (CFRP) are light weight materials and do not exhibit good electrical behaviour. CNTs are among the stiffest and strongest fibres known, having high electrical conductivity.

2.1.7. BIOMIMETIC MATERIALS

Biomimetic is the science of mimicking nature, and biomimetic materials seek to imitate the best features of natural materials. Examples: such as honeycomb giving a lightweight structure with exceptional mechanical strength, antler bone being tougher than any man-made ceramic composites, lotus leaf giving self-cleaning surfaces, chameleon's skin changing colours with the environment, etc. By manipulation of materials at the atomic level enabled by nanotechnology advances, Biomimetic materials research provides a productive approach for new materials and molecular manufacturing.

2.8.NANO-TECHNOLOGY IN FIRE PROTECTION

Researches into Nano-cement (made of Nano-sized particles) have the potential to create a new collection in this area of application. This is achieved by the mixing of carbon nanotubes (CNT's) with the cementious material to fabricate

fibre composites that inherits some of the outstanding properties of the nanotubes such as strength. Fibers made up of Polypropylene are also considered as the process of increasing the fire resistance and thus is a cheaper option for conventional insulation. Carbon Nanotubes may be used to prepare protective clothing materials due to its flame retardant property.

3. Nanotechnology in Pavement Engineering

Compared with typical civil engineering structures, Pavements operate on hugely divergent dimensional scales. The development of improved materials using nanotechnology techniques is one of the areas where probably the maximum can be achieved to enable beneficial impacts from nanotechnology in pavement engineering. Here engineers use a wide range of materials for the construction and maintenance of road pavements. Many of these materials are natural and modified by using the products made from cement, Bitumen and various chemical admixtures.

Various techniques using Nanotechnology have been applied for enhancing materials for pavement engineering are as follows:

3.1. Modelling of self-healing materials, starting with biological examples which may potentially be expanded to infrastructure where cracks developed in the pavement may self-heal by introducing **microcapsules** in the cement matrix.

3.2. When flyash is added with pavement materials it acts as self- healing which is observed before by (barstis and Crawley 2000) and can be seen as nano scale effect which has been already used.

3.3. Incorporating **TiO2** in concrete renders the concrete a material that performs certain photo catalytic activities, has been well developed and applied (Cassar 2005). Typically, the photo catalytic reaction is applied for the provision of self-cleaning surfaces and also for the removal of NOx, SOx, NH3, and CO pollution from urban areas through a chemical reaction triggered by naturally occurring ultraviolet light.

3.4. Addition of **CNTs** to concrete increases the hydration rate developing strong bonds between the CNT and the cement paste, while (Yakovlev et al. 2006) measured increases of up to 70% in the compressive strength of CNT reinforced concrete and decreases of up to 12% in the heat conductivity of the concrete. Carbon nanotubes (CNTs) will not corrode in the corrosion prone environment as like it happens in the case of steel fibre reinforced concrete. This benefit can be specifically evaluated for application in marine environments.

3.5. Thin films of Nano sized material can be deposited on the surface of a host material through various techniques. This includes **SAM** and sol-gel methods. Objective of the treatment is to host material properties. Typical reasons for the change includes the incompatibility between the aggregate host material and the binder used (e.g., cement or bitumen) and the need to improve the bonds between the host and the binder.

3.6. A major road safety need in rural Africa is the illumination of road pavements to improve visibility and road safety. Where **Nano phosphors** combined with road surfacing materials or paints for this purpose was used. Nano phosphors are Nano scale crystalline structures with a size dependent band gap that can be altered to change the colour of light. [9]

4. Nanotechnology in Aerospace [10]

Aerospace and aviation needs in any era, the strongest and most thermo stable materials available, at nearly any cost. New materials allow to greatly improving all characteristic of space ships, rockets, engines, aircraft, and design a new type of space, propulsion, and aviation system. A new material named as “AB matter” has been synthesised having extraordinary properties (for example, tensile strength, stiffness, hardness, critical temperature, superconductivity, super transparency, zero friction, etc.), which are up to millions of times better than corresponding properties of conventional molecular matter.

