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6. Impact of Nanotechnology in Increasing the Environmental Changes

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ABSTRACT

Improved air, soil, and water quality are only some of the major environmental concerns that face the world today. Industrial and mining sites are being improved, pollutants are being detected and treated, and pollution is being prevented. The usage of nanomaterials may be a solution to some of these issues. Nanomaterials can help clean the environment and even provide efficient energy solutions, such as solar cells based on nanomaterials. In addition, nanomaterials increase the quality and performance of a wide range of consumer goods. Exposure to manmade nanotechnology is on the rise because of this. Nanotechnology, on the other hand, has both positive and negative effects on the environment.

KEYWORDS

Nanotechnology, Environment, Climate, Environmental Changes, Nanoparticles for Environment.

Introductions:

Even though nanotechnology has the opportunity to boost human health and environment directly, it also carries the risk of unintended consequences, which could have negative consequences for both humans and nature. In order to reap the benefits of this new technology in terms of health, the environment, and sustainability, research must first assess the environmental and health implications. The impact of nanotechnology extends from its medical, ethical, mental, legal, and environmental applications to fields such as engineering, biology, chemistry, computing, material science, military applications, and communications. For air and water quality monitoring, nanotechnology advancements may also be ready to deliver more sensitive detection systems that can simultaneously measure numerous factors in real time. It is becoming increasingly common to use photocatalytic capabilities of titanium oxide nanoparticles to build self-cleaning surfaces that minimize existing pollution from industrial emissions. The environmental impact of nanoparticles, however, is still largely unknown; in some situations, chemical composition, size, and shape have been demonstrated to have a role in toxicological effects. The use of carbon nanotubes and metal oxide frameworks as hydrogen storage materials backed by lightweight, high-strength nanotechnology can help save resources. Non-porous silicon and titanium oxide in improved solar cells, as well as nanostructured electrode materials, are other energy-related uses. When evaluating whether the potential advantages of nanotechnology outweigh the hazards, it is critical that an effective system for recycling and recovering nano materials be developed. For determining the true environmental implications of a process or product, lifecycle assessments will prove to be an invaluable tool. Nanotechnology's impact on the environment, both positive and negative, is examined. Detection systems for air and water quality monitoring could also benefit from advances in nanotechnology, allowing simultaneous measurement of numerous parameters in real time response capability. It is common practice to use titanium oxide nanoparticles' photocatalytic characteristics in order to create self-cleaning surfaces that reduce the amount of pollution already in the environment.

Even while nanotechnology has the potential to help solve environmental issues, the president's understanding of the environmental impact of nanoparticles is limited, albeit in some situations chemical composition, size, and shape have been found to play a role. Hydrogen storage materials supported by carbon nanotubes and metal oxide frameworks can be made lighter and stronger using nanotechnology. Advanced photovoltaic cells use Nano porous silicon and titanium oxide, as well as nanostructured electrode materials, to improve their performance. In order to determine whether the potential advantages of nanotechnology outweigh the hazards, an effective system for recycling and recovering nanomaterials is required. If you want to know the true environmental impact of your product, lifecycle analysis is the tool you need. Nanoparticles' current uses and manufacturing costs are poorly documented. Approximately 2,000 heaps of nanoparticles have been manufactured in 2004, and it's expected that the manufacturing rate will increase to 58,000 heaps by way of 2020, according to estimates. As the production and use of nanoparticles grows at an exponential rate, so will exposures to the environment and to humans. As a result, several researchers are concerned about their ability to cause dangerous results (2). In this study, we discuss the behaviour of nanoparticles in the environment and examine commercial nanoparticles, the accidental production of nanoparticles, natural nanoparticles, and the environmental effects of nanoparticles.

Small particles are the focus of nanotechnology because their behaviour is dictated by physical and chemical laws that cannot be applied at a larger scale. They are known as nanomaterials by some, and they have unique features that aren't found in other materials. In the absence of an energy source, hydrogen and oxygen can be used as backups. Hydrogen played a significant role in the storage of fuel some 40 years ago. Hydrogen production was also boosted as a result of the increased efficiency of storage. Fuel-consuming vehicles are being replaced by electric cars that can travel up to 1100 miles on a single charge in an effort to minimize fuel costs. Zero-emission vehicles like electric cars have shown to be a boon. These batteries use a lot of nanotechnology to speed up the charging process and cut down on the amount of time they need to be recharged. Nanotechnology is also used by Frost & Sullivan to reduce CO_2 emissions by up to 3 million tons per year and the insulation of solid-wall buildings (Ahmed, Hyder, Liaqat & Scholz, 2019).

Green Technology:

There is a remedy in the employment of environmentally friendly technology or green production. Natural resources are being conserved by the implementation of this environmentally friendly technology. Using less raw materials, less energy, and producing less waste is the goal of this technology. The generation of waste is a well-known side effect of any manufacturing process. With the use of environmentally friendly chemicals and energy-efficient manufacturing techniques, this can be reduced to a large extent. In the cleaning sector, the use of micro emulsions in place of VOCs is a green technology.

