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The Role Of Nanotechnology Applications In Construction As A Tool To Reduce Materials

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Abstract :

The tremendous technological development in the late twentieth century and persistent scientific research led to the emergence of nanotechnology, and its applications were quickly linked in the daily life of individuals through small and high-speed computers, and it was also optimized in the field of construction and building by improving the properties of raw materials. Which make surfaces resistant to scratches or prevent dust and waste from sticking to them, and additives to concrete self-treat cracks, and it is a tool for sustainability and building development because it offers its ability to increase the life span of the building to five times the normal life without depleting resources and environmental pollution in addition to the process Operation that gives you a faster picture and a lower cost.

Key words: Role - Applications - Nanotechnology - Construction - Tool - Material Reduction.

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Introduction :

With the tremendous technological development in the late twentieth century and the continuous scientific research that led to the emergence of nanotechnology, its applications were quickly linked in the daily life of individuals through small and high-speed computers, and the optimal investment appeared in the field of construction by improving the properties and raw materials by re The arrangement of the particles of the material to gain the surfaces resistance to scratching processes or prevent the adhesion of dust and residues to them, and the additions to concrete treat cracks on their own, and so they are the magic key to progress, growth and economic and environmental prosperity on science and knowledge because it has the ability to increase the life span of the facilities to five times the normal life In addition to the operation process, which gives it a faster image and a lower cost.

Therefore, the current research deals with the definition and presentation of applications used in the field of construction to achieve sustainability, provision of resources and the definition of the most important global experiences that used those applications in this field with a mention of the most important applications used, and the most important facilities in which this technology was applied after the operation process.

Research Problem :

The concepts of the term nanotechnology are widely used in scientific research because it provides unprecedented capabilities in the properties and methods of manufacturing materials and using them in the fields of practical life, *(Lazaro, 2010)* and produces materials with properties and configurations that are more efficient in work and ability to operate than materials found in all natural systems. *(Ayşin, et al., 2014)*

Therefore, the research problem lies in the lack of interest in nanotechnology products and their impact on the construction sector due to the difficulty of the decision-makers accepting to integrate this new science of technology into the built environment that achieves the concept of sustainability to achieve high efficiency in quality, reduce cost and reduce the element of time, thus preserving raw materials. Local.

Research Aims :

The research aims to :

1- Main objective: the use of nanomaterials in raising the efficiency of construction work, which is considered as a tool to achieve quality standards, economic standards and standards to reduce operating time.
2- Sub-goals :
    a. Demonstrate the added value of building using applications of nanomaterials in the construction sector.
    b. Increase awareness of the use of nanomaterials applications in the construction sector that help achieve environmental dimensions.

Research Methodology :

The search is based on three frames :

A. A theoretical framework: in which the concepts of nanotechnology, its history of development, its relationship to energy and the sustainable environment, applications in the fields of life, types of technologies, and the possibility of their application in the field of construction and building are reviewed.
B. Analytical framework: An analysis of some experiences of global and local projects that have applied nanotechnology in construction projects and draw conclusions and indicators from them.

Theoretical framework :

Definition Of Nanoscale :

Is a Greek word meaning little troll, It is meant here the infinitesimal, *(Soueid, et al., 2011),*What is meant by nanoscience is that science that is concerned with studying and characterizing materials in a way that enables it to change the properties of any substance and maximize its characteristics by rearranging its atoms in such a way as to obtain these distinct properties, whether physical (such as color and transparency), chemical (chemical activity) or

mechanical (such as hardness) And flexibility), before restructuring to enhance performance in an unprecedented way. *(Berger, 2021)*

Nanoscale :

It measures the nanoscale, which is the most accurate metric unit representing one billionth of a meter, and it includes the dimensions of one nanometer to 100 nanometers. *(Clara, et al., 2018)*, Nanoscience is the study of the basic principles and properties of molecules and compounds at the nanometer scale. *(Omar, 2013)*

Nanotechnology is known as "the science concerned with the study of material processing at the atomic and molecular scale and is devising innovative techniques and means that are measured in nanometer dimensions, which is the thousandth of a micrometer (i.e. a part of a millionth of a millimeter) and nanotechnology deals with measurements between 0.1 to 100 nanometers, which are Atomic groupings ranging from five to one thousand atoms, and are concerned with the properties of materials and therefore their fields vary widely from semiconductors to modern methods based on molecular self-assembly. *(Zaki, 2015)*

It is divided into two parts :

- Top Down: Nanoparticles are manufactured from larger particles by using sculpting, grinding or crushing any small technique.
- Bottom Up: in which nanoparticles are manufactured from individual particles and atoms by direct control.