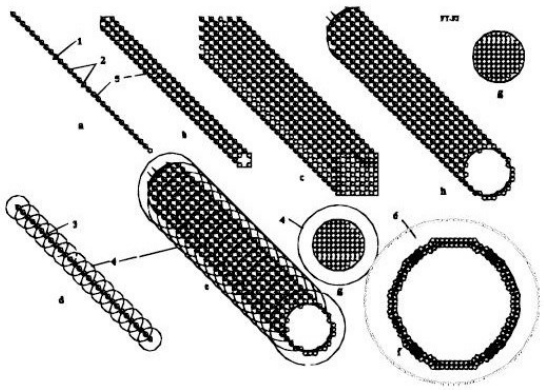
Nanotubes have been synthesised which are stronger than steel by a hundred times surely an amazement to a 19th century observer if he could behold them.

5. AB Matter

Normally matter is made of atoms and molecules .The nucleons are located in the nucleus, but the

electrons rotate in orbits around nucleus in distance in millions times more than the diameter of nucleus. Therefore, in essence, what we think of as solid matter contains a relatively "gigantic" vacuum free space where the matter nucleus occupies but a very small part of the available space. The electrons present in the orbits repel atom to atom and resists the increase in the matter's density. Thus it feels solid to the touch.

Design of AB Matter



Design of AB Matter from nucleons (neutrons, protons, etc.) and electrons:

a) linear one string (monofilament) (fiber, whisker, filament, and thread)
b) ingot from four nuclear monofilaments;
c) multi ingot from nuclear monofilament;
d) string made from protons and neutrons with electrons rotated around monofilament;
e) single wall femto tube (SWFT) fiber with rotated electrons;
f) cross section of multiwall femto tube (MWFT) string;
g) cross section of rod;
h) SWFT string with electrons inserted into AB Matter.

Notations:

1—nuclear string; 2—nucleons (neutrons, protons, etc.); 3—protons; 4—orbit of electrons; 5—electrons; and 6—cloud of electrons around tube.

For distance d=2x10^{-15} m the force equals F=10.5 N. Where the force makes the string and net to remain in unfold and stable form.

$$F = k\frac{e^2}{d^2}\left(1+\frac{1}{2^2}+\frac{1}{3^2}+\cdots+\frac{1}{n^2}+\cdots\right)=\frac{\pi^2 k e^2}{6}\frac{e^2}{d^2}=1.476\times 10^{10}\frac{e^2}{d^2} \quad \text{.....(11)}$$

Uses of AB Matter:

1. Simplest use of AB Matter is to strengthen and reinforce normal material by AB Matter fiber.
2. AB Matter fiber is stronger having a gigantic ultimate tensile stress than normal material by a factor of millions of times, can sustain million degrees of temperature and do not accept any attacking chemical reactions.
3. AB Matter fiber or net can be inserted into steel, aluminum, plastic, and the resultant matrix of conventional material which increases strength by thousands of times.
4. The strength of AB matter thread having diameter 100 thousand times less than an atom's diameter can suspend a weight nearly of human mass.
5. AB Matter film and net may be used for energy storage which can store up huge energy intensities and used also as rocket engines with gigantic impulse or weapon or absolute armor.
6. AB Matter is stronger than steel by 100 thousands billions by billions times and then nanotubes by 10,000 billion by billion times.
7. As it is observed that the fiber/nets from AB Matter have very high strength with very small mass. It can be provided as an absolute heat shield for the Space Shuttle Orbiters.
8. The AB Matter does not have orbital electrons. By which Nucleons cannot combine with usual atoms having electrons. Especially, the AB Matter is absolute corrosion resistant.
9. The AB matter possesses Zero heat/thermal conductivity.
10. AB matter possesses zero mechanical friction. Which is very important for aircraft, sea ships, and vehicles because about 90% of their energy they spend is in friction?
11. AB matter has Super or quasi-super electric conductivity at any temperature.
12. AB matter possess High dielectric strength .Thus may be used for devices to produce high magnetic intensity.

