Power Generation and Water Resource Technologies in an Industry

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ABSTRACT:
Increasing industrialization and unsustainable consumption pattern are escalating the environment problem due to depletion of resources and energy. The unsustainable use of renewable resources and the generation of toxic materials during industrial operations are creating problems to biodiversity, environment and human health. Industrial production by using environmental friendly sound technologies is considered to be one of the best strategies to provide the paradigm to put our society on the path of sustainability. Energy is the primary input in any industrial operation and also a major input in sector such as commerce, transport, telecommunications, etc. besides the wide range of services required in the household and industrial sector. Owing to the far-reaching changes in the form of energy and their respective roles of nanotechnology in supporting human activities, research and training on various aspects of power demand and environment have assumed great significance.

Applied Nanotechnology works on climate change solutions by building on global research utilising Dye Solar Cell (DSC). Artificial photosynthesis method. Nanotechnology methodology for industrial development and applications. Dyesol's technology identified in forecasts through Photovoltaic Roadmaps as the emerging solar technology. Use of high-priced raw materials, a manufacturing process that does not produce toxic emissions, and potential for rapid efficiency enhancement. DSC can be integrated into metallic cladding for roofs and walls, glass facades of commercial buildings, recharging systems for electronic equipment. Applications derived from nanotechnologies are expected to make a significant contribution to diverse fields as: (a) Water purification and treatment, which will become increasingly important in both urban areas, agriculture and mining, particularly as a result of the impact of climate change (b) Health care, involving applications in medicine, dentistry, pharmaceuticals and diagnostics (c) Energy efficiency and clean technologies, including improved battery storage, improved solar cells, and micro-power supplies for personal electronics.

Bi-fuel vehicles will run on solar power and will automatically switch to petrol or diesel whenever the requirement arises. Hence directly/ indirectly of increasing power generation demand and water resources are one of the most important parameters, which must be conserved for industrial setup and its operation in natural environmental ecosystem. Increasing population, reduced greenery, cutting forests and increasing carbon dioxide level will reduce energy and water resources one day. Sustainability - “The continuous supply of power and clean water for human and other uses without compromising the environment, economic and welfare of future generations.” Do not be contented with showing natural world friendship in words alone; let your heart burn with devoted thought for all, who may come across natural path to save the earth. A clear conscience of nanotechnology is usually a sign of good experience for power and water conservation and any change, even a change for the better, is always accompanied by drawbacks and discomforts.

1. INTRODUCTION

Nano-sciences and nanotechnologies research development, innovation are governed by an integrated, safe and responsible policy framework. This development strategy is being implemented through a wide range of activities, whose purpose it is to ensure that development and deployment of nanotechnology are carried out in a way that takes people's expectations concerns into account, especially as regards human, environmental safety delivers tangible benefits for the citizen and the society (Baughman et al., 1999). Since 1995 the Dyesol research team has collaborated with the Queensland University of Technology's Faculty of Built Environment & Engineering, Prof. John Bell. Two teams have worked closely to develop new complementary catalyst and electrolyte materials to increase efficiency in exploring DSC performance. Catalytic counter electrode and the ion conducting electrolyte of a DSC (the cathodic subsystem) have significant performance impacts on energy conversion efficiency. This project targets commercial DSC at 12% efficiency and will be investigating liquid, gel and polymer cathodic subsystems and materials that will expand DSC applications e.g. see Fig. 1.

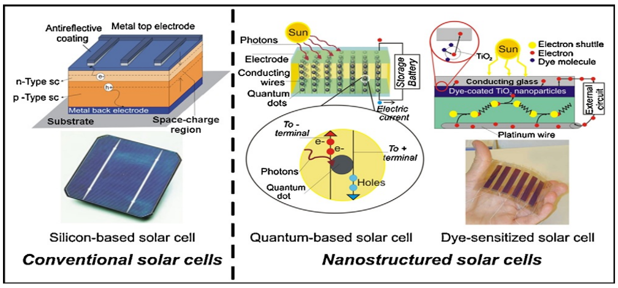

Figure 1. Photovoltaic technology evolution: from conventional to nano-structured solar cells

- Charge separation: It is a photo-electrochemical cell - as charge separation occurs on interface between a wide band-gap semiconductor TiO_2 (*e.g.* titanium dioxide) and an electrolyte.
- It is not a dense film as is amorphous silicon, but a nano-particulate cell: a "Light Sponge".