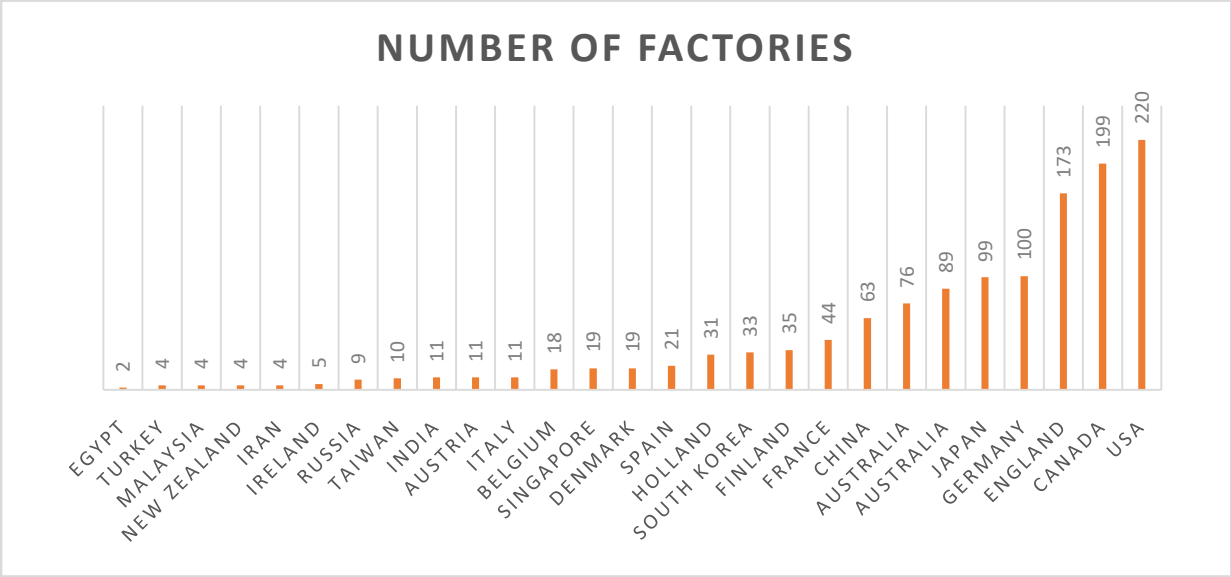
And the measurement by measurement is matched by an expansion in the nature of the materials used, so nanotechnology deals with any phenomena or structures at the small nanoscale level, such nanoscale phenomena may include a quantitative restriction that leads to new electromagnetic and optical phenomena of the material whose size is between the molecule and the volume of the visible solid and includes nanoscale phenomena. Gibbs - Thompson also affected, which is the decrease in the melting point of a substance when its measurement becomes nanoscale, as for nanostructures, the most important of which is carbon nanotubes. (Figure. 1) *(Abdel Hamid, 2017)*

The Economics Of Nanotechnology :

The late twentieth century marked the beginning of the launch of nanotechnology in fierce distances with the aim of pioneering and imposing

hegemony on the building and construction market with nanoscale applications. Perhaps the matter reached the most intense monopolies of some markets under the pretext of patents and intellectual property laws on both the scientific and civil society alike. *(Al-Iskandarani, 2016)*

Perhaps the economic collapse that occurred in 2008 and the payoff that followed proved that the real investment is in science and not in the accumulation of money, and nanotechnology has begun to play a pioneering role in reviving The global market through products whose presence is increasing day by day and the areas that enter the production process are increasing (Figure No. 1), *(Abdel Hamid, 2017)*, as more than 3059 companies around the world produce materials that enter into the manufacture of nanotechnology so that their trade in 2016 reached nearly 306 billion dollars in The field of buildings and constructions only for its important role in not polluting the environment and increasing the life span of facilities, while it reached $ 614 billion in other industries such as televisions, computers and mobile phones in the same year. *(Taha, 2015)*



Graph No. (1) shows the number of companies producing nanoscale applications around the world.