Applications of AB matter in various fields

1. Storage of Gigantic Energy
2. New Propulsion System of Space Ship
3. Super weapons
4. Super armor from Conventional Weapons
5. Simple Thermonuclear Reactor
6. High Efficiency Rocket, Jet, and Piston Aviation Engines
7. Hypersonic Aircraft
8. Increasing Efficiency of a Conventional Aviation and Transport Vehicles
9. Improving Capabilities of All Machines
10. Computer and Computer Memory

V. Nanotechnology in Electronics and Information Technology

Now a day's nanotechnology is being used in many computing, communications and various applications in electronics to provide smaller, faster and more portable systems, which can manage and store more and more amount of information's.

These continuously evolving applications include:

1. Nano scale transistors that are faster, more powerful, and increasingly energy efficient; soon your computer's entire memory may be stored on a single tiny chip.
2. Magnetic random access memory (MRAM) enabled by nanometer-scale magnetic tunnel junctions that can quickly and effectively save even encrypted data during a system shutdown or crash.
3. Displays for many new TVs, laptop computers, cell phones, digital cameras, and other devices run nanostructured polymer films known as organic light-emitting diodes, or OLEDs. It offers more brighter images in a flat screen with wider viewing angles, light weight, better picture density, longer lifetime and lower power consumption.
4. Other computing and electronic products include Flash memory chips for iPod Nanos, ultra-responsive hearing aids, antimicrobial/antibacterial coatings on mouse/keyboard/cellphone casings, conductive inks for printed electronics for RFID/ smart cards/ smart packaging, flexible display for the readers of e-book and video games with more reality.
5. Prototype solar panels incorporating nanotechnology are more efficient than standard designs in converting sunlight to electricity, promising inexpensive solar power in the future. These are naturally cheaper to manufacturing and have easy installation. Since can be prepared using printing like process and can be made in flexible rolls rather than discrete panels.
6. Nanotechnology is already being used in numerous new kinds of batteries that are less flammable, quicker-charging, more efficient, lighter weight, and that has a higher power density and hold electrical charge longer.
7. Using nanotechnology, researchers developed what they call "ultra capacitors." An ultra-capacitor is a general term that describes a capacitor that contains Nano components. Research's in the field of ultra capacitors have been carried out massively of its high density interior, compact size and higher capacitance level. This decrease in size makes it increasingly possible to develop much smaller circuits and computers.[12]

VI. Nanotechnology as a filtration aid:

Nano filtration is a process of pressure-driven membrane separation for removal of submicron particles with a molecular weight cut-off (MWCO) between 200 and 1000. [13]

1. Nanotechnology could help to meet the need for affordable clean drinking water through rapid low-cost detection of impurities in and filtration and purification of water. Example: Researchers have discovered unexpected magnetic interactions between ultra-small specks of rust, to remove arsenic or carbon tetrachloride from water.[12]
2. Researchers have developed a Nano fabric "paper towel," woven from tiny wires of potassium manganese oxide that can absorb 20 times its weight in oil for cleanup applications.
3. Nano filtration is also widely used in food processing applications such as dairy, for simultaneous concentration and partial

(monovalent ion) demineralization. In the recent days, use of nano filtration has been stretched into other industries like milk and juice production. Research and development in the field of solvent-stable membranes has allowed the application for Nano filtration membranes to extend into new areas such as pharmaceuticals, fine chemicals, and flavor and fragrance industries.[12]

4. Bacteria and viruses from both surface and ground water supplies can be removed by using Nano filters. Nano filtration membranes exhibited greater than 6 log removal of Bacillus subtilis as a replacement for bacteria removal without the use of coagulants.
5. Nano filters remove a percentage of dissolved organic carbon (DOC) that serve as DBP precursors in drinking water sources. The rejection can be physical or electrochemical.[13]
6. Nano filters can be used to remove color in boggy surface water. Average raw water color ranged from 50 to 60 color units (CU) on the basis of the American Public Health Association (APHA) color index, whereas permeate water averaged less than 1 CU. Nano filtration rejects water varied with membrane type but averaged between 180 and 420 CU.
7. The adsorption studies illustrated that the Nano scale maghemite was very effective for the removal of CrVI, CuII and NiII from wastewater. Adsorption of metals by Nano scale maghemite reached equilibrium within 10 min and the removal efficiency was highly pH dependent, which also governed the selective adsorption of metals from the solution. The optimal pH for the selective removal of Cr, Cu, and Ni is 2.5, 6.5, and 8.5, respectively.[14]
8. Nanomaterial's, especially zero-valent metals (ZVMs), for groundwater remediation is an emerging approach that is promising due to the availability and effectiveness of many nanomaterials for degrading contaminants.
9. The use of various nanomaterial's, including carbon nanotubes and TiO2, shows promise for treatment of surface water, including for purification, disinfection, and desalination.[15]
10. Titanium dioxide (TiO2) is also a leading candidate for Nano remediation and wastewater treatment; although in 2010 it is reported and not yet been expanded to full-scale commercialization. When exposed to ultraviolet light, such as in sunlight, hydroxyl radicals are obtained from titanium dioxide, which are highly reactive and can oxidize contaminants.[15]