- A dye monolayer chemically absorbed on the semiconductor is the primary absorber of sunlight; free charge carriers are generated by electron injections from a dye molecule, excited by visible radiation.

The aim is, therefore, to cover important European Technology Platform related priorities for sustainability, *e.g.* in chemistry, construction, textile, fibers and forest based industries, transport and agro-food related sectors, with nanotechnology as the *"Key Enabling Technology"*. Further, Energy, Environment and Healthcare are at the forefront of global challenges, and of concern to every citizen. Despite the significant economic potential of environmental, energy and health technologies, nanotechnology must stand in forefront for providing solutions. Societal, governance, health-safety-environment related issues must seamlessly accompany the expansion of industrial applications. *The potential input to sustainable development makes nanotechnology one of the "Key Enabling Technologies". This activity will give priority to potential applications incorporating nanotechnology in various industrial sectors, which have a significant potential to improve sustainability e.g. in terms of material, energy or process efficiency, industrial productivity in addition to contributing industrial competitiveness and bringing benefits to consumers.*

Advance sustainable management and exploitation of marine water resources (fisheries, aquaculture) in particular monitoring of quality of shellfish waters and minimize risks to human health. These sensors should target the detection and monitoring of high impact and presently difficult to measure emerging pollutants and other substances, e.g. algal toxins and their producers, synthetic organics, herbicides/pesticides and *Persistent Organic Pollutants*, including *Polycyclic Aromatic Hydrocarbons* should enable early diagnosis of deterioration of the environmental status of the marine waters in multi-stressor conditions.

1.1. Superior Renewable Resources Scope

A more efficient use at industry level, of material and energy resources, while at the same time ensuring high productivity rates, has become a key issue for a sustainable nanotechnology modern sector. In this regard, a more extensive integration of technologies related to renewable energy, material resources, an optimal re-use of air, water and scrap (or other waste) along the lifecycle of industries may become a precious supplement to current strategies for resources efficiency. The resources consumed in the production processes including air and water should be minimized by nanotechnology energy efficiency optimization in a continuous and iterative manner.

- Water scarcity and supply reliability, affecting irrigation, domestic and industrial water use, and environmental flows.
- Higher temperatures, altered groundwater, soil conditions, sea-level rise, changed rainfall regimes will affect urban infrastructure including failure of urban drainage and sewerage systems, potential blackouts, transport disruption, and greater building damage.
- For transformation of chemicals and substances, such as setting up catalytic reactions allowing the conversion of industrial waste into power, energy, CO_2 and water purification etc.

2. INDUSTRIAL WASTE MODELLING

After discovery of carbon nano-tubes (CNTs) (Baughman, 1999), numerous works have been devoted to study the properties and applications of this fascinating novel material (Frisch et al., 1998). The applications of CNTs are widely ranged from nano-biotechnology to nano-mathematic (Guan-Ping et al., 2006 and Harris, 1999). However, based on nano-tubes properties exhibiting absorption and storage behaviour depending upon the tubular diameter. Therefore, considerable efforts have been raised to synthesize CNTs with properties independent of tubular diameter (Iijima, 1991). Among them, the group of heavy metals and especially Hg^{+2} and Pb^{+2}, which always exhibit toxic behaviour are considered as proper alternates of other heavy metals (Lemi et al., 2004).