Nanoparticle production and use is being closely monitored by scientific authorities, who are also keeping tabs on the consequences. For this, the technology's advantages must be balanced with its possible negative consequences.

Nanotechnology Be Used to Help Limit Climate Change:

In the last few decades, global warming has escalated to a crisis level of importance. Changes in solar output, depletion of the ozone layer as a result of harmful pollution generation, volcanism, and human activities have all contributed to the development of the potentially dangerous issue of global warming. Exhaustion of greenhouse gases has resulted in the loss of global temperature regulation. Every year, the temperature rises by about 0.56° C. 70 % of respondents polled believe that human activities have caused global warming since we have no way of preventing it. If these activities don't stop, by 2050, 83 % of carbon dioxide emissions will lead to an 11.6 % increase in temperature compared to now. CO_2 emissions in the atmosphere are a major problem for climate change mitigation.

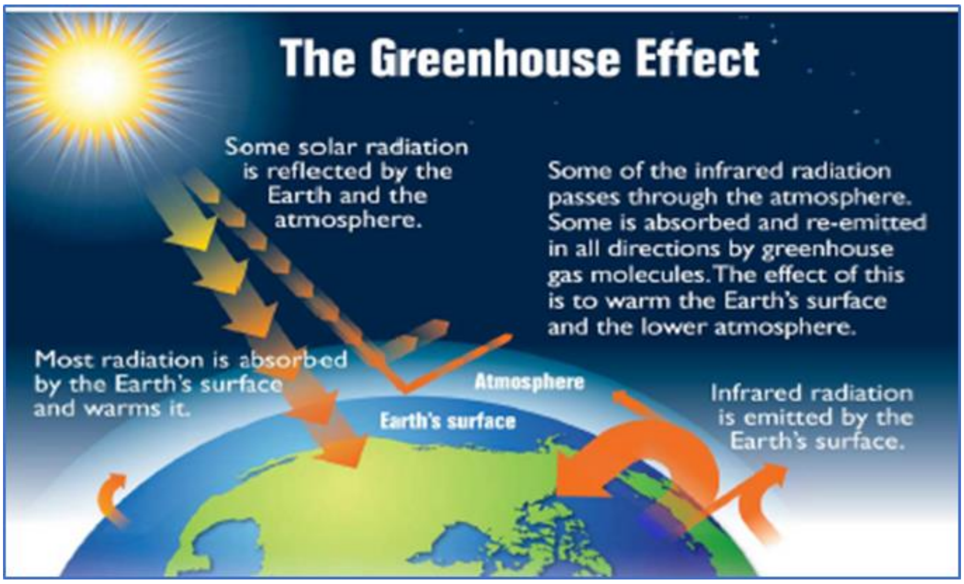

Figure 1: The Greenhouse Effect

(Source: US EPA Climate Indicators in the United States, 2012)

Used Nanotechnology to:

Engineering nanomaterials (ENM) are being released into the environment at an increasing rate as a result of manufacturing, use, transportation, and disposal. Therefore, it becomes relevant to guage the potential impact of those ENMs on the environment and human health; particularly, since ENMs could interact with organisms and environmental complex matrices The ability to adapt the structures of materials with extremely small scales to actualize specified attributes is critical to many of the advantages of nanotechnology.

Materials can be improved in numerous ways through the use of nanotechnology, including making them stronger, lighter, more durable, more reactive, more receive-like, or better electrical conductors. It's not uncommon to see products from well-known brands on store shelves that claim to be made with nanoscale materials and methods:

- Additives in the nanometer range Two or more surface treatments of materials can give lightweight ballistic energy deflection and personal body armor, or they can help them resist wrinkles, staining, and bacterial growth. They can both do both.
- Repaired environmental damage that had occurred before.
- Correct environmental problems that currently exist.
- Preventing future environmental impacts is unquestionably important for the survival of our planet for future generations.

Figure 2: Applications of Green Nanotechnology

Environmental Applications of Nanotechnology:

It's reasonable to predict that Nano chemistry will have a significant impact on wastewater treatment, air purification, and energy storage devices. Effective filtration techniques can be achieved through mechanical or chemical means. Filtering techniques that use membranes with the right hole sizes are one type of filtration technology. For mechanical filtering with extremely small pores less than 10 nm (Nano filtration), nonporous membranes can be used. They may be constructed of nanotubes. The removal of ions and the separation of various fluids are the primary uses of Nano filtration.

The use of magnetic separation techniques in combination with magnetic nanoparticles provides an efficient and dependable way to remove heavy metal contaminants from wastewater. It's cheaper and more efficient to use nanoscale particles to remove impurities than typical precipitation and filtration procedures. The use of nanoscale iron particles as a cleaning agent for brownfield sites has also been demonstrated.