VII. Nanotechnology in Day to Day use:

Today there already exist over 800 everyday commercial products that rely on Nano scale materials and processes. Stronger, lighter, more durable and more reactive materials can be prepared using this technology.

1. Nano scale additives are used in polymer composite materials for baseball bats, tennis rackets, motorcycle helmets, automobile bumpers, luggage, and power tool housings can make them simultaneously lightweight, stiff, durable, and resilient.
2. Nano scale additives to or surface treatments of fabrics help them resist wrinkling, staining, and bacterial growth, and provide lightweight ballistic energy deflection in personal body armor.
3. Nano scale thin films on eyeglasses, computer and camera displays, windows, and other surfaces can make them water-repellent, antireflective, self-cleaning, resistant to ultraviolet or infrared light, antifog, antimicrobial, scratch-resistant, or electrically conductive.
4. Nano-engineered materials in the food industry include Nano composites in food containers to minimize carbon dioxide leakage out of carbonated beverages, or reduce oxygen inflow, moisture outflow, and the bacterial growth to keep food safer, fresher and can be preserved longer. If nano sensors may be used for preparing packages, it can warn against spoiled food. Nanosensors are being developed to detect salmonella, pesticides, and other contaminates on food before packaging and distribution.

5. Nanoscale materials in cosmetic products provide greater clarity or coverage; cleansing; absorption; personalization; and antioxidant, anti-microbial, and other health properties in sunscreens, cleansers, complexion treatments, creams and lotions, shampoos, and specialized makeup.
6. Nano-engineered materials make superior household products such as degreasers and stain removers; environmental sensors, alert systems, air purifiers and filters; antibacterial cleansers; and specialized paints and sealing products.
7. Nano-engineered materials in automotive products include high-power rechargeable battery systems; thermoelectric materials for temperature control; lower-rolling resistance tires; high-efficiency/low-cost sensors and electronics; thin-film smart solar panels; and fuel additives and for cleaner exhaust and extended range improved catalytic converters are being used.
8. Nanoparticles are used increasingly in catalysis to boost chemical reactions. This lowers the amount of catalytic materials necessary to prepare the required results, which saves money and reduces the pollutants. Whose applications are petroleum refining and automotive catalytic converters.

VIII. Nanotechnology in Corrosion Mitigation. [16]

Electrokinetic nanoparticle (EN) treatments is one of the method employed to mitigate corrosion in reinforced concrete. In this method electric field is used to insert pozzolanic nanoparticles through the concrete capillary pores directly to the reinforcement. The intent was to use the nanoparticles as pore-blocking agents to prevent the ingress of chlorides.
(EN) Electrokinetic nanoparticles treatment involves the dosing of the nanoparticles into concrete or hardened cement paste to reduce the permeability while increasing the strength (Cardenas and Struble 2006; Cardenas 2002; Kupwade-Patil 2007; Cardenas and Kupwade-Patil 2007) .The EN-treated specimens exhibited a reduction in corrosion rates by a factor of 74 as compared to the untreated controls.

This concept uses electrophoresis and ionic conduction to carry pore-blocking agents into the capillary pores of concrete. The nanoparticle used was 24 nm in size with a 20-nm silica interior surrounded by a layer of 2-nm alumina particles. [17]
EN treatment was effective in reducing the magnitude of the corrosion potential associated with reinforcement corrosion. (Kupwade-Patil 2007; Cardenas and Kupwade-Patil 2007).