The stable one-dimensional structure of CNT was either theoretically recognized or experimentally synthesized (Baughman and Loiseau, 1995). Previous studies indicated that CNTs are very important in the gas storage; electrochemical determination of the metal ions or molecules for work preparation studies the existence of mathematical modeling (Chopra and Wolfgang, 1995). This mathematical modeling Eq. 1 for separation of the metal ions based on the Gaussian 98 software using for other heavy metals, based on (E_{tot}) total interaction energy between (E_M) metal ions and carbon nano-tube (E_{CNT}) and by this modeling; we can design a new approach for separation of industrial waste mixture metal ions and others. The mathematical equation for total energy of heavy metal absorption is:

$$E_{tot} = [E_{M@CNT} - (E_M + E_{CNT})] * 627.529 \text{ k cal/mol} \qquad (1)$$

2.1. Nanotechnology Applications in Demand

The nanotechnologies applications are expected to make significant contribution to diverse fields as:

- Water purification and treatment will become increasingly important in urban areas, agriculture, mining, particularly as a result of the impact of climate change.
- Health care, involving applications in medicine, dentistry, pharmaceuticals and diagnostics.

- Energy efficient clean technologies, including enhanced battery storage, solar cells, and micro-power supplies for personal electronics.

3. GLOBALIZATION

The global economy currently in a state of fluctuation will continue to grow and develop through the influence of developing nations such as China, India, Russia and South America. This will principally be driven by their increasing demand for number of commodities and products, including food, energy, resources, minerals, water and consumer products. Existing fossil fuel supplies will diminish significantly over the next twenty years (Frost, 2009). Therefore, increased demand for alternative energy sources will emerge in order to conserve power the needs of the increasing global population and the industries that supply their products and services. Future alternative energy systems will characterize as chiefly clean, renewable in nature possessing low or negligible carbon emission in complete lifecycle of power production. Environmental mission through new regulations and society's changing attitudes for lower carbon emissions will have a significant impact on industry and government will continue to demand increased ecological liability from consumers, industry to reduce impact on earth-climate change factors.

3.1. Kitchen Waste to Electricity Generation

Electricity generation from kitchen waste or scrap is itself is a major project assignment we deals with, which could enhance step towards the energy generation contribution for the progress of the nation. Not only in India, but also in foreign countries has taken initiatives to achieve target in energy generation. Essential part of our daily life is kitchen, where we come across various types of food materials consumption in use on daily basis. Certainly after use of kitchen food materials, the waste scraps of food material left as a waste, which could be recycled for power generation. (a) Waste food material converted into pulp and packing used to get filtered (b) Before entering into digestion tank pasteurization process is followed (c) After completing process the left material used for farming fields as fertilizers e.g. see Fig. 3.1.

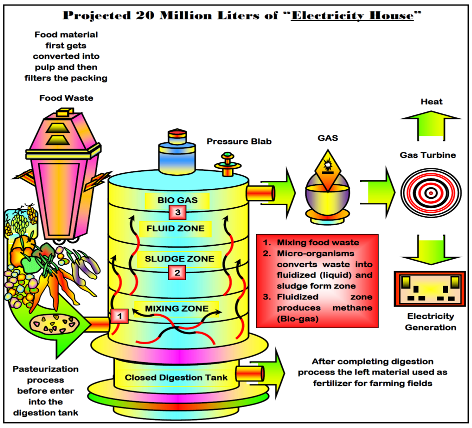

Figure 3.1. Kitchen waste to electricity generation

3.1.1 Municipal solid waste

On existing demand of power the municipal solid waste can be used to generate energy. Several technologies have been developed that make the processing of *Municipal Solid Waste* (MSW) for cleaner energy generation and more economical than ever before, including landfill gas capture, combustion, pyrolysis, gasification and plasma arc gasification. EPA regulations in 1995 and 2000 under the Clean Air Act have succeeded in reducing emissions of dioxins from waste-to-energy e.g. see Fig. 3.1.1 amenities by more than 99%; while mercury emissions have been reduced by over 90%.