Uses Of Nanometer In Construction And Building :

A large number of research centers around the world are working on the development of new nanomaterials that contribute significantly to the field of construction, which is the most promising applications, as this technology contributes to the production of building materials with economic and

environmental benefits in addition to comfort for the users of the facilities, as they are sustainable and environmentally friendly. And with higher effectiveness in reducing energy consumption and the ability to self-clean with less effort because of its unique thermal, electrical, physical, chemical and mechanical properties that enable it to resist high temperature and harmful radiation, protect against fires and treat any cracks and cracks, so this technology is included in additives to concrete mixes. (Concrete) such as silica, cement and gypsum materials, tiles, ceramics, glass, woodworking and steel industry, and by that it aims to preserve the integrity of the ecosystem and local resources of raw materials from penetration. *(Donia, 2019)*

Nanotechnology Applications In Concrete :

An understanding of the behavior and structure of the concrete mixture enables the employment of nanotechnology to optimize the employment as it is a group of the package of particles in the concrete that can be improved by using nanosilka, which leads to the densification of the structural structure on both the nanoscale and micro scales and thus leads to the production of improved mechanical properties of concrete as it prevents penetration Water for concrete and thus improves the durability property. *(Shams El Din, 2016)*

Polycarboxylate, which is a plastic-like substance that gives concrete the property of self-compaction, can be added as it adopts the behavior of thick fluids, so it does not need to be exposed to vibrations after pouring it to achieve compaction, thus reducing the energy required for construction and reducing the labor cost to 50%, and it can also be used. Carbon fibers in concrete are widely used these days because they increase the resistance of the structural elements of the concrete on the surface of the concrete, and close it because it contains nano silica particles and hardeners. The nanoparticles penetrate the small cracks in the surface of the concrete and close it, and also for the field of strengthening the matrices form a strong bond Between the concrete surface and the concrete reinforcing fibers. *(Hassaballah, 2017)*

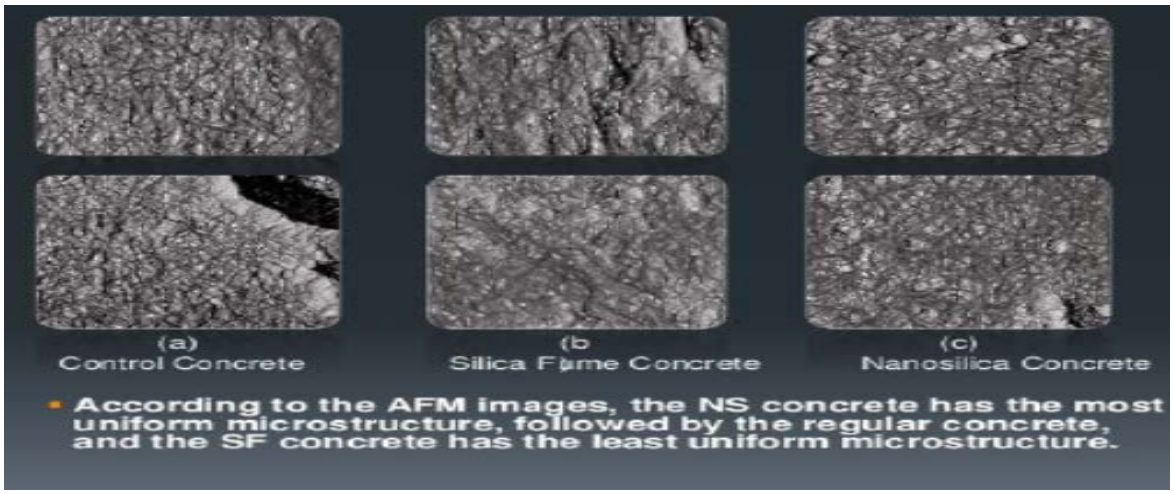


Figure No. (2) shows the shape of the concrete treated with nanotechnology

Applications Of Nanotechnology In Glass :

