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Utilization of green chemistry for enhancing water quality

Manmohan Krishna Upadhyay
Department of Chemistry, Mahant Adwaitnath Govt. Degree College, Junglekaudia, Gorakhpur, Uttar Pradesh, India

Abstract
Our environment, which is endowed by nature, needs to be protected from ever-increasing chemical pollution. The challenge for the institution and industries is to come together and pursue development in the field of greener chemistry by reducing or eliminating the use and generation of hazardous substances. The main idea behind this paper is to activate work toward green chemistry for which involvement of academic, industrial, and governmental and non-governmental bodies is needed collectively, which will help the designing and development of environment-friendly chemistry practices in India. Water resources are finite and the population that depends on those supplies is increasing inexorably. To prevent the concentration of water pollution, efficient safety measures have be employed that prevent point-source and nonpoint-source pollution. Green chemistry solutions are effective way to deal with the water pollution problem as it is the least harmful ways to prohibit contaminants. Proper remediation has been provided to aid correct contamination of groundwater, which affects nearly hundred million people worldwide. A variability of novel methods has been included for prevention and remediation of water pollution that occasion radical reaction and the utilization of advanced nano-based techniques. This current paper is mainly focusing on current aspect of water pollution control strategies with green chemistry.

Keywords: green chemistry, water pollution, pollutants etc

Introduction

Green technology is the application of the environmental science and technology for the development and application of products, equipment and systems to conserve the natural resources and environment, as well as to minimize or mitigate the negative impacts on the environment from human activities. While ‘Green Technology’ is trendier terminology, it carries meaning no other than ‘Clean Technology’ or the more traditionally used ‘Environmental Technology’. The field of green technology encompasses a continuously evolving group of environmental friendly methods and materials, from techniques for generating non-conventional energy source such as solar power to management tools that help in auditing greenhouse gas emissions. Green technology development must be sustainable, meaning “balancing the fulfillment of human needs with the protection of the natural environment and resources so that these needs can be met not only in the present, but in the indefinite future”. Scheme of sustainable development can be fulfilled at the confluence of three key dimensions, *viz*. environment-social-economic, thus satisfying ‘bearable’ environment and social impact, ‘equitable’ social and economic solutions, and ‘viable’ economic and environmental options. Conventional green technologies have been applied in the fields of water and wastewater treatment, air pollution control, environmental remediation, waste treatment and management, and energy conservation. The following sections discuss some basic knowledge and applications of green technologies in these fields.

Water Treatment

Water treatment is the process of removing undesirable chemical, physical and biological contaminants from raw or contaminated water. The purpose is to produce water suitable for a specific application. Water treatment may be designed for a variety of applications, including meeting the requirements of human consumption (potable water), medical and pharmacology, chemical and industrial applications. The common stages of treatment include pre-chlorination, coagulation and flocculation, sedimentation, filtration, disinfection, post-chlorination and fluoridation. The main purpose of pre-chlorination is to remove odor, taste and smell of raw water in particularly those containing organic substances such as humid acids. Coagulation and flocculation and chemical process that removing fine and suspended solids in the water. The flocculated solids are removed via the sedimentation tank. Fines particulates that escape the coagulation-flocculation-sedimentation process will be trapped in the downstream sand filter beds. Some modern treatment plants adopt unconventional green technology to increase the filtration efficiency, such as the use of membrane filtration. The water after filtration needs to be disinfected using chlorination to eliminate pathogenic microorganisms such as parasites, bacteria, algae, viruses, fungi. Because of the concern of formation of carcinogenic trihalomethane in drinking water arising from the use of chlorination, more and more treatment plants are switching to ozonation as the disinfection method, albeit ozonation is relatively more expensive in the first and running costs. As ozone is highly unstable and it reverts to oxygen soon after it is produced, it has no residual disinfection effect as chlorination does. To provide residual disinfection capability, post-chlorination is still being practiced in many treatment plants. To complete the water treatment process, the last step of treatment is fluoridation with an objective of preventing teeth decay of the population.

