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Current Technologies for Waste Water Treatment in Chemical Industries in India

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ABSTRACT

Water, food and energy securities are emerging as increasingly important and vital issues for India and the world. Most of the river basins in India and elsewhere are closing or closed and experiencing moderate to severe water shortages, brought on by the simultaneous effects of agricultural growth, industrialization and urbanization. Current and future fresh water demand could be met by enhancing water use efficiency and demand management. The present work aims at highlighting the various industrial wastewater treatment technologies currently available including physico-chemical and biological processes as well as constructed wetland and conventional or advanced oxidation processes. An estimated 38354 million litres per day (MLD) sewage is generated in major cities of India, but the sewage treatment capacity is only of 11786 MLD. Similarly, only 60% of industrial waste water, mostly large scale industries, is treated.

The paper presents the importance and the necessity to increase the efficiency of cleaning process of the residual waters from waste industry. There are presented the methods of treatment of the residual wastewaters, in order to find the best condition and parameters treatment process.

I. Introduction

There are more than 326 million trillion gallons of water on Earth. Less than 3 % of all this water is fresh water and of that amount, more than two-thirds is locked up in ice caps and glaciers. With so much water around it seems like there is enough to see us through for millions of years. 97% of the water on the Earth is salt water and only three percent is fresh water slightly over two thirds of this is frozen in glaciers and polar ice caps. The remaining unfrozen freshwateris found mainly as groundwater, with only a small fraction presentabove ground or in the air.India accounts for 2.45% of land area and 4% of water resources of the world but represents 16% of the world population. Total utilizable water resource in the country has been estimated to be about 1123 BCM (690 BCM from surface and 433 BCM from ground), which is just 28% of the water derived from precipitation. About 85% (688 BCM) of water usage is being diverted for irrigation (Figure 1), which may increase to 1072 BCM by 2050. Due to increasing population and all round development in the country, the availability of fresh water id reducing since 1951 from 5177 m 3 to 1869 m 3 , in 2001 and 1588 m3 , in 2010. It is expected to further reduce to 1341 m 3 in 2025 and 2 1140 m 3 in 2050. Hence, there is an urgent need for efficient water resource management through enhanced water use efficiency and waste water recycling.

II. TECHNOLOGIES TO TREAT CHEMICAL INDUSTRY EFFLUENTS

In terms of wastewater treatment there are four classifications of treatment. Preliminary treatment involves the removal of large particles as well as solids found in the wastewater. The second classification is primary treatment, which involves the removal of organic and inorganic solids by means of a physical process, and the effluent produced is termed primary effluent. The third treatment is called secondary treatment; this is where suspended and residual organics and compounds are broken down. Secondary treatment involves biological (bacterial) degradation of undesired products. The fourth is tertiary treatment, normally a chemical process and very often including a residual disinfection.

III. METHOD OF TREATMENT

Bio-refineries wastewater treatment:

Bio-refineries for the production of fuel ethanol produce large volumes of highly polluted effluents. Anaerobic digestion is usually applied as a first treatment step for such highly loaded wastewaters. At present, the anaerobic biological treatment of biorefinery effluents is widely applied as an effective step in removing 90% of the Chemical Oxygen Demand (COD) in the effluent stream. During this stage, 80–90% BOD removal takes place and biochemical energy recovered is 85–90% as biogas. To reduce the BOD to acceptable standards, the effluent from an anaerobic digestion step requires further aerobic treatment. However, biological treatment processes alone are not sufficient to meet tightening environmental regulations.A proper choice of tertiary treatment can further reduce color and residual COD. Yet another approach is to use algae. The advantage of wastewater treatment using algae is that one can reduce the organic and inorganic loads, increase dissolved oxygen levels, mitigate CO2 pollution and generate valuable biomass by sequential use of heterotrophic and autotrophic algal species and the generated biomass can be an excellent source of 'organic' fertilizers. As documented in studies on eutrophication, algae are known to thrive under very high concentrations of inorganic nitrates and phosphates that are otherwise toxic to other organisms. This particular aspect of algae can help remediate highly polluted wastewaters

Municipal wastewater treatment using constructed wetlands:

Constructed wetlands (CWs) are a viable treatment alternative for municipal wastewater, and numerous studies on their performance in municipal water treatment have been conducted. A good design constructed wetland should be able to maintain the wetland hydraulics, namely the hydraulic loading rates (HLR) and the hydraulic retention time (HRT), as it affects the treatment performance of a wetland. Indian experience with constructed wetland systems is mostly on an experimental scale, treating different kinds of wastewater. One of the major constraints to field-scale constructed wetland systems in developing countries like India is the requirement of a relatively large land area that is not readily available. Subsurface (horizontal/ vertical) flow systems, generally associated with about a 100 times smaller size range and 3 times smaller HRTs (generally 2.9 days) than the surface flow systems (with about 9.3 days HRT's, are therefore being considered to be the more suitable options for the developing countries. Shorter HRTs generally translate into smaller land requirement. Batch flow systems, with decreased detention time, have been reported to be associated with lower treatment area and higher pollutant removal efficiency. Thus, batch-fed vertical sub-surface flow wetlands seem to have an implication for better acceptability under Indian conditions

Wastewater application methods:

Farm workers and their families practicing furrow or flood waste water irrigation techniques are at the highest risk. Spray/sprinkler irrigation leads to the highest potential deposit of the salts, pathogens and other pollutants on the crop surfaces and affects nearby communities. Drip irrigation is the safest irrigation method but suffers from clogging of the emitters, depending on the wastewater total suspended solid concentrations. Use of appropriate filters such as gravel, screen and disk filters in combination with drip systems has been observed to tremendously reduce the clogging and coliform incidence.