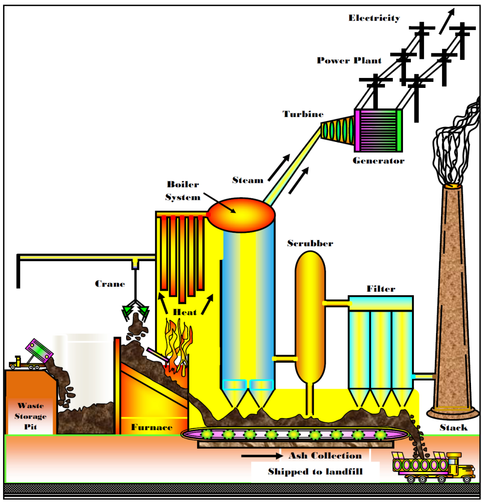

Figure 3.1.1. Waste to energy OR power generation

4. NANO-CLIMATE CHANGE DRIVERS

Climate change is also driving nanotechnology applications in the environmental remediation industry, including water and wastewater treatment industry. Growing numbers of communities are living in areas of severe water stress, driving the need to be more sustainable in their use and associated treatment of water and these nanotechnologies are beginning to gain greater use in water systems (OECD, 2011). Nanotechnology-based remedial applications developed for use in the environment might have important positive impacts that may directly affect human health. Air, water, soil quality remediation and contamination are areas; where nanotechnology enables solutions, which have numerous opportunities. Water is very important resource in many industries (e.g. agriculture and mining) contributing to the economy, which rely heavily on a secure source of clean water access.

However, processed water is able to be used in many applications for these industries and nanotechnology has the potential to satisfy the water filtration needs of industrial, commercial, residential and personal consumers (Boehm, 2009). The water industry in Australia already applies nanotechnologies for the detection and treatment of contaminated water. In future these are envisaged to be particularly efficient for three key water handling purposes: treatment and remediation, sensing and detection, and pollution prevention. Managing and securing access to clean water is major challenge not only in Australia, but globally in developed and developing countries water shortages can have a tremendous impact on health industries e.g. agriculture, manufacturing, mining, power production and more than half billion people in severe water stress areas are presenting major opportunity for nanotechnology to address this issue (OECD, 2011).

4.1. Fossil Fuels Leverage

Coal, natural gas, petroleum are currently responsible for 67% of global electricity production. A current area of focus for biotechnology and synthetic biology is leveraging large global reserves of hydrocarbons such as oil, gas, shale and oil sands with biology tools. Coal bed methane is globally available sources of natural gas, vast and largely untapped reserves. Biotechnology and synthetic biology research is underway to harvest methane through microbial digestion and other processes (Brinks, 2007). Bio-hydrometallurgy is an interdisciplinary field involving nanotechnology processes that make use of microbes (bacteria, algae) that take place in aqueous environments and deal with metal production; water treatment industries in order to find new approaches and technologies to: (a) Process ores and concentrates (b) Remediate waste waters (c) Recover and recycle metals.

4.1.1. Hydrogen Fuel

Hydrogen fuel is an area of focus for commercial applications of nanotechnology (OECD, 2011) or synthetic biology as clean, efficient process for extracting hydrogen from water. Hydrogen is highly desirable as a fuel source, because it is clean-burning and only produces water as a by-product. Hydrogen also has second highest energy density per unit of weight of any known fuel.

5. CONCLUSION

Hence, nanotechnologies are expected to play a noteworthy role in water resource management e.g. in industries (mining and agriculture). Agriculture is by far the largest user of water and is responsible for many cases of water pollution. Precision farming using wireless nano-sensor technologies will provide users with water management systems featuring good accuracy, rapid response rates, robustness, potentially combining sensing and feedback e.g. at measuring levels of contamination and treating them. Water management in agriculture will be significantly superior in the future through the efficient application of rising nanotechnologies. Developing appropriate metrology standards required for nanotechnologies are effective methods for measuring air and water-borne nano-materials as shown in Eq. 1. Due to increases in water demand and climate change, strategies that reduce demand, increase efficiency and maximise wastewater reuse will be vital in implementing sustainable future projections.

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