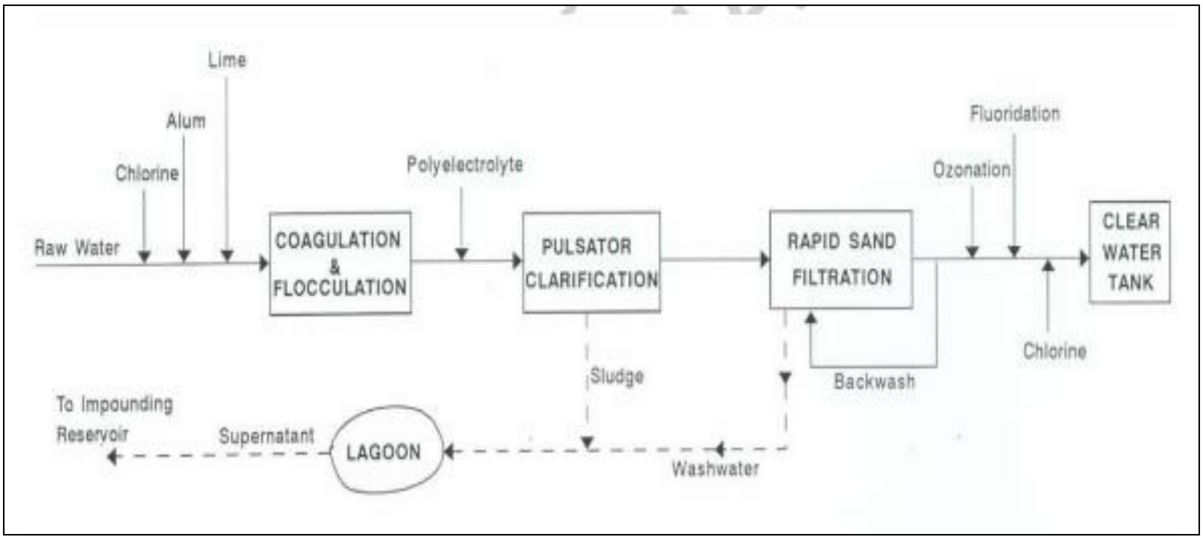

Fig 1: schematic unit processes in a typical water treatment plant

The standards for drinking water quality are typically set by governments or by international standards such as the World Health Organization. It is not possible to tell whether a water sample is of an appropriate quality by visual examination. Chemical analysis, while expensive, is the only way to obtain the information necessary for deciding on the appropriate method of treatment. According to a 2007 World Health Organization report (WHO 2007), 1.1 billion people lack access to an improved drinking water supply, 88% of the 4 billion annual cases of diarrheal disease are attributed to unsafe water and inadequate sanitation and hygiene, and 1.8 million people die from diarrheal diseases each year.

The WHO estimates that 94% of these diarrheal cases are preventable through modifications to the environment, including access to safe drinking water. Simple green technologies for treating water at home, such as chlorination, filters, and solar disinfection, and storing it in safe containers could save a huge number of lives each year (WHO 2005). It appears that reducing deaths from waterborne diseases is a major public health goal in many developing countries.

Wastewater Treatment

Wastewater treatment is the process of removing contaminants from wastewater and household sewage, both industrial effluents and domestic. It includes a series of green technologies to remove physical, chemical and biological contaminants with an objective to produce an environmentally-safe treated effluent stream. The purpose of wastewater treatment is to prevent water pollution of the receiving watercourse. Before discharging wastewater back into the environment, it is necessary to provide some degree of treatment or purification in order to protect public health and environmental quality.

This is achieved by wastewater treatment plants designed to: • reduce dissolved biodegradable organics • remove most of the suspended solids • destroy pathogenic microorganisms

When effluents are discharged into sensitive areas which may intermittently suffer eutrophication, they must also comply with nutrient standards. Two additional important parameters are total phosphorus and total nitrogen. Disinfection, usually with chlorine, serves to destroyed most pathogens.

Wastewater treatment processes are often divided into four stages: • Pre-treatment • Primary treatment • Secondary treatment • Tertiary or advanced treatment.