Potential Environmental Effects:

The surface area of nanoparticles is greater than that of bulk materials, making them more dangerous to the human body and the environment. As a result, nanoparticles have garnered national and international attention because of their potential impact on society. Additionally, the use of nanoparticles in air pollution monitoring and cleanup can reduce material consumption and remediation costs. Graphene-based coatings and carbon nanotubes have been developed to decrease the weathering effects on composites used in wind turbines and aircraft. Nanoscale inclusions of graphene have been found to be more effective at reducing the degradation of UV exposure and salt than other materials. You can extend the life of your material by applying it a nanoscale coating that resists salt exposure and UV rays more effectively. These carbon nanotubes are being used to improve data information systems. While nanoparticles have many benefits, there are a few concerns that must be taken into account: Particle size analysis is a critical issue with nanomaterials. Throughout the development of nanotechnology, new and unique nanomaterials are being created. However, the form and size of the components have a significant role in determining the toxicity of the chemical. In order to preserve the environment, current technology is incapable of perceiving nanoparticles because of a lack of knowledge and methods for identifying nanomaterials.

Positive Impacts:

Improved water quality is possible because to nanotechnology. In water treatment, the use of nanomaterials such as carbon nanotubes (CNTs), zeolites, zero valent iron (ZVI), and silver nanoparticles is possible. Other nanomaterials, such as zinc oxide (ZnO), titanium dioxide (TiO_2), and tungsten oxide, act as photo catalysts. When exposed to light, these photo catalysts can oxidise organic pollutants and transform them into non-toxic materials. When it comes to photo resistance and photoconductivity, TiO_2 tops the list since it is readily available, low-cost, and non-toxic. Microbes are sensitive to silver nanoparticles, which are antibacterial. Wastewater treatment employs many polymeric nanoparticles.

Nano filtration, another cutting-edge innovation, can be used to treat water in a variety of settings, including the office, the home, and even the industrial sector. An energy efficient desalination process uses a non-porous membrane made of molybdenum disulphide (MoS_2) that filters five times more than traditional membranes. Nano fabric paper towels have been produced that are woven from tiny wires of potassium manganese oxide that can absorb oil 20 times its weight in order to clean up oil spills in waterways. A solution to the problem of tainted water and the preservation of more pollution has been found in nanotechnology.

Toxic gases in the atmosphere can be cleansed with the use of nanotechnology. Molecular sensors must first be used to identify the pollutant particles. To detect heavy metal ions and radioactive elements, scientists have developed a sensor termed a "Nano contact sensor." These sensors are tiny, affordable, and easy to use on the job site. They also have a long battery life. Detection of NO_2 and NH_3 gases using single-walled nanotubes (SWNTs) is currently being investigated. In addition, as compared to conventional sensors, which operate at temperatures ranging from 200 to 600°C, SWNTs sensors can achieve higher sensing activity at room temperature. It has been discovered that cantilever sensors can detect VOCs, heavy metals and pesticides. Toxic gases including NO_x, SO_2 and CO_2 can be absorbed by a mixture of CNTs and gold particles. Manganese oxide, another porous nanomaterial, is better at absorbing hazardous gases because of its huge surface area.

As a result, we can help safeguard human health and the environment by identifying pollutants using special sensors. To put it another way, nanotechnology can help us reduce waste, reduce greenhouse gas emissions and release dangerous chemicals into water bodies.

Potential Environmental Benefits:

A slew of new products touting environmental and climate-friendly benefits have appeared on the market in response to rising costs for raw materials and energy and growing customer concern about the environment. Novel and ecologically friendly goods can benefit from the unique physical and chemical features of nanomaterials.

For instance, nanotechnology-based dirt- and water-resistant coatings can extend the useful life of a product by increasing the material's resistance to mechanical stress and weathering; novel insulation materials can boost a building's energy efficiency; and the addition of nanoparticles to a material can reduce its weight and save energy during transportation.

Nanomaterials are used in the chemical industry because of their unique catalytic properties and because they can be used to substitute ecologically harmful chemicals in certain applications.

Most commercially accessible 'Nano-consumer items' are not designed to safeguard the environment. Nano silver-infused clothing and carbon-nanotube-enhanced golf clubs do little to safeguard the environment. Manufacturers frequently make such claims without demonstrating their validity. There are several products on the market that promise to make cleaning easier while also conserving time, water, and cleaning agents, such as those with self-cleaning surface coatings or spot protection textiles.

Much emphasis is placed on the long-term possibilities of nanotechnology. But this is frequently due to unrealistic hopes. In order to assess a product's environmental impact, both positive and bad, it is necessary to look at the product's complete life cycle, from raw material production to final disposal.

In general, environmental advantages aren't described in terms of how much energy and resources are used to make the products themselves (see "Nanotechnology and the environment – Potential benefits and sustainability consequences" for more information).

Conclusion:

To protect the environment and climate, Nano technological goods, processes, and applications are projected to save raw materials, energy, and water while lowering greenhouse gases and hazardous wastes. As a result, the use of nanomaterials holds the promise of positive effects on the environment and long-term sustainability.

If you're worried about the environment, you should know that nanotechnology is now playing a little role in research and practical applications. Companies in the field of environmental engineering itself place a low value on nanotechnology.

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