

A Critical Review on Performance of Wastewater Reuse Systems

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Abstract

Interest in wastewater reuse is increasing all over the world. India, as a developing country also faces water crisis. Hence, reuse of wastewater is an emerging field which is attracting new researches to develop new technologies to curb this rapidly growing problem of water crisis. Implementation of wastewater reuse leads to sustainable development thereby helps in reducing the water demand and the overall sewage production. The success of water reuse projects does not depend only on the availability of technology and policy, but also on the willingness and the presence of institutional infrastructures. It should also be ensured that the treated water should be monitored and distributed safely. Most of reuse systems are found applicable to a particular wastewater or environmental and economic conditions, thus highlighting the need of system that can work in different conditions satisfactorily. So, a detailed literature review of two important chemical and biological processes used in wastewater reuse system has been done here and their efficiencies are found. The paper also examines the performance of reuse systems by taking environmental and Economic factors into account and thus the limitation and gaps in the existing works are identified and future scope of study in this field is discussed.

Keywords: Biological and chemical processes, efficiency, environmental and economic factors, performance, wastewater reuse system.

1. Introduction

Water reuse is gaining popularity throughout the world as an option for supplying a reliable alternative supply of water for applications that do not require high-quality water, freeing up limited potable water resources, while reducing effluent discharges into receiving waters. At present, water reuse is practice in India on a relatively small scale, and mostly in isolated cases. Water is becoming a rare resource in the world. In India alone the International Water Management Institute (IWMI) predicts that by 2025, one person in three will live in conditions of absolute water scarcity (IWMI, 2003). It is therefore essential to reduce surface and ground water use in all sectors of consumption, to substitute fresh water with alternative water resources and to optimize water use efficiency through reuse options. These alternative resources include rainwater and grey water. One alternative source of water is wastewater recycling. Scientists around the globe are working on new way of conserving water. It is an opportune time, to refocus on one of the technique to recycle water—through the reuse of wastewater by economical way. Wastewater is non-industrial wastewater generated from domestic processes such as toilet, kitchen, sink and bathing. Dish, shower, sink, and laundry Due to rapid industrialization and development, there is an increased opportunity for waste water reuse in developing countries such as India.

There are different wastewater treatment units and processes available, the choice of the process for treatment i.e. chemical or biological, depends on wastewater characteristics, environmental and economic condition. Environmental factor must be considered before choosing appropriate process. In this study two processes i.e. Sequential batch reactor and Constructed wetland are included and reviewed.

1.1 Sequential batch reactor (SBR)

In recent year sequential batch reactor has been employed as an efficient technology for wastewater treatment, especially for domestic wastewaters, because of its simple configuration (all necessary processes are taking place time sequenced in a single basin) and high efficiency in BOD and suspended solid removal. SBRs could achieve nutrient removal using alternation of anoxic and aerobic periods. Fill and draw sequential batch processes similar to SBR are not a recent development as commonly thought. Between 1914 and 1920, several full scales fill and draw system were in operation. Interest in SBRs was revived in the late 1950s and equipment and technology. The SBR treatment cycle consists of a time sequence which typically includes the following step: FILL, REACT, SETTLE, DECANT, and IDEAL. When biological nutrient removal (BNR) is desired, the step in the cycle are adjusted to provide anoxic or anaerobic periods within the standard system (USEPA, 1992)

1.2 Constructed wetland

Constructed wetlands have been increasingly used throughout the world for secondary and especially for tertiary treatment of wastewater and storm water. If well designed and maintained, their effluents can meet the high standards required for reclaiming the water. One can also partially reclaim nutrients by harvesting the aquatic vegetation or

by combining wastewater treatment with aquaculture. Constructed wetlands further provide certain ancillary benefits such as wildlife habitat function, recreational facilities etc. A constructed wetland or wet park is an artificial wetland created as a new or restored habitat for native and migratory wildlife, for anthropogenic discharge such as wastewater, storm water runoff, or sewage treatment, for land reclamation after mining, refineries, or other ecological disturbances such as required mitigation for natural areas lost to a development.

2. Literature Review

2.1 Sequential batch reactor (SBR)

Lin et al. (2004), investigate the municipal sewage wastewater treatment by chemical coagulation and sequencing batch reactor (SBR) methods with an aim to elevating water quality to meet the standards required for agricultural irrigation. Both the conventional and modified SBR methods are considered. The conventional SBR technology is a batch process based on a single activated sludge treatment reactor. Chemical coagulation alone was able to lower the wastewater COD and color by up to 75 and 80%, (COD and NTU to below 20 and 2mg/l). The water quality was consistently excellent and was deemed suitable for agricultural irrigation.

Arrojo et al. (2005), gave a study on SBR process, in SBR process with help membrane process completely removes coliform bacteria and suspended solids, thus providing a higher quality effluent with respect to conventional processes. After SBR treatment neither found faecal coliforms nor E. coli were found in permeate. The removal efficiency of both bacteria and suspended solids by membrane filtration was 100%, suggesting that the experimented compact system (SBR + membrane filtration) could produce an effluent suitable for reuse in agriculture and could be a suitable technology for rural communities.

Subbaramaiah and Mall (2012), this study show Use Based on the experimental results obtained, Sequencing batch reactor (SBR) was an attractive alternative to conventional biological wastewater treatment systems, optimum value of MLSS concentration to be maintained in the reactor is found to be 5000 mg/l. treatability of SBR for BA is good for higher concentrations (< 200 mg/l), and also removal percentage was increases with increase in initial concentration. The optimum value of temperature was found at 30°C. The optimum value of aeration time during fill phase is found to be 3 h, at full aeration rate of removal is rapidly increasing compare with anoxic condition in fill phase.