The preliminary and primary treatment processes involve separating the floating and suspended solids from the wastewater. This separation is usually accomplished by screening and sedimentation. The effluent from primary treatment will usually contain a considerable amount of organic material with a relatively high biochemical oxygen demand (BOD). Secondary treatment involves further treatment of the primary effluent. Removal of the organic matter and the residual suspended material is generally accomplished by biological processes. The effluent from secondary treatment usually has little BOD. Advanced treatment is used for the removal of dissolved and suspended materials remaining after normal biological treatment when required for water reuse or for the control of eutrophication in receiving waters.

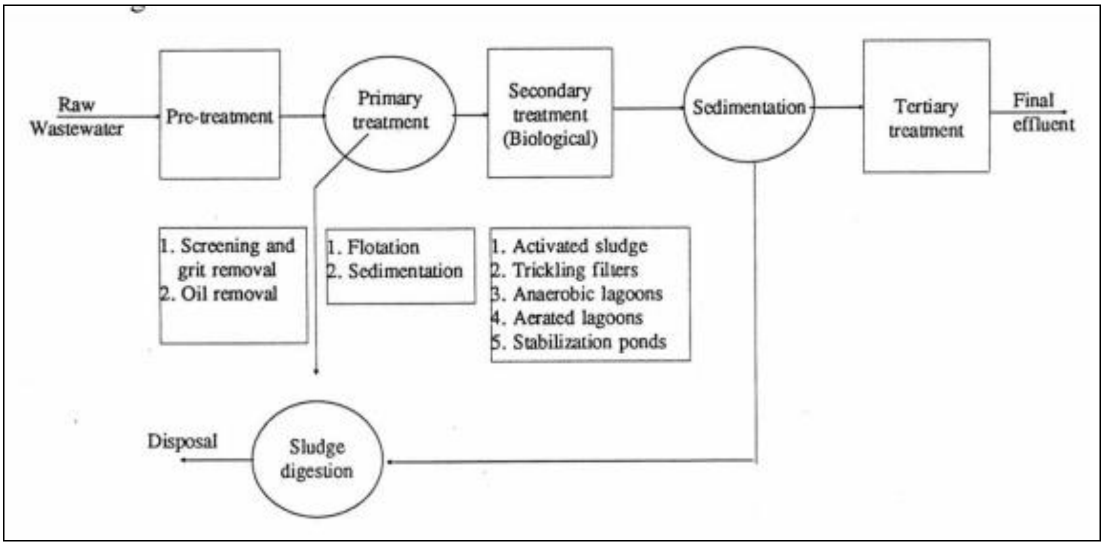

Fig 2: Schematic Flow Diagram of A Typical Wastewater Treatment

The rising cost of water as natural resources and increasing environmental awareness have driven many businesses to deploy green technologies to reduce carbon footprints and to minimize wastewater production. Coupled with an increasing demand for high purity water from other industries, several industries are forced to seek out technological solutions, such as seawater desalination and process/wastewater recycling, to fulfill their water needs (such as seawater desalination, or process/wastewater recycling). Using advanced green technology, it is now possible to reclaim wastewater effluent for reuse purposes including drinking water. Water scarcity issues have made treated wastewater an attractive source for some industries (for example, livestock watering and irrigation) in some arid areas. Many industries are taking effort and initiatives to reduce production costs by establishing closed-loop recycling systems within the plants. In many cases, the costs associated with production are directly related to the production of ultra-pure water that is used in the manufacturing process. The consensus is that in many instances throughout the process at manufacturing facilities, it is far more beneficial to treat water through recycling of used water. This gives these facilities a water quality that is much higher than a traditional water source. In turn, the reclaim water produces a product quality that is much more enhanced, while in effect curtailing expenses at the manufacturing facility. It is simpler to recycle water with known constituents, such as the process water, than to formulate a plan to produce pure and ultra-pure water from raw groundwater sources. Efficiency gains and revolutionary technological developments are expected to make recycled water cost-competitive with other water provision options. Advancements in membrane technologies, for example, have increased the potential uses for membranes in treating both process water and wastewater streams achieving both cost and quality competitiveness. As competition intensifies, price cuts will provide some respite to costconscious customers and further boost the uptake of water recycling equipment.

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