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Short Review Paper

A survey: use of Nanotechnology for waste treatment

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Abstract

Waste disposal is a drastic problem, world facing in 21st century. Industrialized countries like Japan, India are the runner up in this line. The ordinary methods like pyrolysis, Landfills, and incineration etc. are non-ecofriendly, expensive and take time. Using Nano-technology fabrication concept of efficient nano-filter and Ag, Cu, ZnO, TiO_2 nanoparticles (nps), Carbon Nanotubes etc waste treatment is become more effective. Comparative survey of nano-technology and other techniques show that it is much better for the purpose of waste disposal.

Keywords: Organic waste, Nano-material, Nano-filtration, Granular Activated Carbon(GAC)), Carbon Nanotubes (CNTs), Multi Walled Carbon Nano-Tubes (MWCNTs), Nano Silver Particles (Ag-nps).

Introduction

India is the tenth most industrialized country in the world with about 88 percent industrial cluster scattered across the country (According to central pollution control board). Industries like pulp and paper, thermal power plant, textiles and steel and iron industries are highly water intensive causing pollution of rivers through industrial cluster are severely polluted as seen in the case of Plachimada, Kerala and in the Tungabhadra sub basin, Karnataka. Pollution in these rivers cause bad effect, on health, environment and economy residue around these rivers. Government of India spent approximately more than Rs 1500 Crore over the past two decades on the river Yamuna but it is found still toxic. Recent examination of Yamuna found several unidentified by-products in the river water.

According to national solid waste association of India, main source of waste water are house hold waste, commercial, street sweeping, hotel and restaurants, clinics and dispensaries, construction and demolition horticulture and sludge. Method of waste disposal at present are blazing in air, disposing in ocean, Sanitary Landfills, Incineration, Manure formation, Ploughing in farms, as animal food, Crush, mixing and discard into sewers etc. About a 48% of the waste we produce as organic waste which can easily be made into reusable, high quality compost and rest can be recycled as shown in Figure-1. Pie-chart shows the percentage of different kind of waste.

Generally public think about waste management of solid, the ultimate solution, typically the landfill. The most important and ultimate state of waste management is proper channel treatment and get rid of waste. But in natural environment, optimum composition of water, Oxygen, Carbon, and Nitrogen, microbes are active to break down wet matter to produce manure. The composting process is done by microbes to break down wet organic matter into composite. So many strategies are followed time to time, now nanotechnology is new hope in waste disposal treatment efficiently.

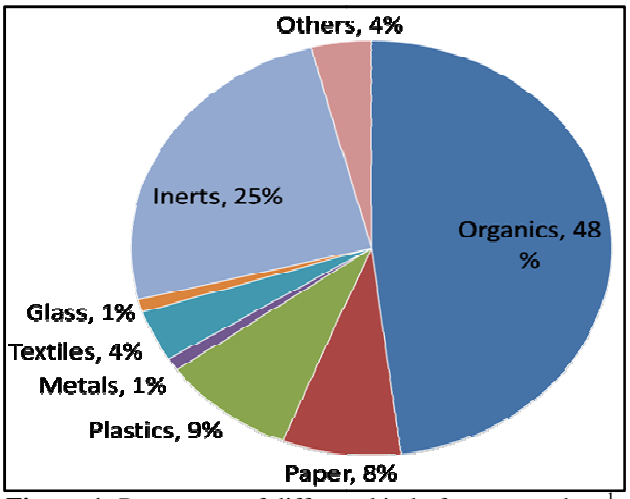

Figure-1: Percentage of different kind of waste produce[1].

Nanotechnology

Nanotechnology is engineering at atomic and molecular level. Nano particles used in present time technology is about 1 to 100 nanometer in size and at this over small size, general rules of Chemistry are not applied. In nature Nanotechnology emerged billions of years ago, its best example is photosynthesis where plants convert carbon dioxide by using energy from the visible range of sunlight to Oxygen.

The whole transformation take place in structure called Chloroplast composed of several nanothylakoid disks that contain a green pigment (Chlorophyll). Another example is enzymes that catalyze chemical reaction and sometimes considered as indispensable for the development of specific reaction[2]. Nanotechnology can solve social issues regarding reduce waste production, clean-up industrial Contamination, recycling and reuse waste water that is safe for drinking and good for aquatic biota. Nanotechnology is the most effective for the treatment of waste disposal as it makes the filter, sensor, metal removal more effective with solar energy being used for its process. Industrial pollutants such as, Bisphenol-A, Alkyl Phenol, Phthalates etc. could be separated from polluted water by using nanolevel filtration process. Nano-filtration process is merged in many industrial waste treatment plants to produce effluents with less concentration of industrial waste.