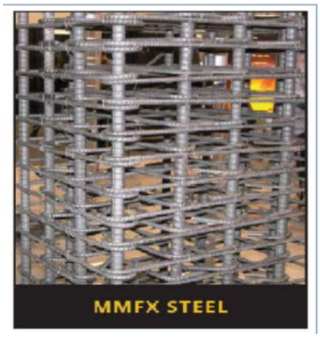
Most of the glass used in construction is used on the outside of buildings, so controlling the amount of light and heat entering the building is an important matter that must be taken into account, so the researches made in this regard have come out to us by using solutions based on nanotechnology, a strategy to block the incoming light and heat through Windows resist weather changes (heat absorption), so they absorb solar energy through the glass and convert it into light through layers of nanotechnology treated glass, and a thin layer of paint is being developed to be placed on glass windows, and it is one of the spectrum-sensitive surface applications that has the ability It helps filter out unwanted infrared frequencies of light, which are responsible for raising the room temperature (and thus reducing heat gained in buildings). *(Cub, 2015)*

Fire-resistant glass is also one of the most important applications of nanotechnology, as it turns into a transparent fire shield when exposed to heat as a result of the presence of a layer of nanoparticles of silica dust located between the glass panels as an interlayer. *(Qasim, 2016)*

Figure No. (3) shows the difference between glass in which nanotechnology was used and glass that did not use nanotechnology

However, among its most important properties (water resistance - anti-fog - and self-cleaning from dust - highly resistant - protection from UV rays - ease of design due to the thinness and low weight of the glass).

Applications of Nanotechnology in Iron :

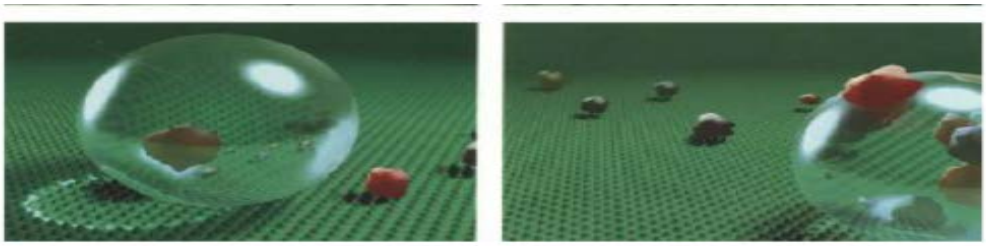


It is considered the most important component of reinforced concrete, and therefore studies have focused on the element of iron, with the aim of reducing corrosion due to chemical reactions that it is exposed to after construction resulting from organic water, and we have produced nanotechnology iron known as MMFX Steel, which has been used in bridges, commercial buildings and buildings with large seas. *(Waziri, 2018)*

MMFX iron has many advantages in terms of resistance to corrosion, rust and corrosion without using any protective paint, in addition to its advantage in forming its flexibility, and its weight is five times that of regular iron, thus reducing the amount of iron used in the origin by 40%.

Applications Of Nanotechnology In Paints Work :

a- Nano paints consist of very small particles that have properties such as flexibility on surfaces and easy adhesion, which will change the concept and technology of paints in the near future, and the most important materials that go into the manufacture of nano paints are (magnesium oxide, copper oxide, cerium dioxide, aluminum, oxide). Zinc, silicon dioxide and others), by combining these materials, we produce nano-rust-free paint and change from environmental factors with the aging of the origin. *(Qasim, 2016)*



B- Self-Cleaning Paints :

They are paints that contain models of titanium dioxide that enable them to self-clean from dirt (Figure No. 4)

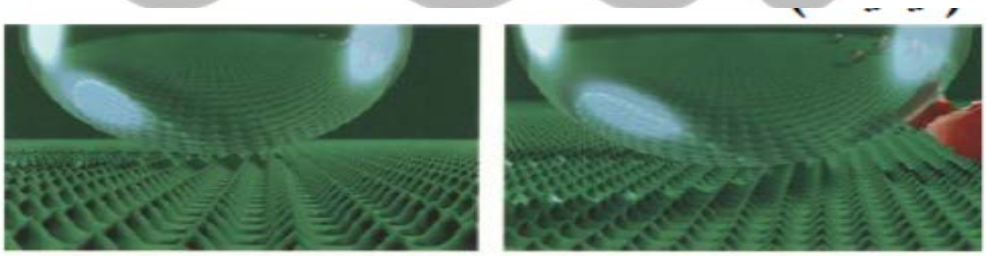


Figure No. (4) shows the difference between the untreated surface to expel dirt on the left and the treated surface on the right

C - Self-Cleaning Water-Based Paints :

They are paints for external surfaces with a water repellent layer that contains wax to enable it to repel water.