Sirianuntapiboon et al. (2005), gave a study based on Sequential Batch Reactor used in dairy wastewater treatment, in dairy waste treatment most of time we are use membrane coupled sequencing batch reactor (MSBR). After treatment our wastewater effluent concentration effectively decrease. Its efficiency COD, BOD₅, total Kjeldahl nitrogen (TKN), and oil and grease removal efficiencies of 89.3, 83.0, 59.4 and 82.4%, respectively, when treatment was done at high organic loading rate (OLR) of 1.34 kg BOD₅/m³d.

Discussion: Lin et al. (2004), Arrojo et al. (2005), Both researcher used domestic wastewater treatment successfully with help SBR process and good effluent result give. And other V. Subbaramaiah and Indra Deo Mall (2012), also were provide successful wastewater treatment and efficiency also good. Sirianuntapiboon et al. (2005), both researcher were able to provide wastewater treatment in dairy wastewater treatment. Dairy wastewaters are generally treated using anaerobic biological methods such as up-flow anaerobic sludge blanket (UASB) reactor and anaerobic filters. However, anaerobic treatment does not completely remove all organic matter and nutrients, and needs complementary post treatment. Also, physico-chemical methods like coagulation, electro-chemical treatment, adsorption, etc. are not able to fully degrade/remove the pollutants particularly dissolved organic compounds. Sirianuntapiboon et al. (2005), both literature efficiency very good more than 85 % COD, BOD remove.

Effluent characteristics of the SBR is suitable for reuse purposes according to U.S.E.P.A. standards. For the future study emphasis should be given to provide a good and effective treatment.

2.2 Constructed wetland

Rousseau et al. (2008), gave a study on constructed wetland for water reclamation. Treated effluent can be reused for restricted or unrestricted irrigation of agricultural crops, toilet flush, watering of gardens, golf courses, and public parks, depending on its quality. In wetland separates operational problems and poor maintenance also problem creat. Other problem Mosquito nuisance and odor problem also big task in wetland. Large land area also required in big city land price more costly so it not suitable for large city it suitable for rural area and low population city. Its main advantage is operation and maintenance cost low and not required more skilled labor. When carefully designed and maintained, constructed wetlands can yield, at relatively low costs, an effluent suitable for reuse and concurrently provide some opportunities to recycle nutrients and to accommodate wildlife.

Watson et al. (1989) and Kadlec and Knight (1996) have discussed the advantages of using wetland technology for wastewater treatment. Minimal fossil fuel is required and no chemicals are necessary. An additional benefit gained by using wetlands for wastewater treatment is the multi-purpose sustainable utilization of the facility for uses such as swamp fisheries, biomass production, seasonal agriculture, water supply, public recreation, wild life conservation and scientific study (Santer, 1989; EPA, 1993; Knight, 1997). Being low-cost and low-technology systems, wetlands are potential alternative or supplementary systems for wastewater treatment in developing countries.

Canter et al., 1982, studied on efficiency of CWs. The performance of wastewater stabilization ponds in achieving the goals for developing countries appears to be satisfactory in many cases. At loading rates of 180–500 kg biological oxygen demand (BOD) per acre per day in the tropics, removal efficiencies of BOD, nitrogen,

phosphorus and indicator bacteria have been reported to be 75–90; 30–50; 20–60 and 60–99%, respectively.

Discussion: Rousseau et al. (2008), gave a study for wastewater reuse in irrigation and other nonpotable purpose, in this study main drawback of odor problem, land area, operational problem, and cost. Finally conclusion is CWs suitable for reuse purpose because cheap cost and efficiency. **Watson et al. (1989) and Kadlec and Knight (1996)** studied on Constructed Wetland and found its multi-purpose sustainable utilization of the facility for uses such as swamp fisheries, biomass production, seasonal agriculture, water supply, public recreation, wild life etc. **Canter et al. (1982)**, studied the efficiency of constructed wetland in developing countries. And checked efficiency of plant BOD, COD, nitrogen, phosphorous, and indicator bacteria.

Here most of the researchers have focused mainly on performance of the system while other problems such as odor, mosquito and large land area are not considered much.

3. Conclusion and Future Scope of Study

1. From the above discussion it can be concluded that in the developed countries much work has been done in the field of wastewater reuse system but we can't say the same about developing countries. In developing countries wastewater reuse is still in the beginning stage and much work is needed in that field.
2. Wastewater treatment performance now a day big problem if we improve our methodology we definitely solved big problem.
3. There are plenty of emerging technology which are making increase performance of wastewater in reused system. But we used only appropriate technology whom suitable.
4. In Indian conditions, sequential batch reactor process are more economical and more efficient. It is a totally chemical process which is great for non-portable purpose. It needs less land but requirement of external energy source for its aeration and equalization along with chemical costs makes it costly.
5. Constructed wetland technology for water reuse in irrigation purpose is suitable because of its good efficiency and for its benefit to green belt areas. Its totally a natural process with no use of chemicals and hence there is no need of specialized supervision to run it. Its main drawback is its bad odour which becomes a breeding place for mosquitoes, requirement of more land and its also a time consuming process when compared to sequential batch reactor.

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