IX. Nanotechnology in medicine

Nanomedicine is the medical application of nanotechnology. The size of nanomaterials is similar to that of most biological molecules and structures; therefore, nanomaterial's can be useful for both in vivo and in vitro biomedical research and applications. In extent to this the combination of nanomaterials with biology has led to the development of diagnostic devices, contrast agents, physical therapy applications and drug delivery vehicles. Now a days there arises problems related to toxicity and environmental impact of the nano scale materials.[18] Nano medicine seeks to deliver a valuable set of research tools and clinically useful devices in the near future.
Nanoparticles may be used in the combination therapy for reducing the resistance to antibody and for their antimicrobial properties [19][20].

1. Abraxane, approved by the U.S. Food and Drug Administration (FDA) to treat breast cancer, [21] non-small- cell lung cancer (NSCLC) [22] and pancreatic cancer, is the nanoparticle albumin bound paclitaxel.
2. Doxil was originally approved by the FDA for the use on HIV-related Kaposi's sarcoma. Now it has been used also to treat the multiple myeloma and ovarian cancer. The medicine is thus encased in liposomes,

which will help in increasing the life of the drug which will be distributed.

3. An early phase clinical trial using the platform of 'Minicell' nanoparticle for drug delivery has been tested on patients with advanced and untreatable cancer, which is built from the mutant bacteria membranes, these mini cells are coated with cetuximab and loaded with paclitaxel. Antibodies which binds the epidermal growth factor receptor (EGFR) which is often over utilized in an number of cancers, as homing device for the tumor cells. The bacteria's are recognized by the tumor cells from which the minicells have developed, regarding it invaded microorganisms and to engulf it. Once inside, the payload of anti-cancer drug kills the tumor cells.[23]
4. In vivo imaging is another area where tools and devices are being developed. Using this nano-technology images formed in the ultrasound and MRI have favourable distribution and improved contrast. Which might be adopted by the self-assembled biocompatible nano device, which may detect, evaluate, treat and report to a clinical doctor easily.
5. Nanotechnology-on-a-chip is one more dimension of lab-on-a-chip technology. Magnetic nanoparticles when bound to a suitable antibody, may be used to label specific molecules, structures or micro organisms. When the gold nanoparticles are tagged with short segments of DNA may be helpful in detection of generic sequence in a sample. Sensor test chips containing thousands of nanowires able to detect proteins and other biomarkers left behind by cancer cells, this could enable the detection and diagnosis of cancer in the early stages from a few drops of a patient's blood.[24]
6. Nanotechnology may be used as part of issue engineering to help reproduce or repair damaged tissue using suitable nanomaterial-based scaffolds and growth factors. If possible the tissue engineering may successfully replace typical treatments like organ transplant and artificial implantation. Nanoparticles like molybdenum disulfide, tungsten disulfide, graphene, CNT, are being used as reinforcing agents for the fabrication of mechanically strong biodegradable polymeric nano composites for application in bone tissue engineering.
7. Neuro-electronic interfacing is a visionary goal dealing with the construction of nanodevices that can permit computers to be joined and linked with nervous system. This idea will permit control and detection of nerve impulses by external computer.

CONCLUSION:

Research in nanotechnology related to construction is still in its infancy, A large-scale and visible initiative from Nano-science and nanotechnology in the construction area could help seed construction related Nano-technological development. Focused research into the timeous and directed research into nanotechnology for construction should be pursued to ensure that the potential benefits of this technology can be harnessed to provide longer life and more economical infrastructure.

Engineering and medical fields are always in need of new materials having better high properties than any available today. Which are millions of times better than corresponded properties of conventional molecular matter. People may think this as fantasy. But 15 years ago most people and many scientists thought nanotechnology is fantasy. Now many Groups and industrial laboratories, even start-ups, spend hundreds of millions of dollars for the development of nanotechnological-range products precise chemistry, patterned atoms, catalysts, metamaterials, etc., and we are also having a new material which does not exist in nature and the other achievements are yet to come out of the pipeline.

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