Figure No. (4) shows the difference between the treated surface to expel water on the left and the untreated surface on the right

D - Antibacterial and antibacterial paints :

This type of nanotechnology is effective in hospitals and research centers to target harmful bacteria and destroy them, which helps to reduce the use of disinfectants that are costly and affect the respiratory system. *(Al-Rifai, 2016)*

E - Paints Insulating Heat, Moisture And Sound :

It works to form a layer whose pores are closed and without voids, and thus the sun's rays are scattered and reflected, and the surface temperature, as a result, is reduced between 10-20 degrees Celsius.

F - Fire-retardant paints :

Often in metal structures, paint is sprayed on the structure, while the matter differs with cement that is made by means of carbon nanotubes with the cement material in order to make fiber compounds that enable them to resist fire. *(Abu Bakr, 2019)*

Some global examples of sustainable buildings using nanotechnology :

[A] Oakland Palace Center - California – USA :

Definition: It is a tower built on an area of 1.2 acres in the shape of a letter (T) with a surface area of 3000 square meters, and it consists of 28 floors, a roof garden as a public park above the multi-storey car park, 5 floors.

Nanotechnology materials are used in the exterior coatings to achieve self-cleaning surfaces, as well as anti-scratch and graffiti paints.

[B] Ara Bamis Museum :

Definition: It is located in Rome, the capital of Italy, and was inaugurated in 2006.It consists of a main building with exhibitions, lecture halls, a restaurant, an open exhibition space and administrative offices.

Nanotechnology has been used in the work of exterior coating with self-cleaning paints, scratch resistance and writing with the use of heat-absorbing glass types.

Regional Examples Of Buildings Using Nanotechnology :

[A] Parvaya Town Maadi :

Definition: The building is located in the Maadi district in Cairo, a kilo and a half away from Carrefour Maadi and next to BMW and in front of the largest club complex (Shooting Club and Maadi Club) The project is located between Carrefour and the Sokhna Tunnel and contains a swimming pool and green areas

with integrated services on an area of 15 acres consisting of (38) towers) 11) An administrative tower on the campus of the ring road directly below it shops and (27) residential towers in the second and third rows in the Compound) and contains (1700) housing units and there is a street with a width of (24 m), a street with a width of (16 m) and a street with a width of (60 m) for the back façade to facilitate Traffic.

The use of Curtait Wall facades is soundproofed and reflective of sunlight.

Picture No. (5) shows the façades that are soundproof and reflective of the sun's rays using nanotechnology

Results :

After shedding light on nanotechnology and its applications in the field of construction and building and the most famous global and local experiences in using this technology in public buildings, analyzing and evaluating it, we find that

it is a green technology and its purposeful applications in the field of environmental sustainability, due to the capabilities it provides that were considered in the recent past a path of imagination. Scientific, as well as its compatibility with the environment, providing the best internal environment, in addition to the economic return in time, effort and money :

1- Nanotechnology works to modify the properties of natural or industrial materials by changing the atomic arrangement of the material, which leads to shrinking the negative properties or adding other properties that were not previously present.
2- Knowing a list of nanomaterials in constructions and buildings to be used and environmentally compatible as a tool to make it sustainable.
3- Nanotechnology can reduce cooling and heating costs and energy consumption in buildings, which is reflected in thermal comfort for the user in the indoor environment.

4- Knowing a list of nanomaterials in constructions and buildings to be used and environmentally compatible as a tool to make it sustainable.
5- Using nanotechnology from smart materials that change their properties to harmonize with the surrounding environment, such as using a paint that alerts in the event of a gas leak or electrical failure or stores electricity during the day to broadcast it at night.

Recommendations :

1- Forming integrated research teams to cover all disciplines related to nanotechnology in the field of construction and building and make integrated studies for environmental and economic aspects.
2- The state must include the uses of nanotechnology applications in buildings and constructions within its national projects.
3- Urging investors and businessmen to participate in nanotechnology research and allocate part of the state's financial resources to carry out scientific research in building and construction works to maximize the benefit from extending the life span of the facilities and achieving internal thermal comfort for the users of the facility, which reduces costs.

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