Nano treatment technique

Conventionally adsorption technique is the most technical, economical and a viable option. Research in waste disposal treatment with adsorption technique has resulted in formation of specific materials for ejection of metals from solution, these material include natural products like activated Carbon, Aluminosilicates, Peat Kaolin, Zeolite, Clay, and Polysaccharides. At present carbon based nanomaterials specially in the structure of carbon nanotubes are being used as unique adsorbents with high efficiency because its specific surface area is high. Multiwall carbon nanotubes (MWCNT) are having metal-ion sorption power of many times larger than the normally used powder and activated granular carbon[3]. Nanomaterials can be used to build structures` that have controlled shapes, density and dimensions for specific filtration applications. Cylindrical membranes with pores tiny enough to filter out the smallest organisms have been developed. Carbon nanotubes are a class of nanoscale materials used in various forms of water filtration.

So the power requirement for Nano-Filter is much lower than reverse osmosis process, for Nano- Filter operates at lesser pressure, generally in the regime of 50-150 psi. Nano Filter film mostly reject ions of divalency at a very higher rate than ions ofmonovalency[4,5].

Nanofiber concept in merging with bio- removal of harmful xenobiotic is the modern method in industrial wastewater remediation technique. Microorganism based biofilm formation can be highly supported using nanofiber architect, and the entire system provides stable and speedy biodegradation[6]. Metal oxide nanomaterials such as titanium dioxide (TiO_2) are among the one nanocatalyst that were verified successfully for their antimicrobial properties. BesidesC_{60} as pollution traces, are being used to provide pollutant fate information to assist in developing water purification strategies. Silver (Ag^+) ions from silver ionic compound which formed from Ag-nps merge with water are extremely harmful to microbes.

Land micro-organisms are influenced by rubbish organic discharge coupled with Ag-nps is present on land. Ag-nps exhibit harmful effect on aquatic animal even now at minute amount in mammals, such type of matter is harmful in excess. Some investigations on plants are in literature, but a current investigation demonstrate an effect of Ag-nps on the progress of grass seedlings because of cell damage. A seeming reasonable basic opening passageway of Ag-npsis through water due to Ag-nps could be separated from some unique textiles[7]. Ag-nps in pollutedaqua system, hence proved by various scientific communities and place that can dangerous for bio- diversity[8]. ZnO has been proven as an superior photocatalyst compared to commercial TiO_2 due to its higher initial rate of activities and adsorption efficacy of solar radiation. As a result, ZnO has been widely used in waste disposal treatment because of its excellent chemical and physical properties. To investigate the photocatalytic activities of the fabricated ZnO NPs, an organic dye, rhodamine B was employed and it was analyzed that on exposure to sunlight in the presence of NPs, ZnO shows good photocatalytic degradation efficiently but rhodamine dye in presence of ultraviolet light degrade more rapidly compare to sunlight[9].

Now, the much intensively investigated nanomaterials for water and wastewater remediation majorly include metal nanoparticles with zero valency, nanocomposites and carbon nanotubes[10]. Hu et. al discovered a new technique by combining the adsorption capacity of nanoparticles (nps) and the magnetic separation method. Additionally, Chromium was successfully removed from the waste water and the nanoscale metal removing capacity after six adsorption-desorption cycles. At present, various zero-valent (neutral) metal nanoparticles, such as Fe, Zn, Al, and Ni, in water pollution treatment have thrust research interest. The standard reduction potentials of Fe, Al, Ni, and Zn favours highly reducing capability, nano level with zero valency aluminium (Al) is thermodynamically not stable in the presence of water, which favors the deposition of oxides/hydroxides on the external area, impeding (completely) the shift of electrons from the metal external area to the contaminants.

Conclusion

The present technologies dealing with the waste disposal treatment are pyrolysis, incineration is expensive and takes time and hard to use but the latest nanotechnology using Nanofiltration, Carbon Nanotubes (CNTs), nanoparticles, nanoadsorbent are more efficient than conventional waste disposal treatment due to the very high specific surface area of material. So the nanotechnology is the latest, advance and efficient way for the waste disposal treatment.

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