Post-harvest interventions

Post-harvest interventions are an important component for health-risk reduction of wastewater-irrigated crops and are of particular importance to address possible on-farm pre-contamination, and also contamination that may occur after the crops leave the farm. The health hazards could be markedly lowered with adoption of some of the low cost practices such as repeated washings, exposure of the produce to sunlight and raising the crops on beds, removing the two outmost leaves of cabbage and also, cutting above some height from ground level

Membrane Bioreactors System :

Membrane bioreactors for wastewater treatment is a combination of a suspended growth biological treatment method, usually activated sludge, with membrane filtration equipment, typically low-pressure microfiltration (MF) or ultrafiltration (UF) membranes. The membranes are used to perform the critical solid-liquid separation function. In activated sludge facilities, this is traditionally accomplished using secondary and tertiary clarifiers along with tertiary filtration. The two general types of MBR systems are vacuum (or gravity-driven) and pressure-driven systems. Vacuum or gravity systems are immersed and normally employ hollow fiber or flat sheet membranes installed in either the bioreactors or a subsequent membrane tank. Pressure driven systems are in-pipe cartridge systems located externally to the bioreactor. An “MBR System” is considered to be a complete and integrated membrane unit (sub-systems) with related components necessary to allow the process to function as desired. An MBR system is often comprised of ten or eleven sub-systems and includes fine screening, theMembrane Zone and, in most cases, some type of post-disinfection process.

An MBR, or Membrane Zone, can best be described as the initial step in a biological process where microbes are used to degrade pollutants that are then filtered by a series of submerged membranes (or membrane elements). The individual membranes are housed in units known as modules, cassettes, or racks and a combined series of these modules are referred to as a working membrane unit. Air is introduced through integral diffusers to continually scour membrane surfaces during filtration, facilitate mixing and in some cases, to contribute oxygen to the biological process.

The benefits of MBR includes a reduced footprint, usually 30-50% smaller than an equivalent conventional active sludge facility with secondary clarifiers and media tertiary filtration. The process also produces exceptional effluent quality capable of meeting the most stringent water quality requirements, a modular schematic that allows for ease of expansion and configuration flexibility, a robust and reliable operation and reduced downstream disinfection requirements

Two Phase Partitioning Bioreactor:

Two-phase partitioning bioreactors use a non-biodegradable, biocompatible and non-volatile organic solvent placed on top of an aqueous phase, which is aerated. The system is considered to be self-regulatory as the xenobiotic is delivered to the aqueous phase at a rate determined by the consumption rate of the microorganisms. There are distinct advantages to this system compared to traditional activated sludge systems and other aerobic systems, including the limited exposure of the microorganisms to organic components in the wastewater, thus reducing any toxic effects as well as offering distinct and clear increased initial loadingrates of xenobiotics. Potential disadvantages include the contact of the biodegrading microflora with the metal ions, resulting in an additional step of biomass removal before effluent discharge.

UASB REACTOR:

The up flow anaerobic sludge blanket reactor (UASB) is a single tank process. Waste water enters the reactor from the bottom, and flows upward. A suspended sludge blanket filters and treats the wastewater as the wastewater flows through it.

The sludge blanket is comprised of microbial granules (1 to 3 mm in diameter), i.e., small agglomerations of microorganisms that, because of their weight, resist being washed out in the upflow. The microorganisms in the sludge layer degrade organic compounds. As a result, gases (methane and carbon dioxide) are released. The rising bubbles mix the sludge without the assistance of any mechanical parts. Sloped walls deflect material that reaches the top of the tank downwards. The clarified effluent is extracted from the top of the tank in an area above the sloped walls.

After several weeks of use, larger granules of sludge form which, in turn, act as filters for smaller particles as the effluent rises through the cushion of sludge. Because of the upflow regime, granule-forming organisms are preferentially accumulated as the others are washed out

IV. CONCLUSION

In developing countries like India, the problems associated with wastewater reuse arise from its lack of treatment. The challenge thus is to find such low-cost, low-tech, user friendly methods, which on one hand avoid threatening our substantial wastewater dependent livelihoods and on the other hand protect degradation of our valuable natural resources. The use of constructed wetlands is now being recognized as an efficient technology for wastewater treatment. Compared to the conventional treatment systems, constructed wetlands need lesser material and energy, are easily operated, have no sludge disposal problems and can be maintained by untrained personnel. Further these systems have lower construction, maintenance and operation costs as these are driven by natural energies of sun, wind, soil, microorganisms, plants and animals.

These options are being shown to be technologically and economically feasible.

Membranes merely serve to separate or fractionate wastewater components, hopefully into more useful and/or less polluting streams, and cannot break down or chemically alter the pollutants.

Constructed wetlands (CWs) have been implemented as wastewater treatment facilities in many parts of the world, but to date, the technology has been largely ignored in developing countries where effective, low cost wastewater treatment strategies are critically needed. CWs may be an economical option for secondary treatment of stabilization pond effluent, the most common treatment system in use in economically poor countries. Given the tropical location of many developing nations.Hence, for planned, strategic, safe and sustainable use of wastewaters there seems to be a need for policy decisions and coherent programs encompassing low-cost decentralized waste water treatment technologies, bio-filters, efficient microbial strains, and organic / inorganic amendments, appropriate crops/ cropping systems, cultivation of remunerative non-edible crops and modern sewage water application methods.

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