ABSTRACT

Wastewater a combination of wastes removed from residencies, institutions, industries and commercial establishments if untreated and is allowed to accumulate, the decomposition of the organic materials it contains can lead to the production of large quantities of malodorous gases. In addition, untreated wastewater usually contains numerous pathogenic or disease-causing microorganisms that dwell in the human intestinal tract or that may be present in certain industrial wastes. It also contains nutrients, which can stimulate the growth of aquatic plants and it may contain toxic compounds. For these reasons, the immediate and nuisance-free removal of wastewater from its sources of generation, followed by treatment and disposal, is not only desirable but also necessary in an industrialized society.

Wastewater collected from cities and towns must ultimately be returned to receiving waters or to the land. The complex question of which contaminants in wastewater must be removed to protect the environment – and to what extent – must be answered specifically for each case. This requires analyses of local conditions and needs, together with the application of scientific knowledge, engineering judgment based on past experience.

The contaminants in wastewater are removed by physical, chemical, and biological means. The individual methods usually are classified as physical unit operations, chemical unit processes, and biological unit processes. Unit operations and processes are grouped together to provide what is known as primary, secondary and tertiary (or advanced) treatment. The term primary refers to physical unit operations; secondary refers to chemical and biological unit processes; and tertiary refers to combinations of all three. In most situations, the complexity of the treatment-process flow sheet will depend on both which constituents need to be removed and the required levels of removal.

At the present time, most of the unit operations and processes used for wastewater treatment are undergoing continual and intensive investigation from the stand point of implementation and application. As a result, many modifications and new operations and processes have been developed and implemented; Still Research is required to be carried out to meet the increasingly stringent requirements for environmental enhancement of water-courses. In addition to the developments taking place with conventional treatment methods, alternative treatment systems and technologies are also under study.
Land treatment of wastewater involves the soil surface and the soil matrix for wastewater treatment. Although land treatment of wastewater has been practiced for centuries, its full potential has only recently been recognized in the field of wastewater engineering. The principal reason for this is the widespread research and development activity generated as a result of the emphasis placed on water reuse, nutrient recycling, and the use of wastewater for crop production. Further the investigation on land treatment of wastewaters resulted in the development of Soil Aquifer Treatment (SAT) system.

SAT, an advanced wastewater treatment system, consists of controlled passage of effluents through unsaturated zone and the aquifer, mainly for purification purposes, as well as for seasonal and multiannual storage. The vadose zone in soil acts as natural filter and is capable of removing all the suspended solids, biodegradable material, bacteria, viruses and other significant organisms from wastewater. As the water percolates downward, biological and chemical actions that take place in the first few feet of soil and sandy substrates breakdown organic compounds and other pollutants. Rapid infiltration achieves an excellent reduction of biochemical oxygen demand, suspended solids and fecal coliform. Significant reductions in phosphorous, nitrogen and heavy metal concentration have also been achieved. SAT adds to purification of effluents by process of slow sand filtration, chemical precipitation, adsorption, ion exchange, biological degradation, nitrification and de-nitrification.

Soil Aquifer Treatment is an emerging natural treatment technology which, in combination with other available wastewater treatment technologies, can produce effluent of acceptable quality for indirect potable reuse. The application of SAT technology in arid and semi arid regions of the world where groundwater resources has been over exploited augments water supply. SAT is a low cost and appropriate option for wastewater reclamation in developed as well as developing countries that ensures sustainability of both surface water and groundwater sources within the context of integrated water resources management.

A large number of research projects have been under taken to study the effectiveness of SAT system in handling wastewater or to treat wastewater from treatment plants enabling them for reuse. The literature review pertaining to these aspects are widely covered in this report.

However SAT system is site specific and is controlled by wastewater quality, soil hydro-geology and duration of wastewater application. Hence it was decided to carryout the studies to evaluate the potential of SAT system in handling different wastewaters under varied process conditions. Thus for the present study the research topic titled Wastewater Treatability Studies by Soil Aquifers Treatment was selected. This study uses a matrix of two soil types and three different wastewaters and
three adsorbents viz. (Groundnut shell-GNS, Saw dust- SD and Rice husk-RH) in an attempt to develop a design and operational methodology for SAT system.

For convenient and clarity of presentation the present research report is documented consisting of the following chapters.

Chapter-I : Introduction
Chapter-II : Literature Review
Chapter-III : Materials and Methodology
Chapter-IV : Results and Discussions
Chapter-V : Conclusions, Limitations and Scope for Further Study

Chapter-I throws light on need for treatment of wastewaters, significance of SAT systems in present context and objectives of present research work.

Chapter-II gives the detailed literature review on the topic of the dissertation work. Issues like characteristics of wastewater, treatment options, land treatment, fundamentals of SAT system and review of literature on SAT system, sources and effects of metals on health and environment, heavy metals removal techniques, removal of nutrients etc. have been covered. Extensive review of metals removal by adsorbents are also documented in this chapter.

Chapter-III describes materials and methodology employed in the investigations.

The data obtained from the studies and inference drawn thereby have been presented in the Chapter-IV. For clarity results are not only tabulated but are also represented by bar charts and graphs. The better removal efficiency with Silty sand compared to Sandy clay and for soil depth of 1.0 m compared to 0.7 m was recorded. SAT system in conjunction with adsorbents exhibited better performance. No significant effect of position of the adsorbents was observed. The neutral pH was found to have significant influence on removal of pollutant from wastewater. Further the initial concentration of pollutants was found to be the parameter of importance which effects the performance of SAT system. However the metals removal potential of adsorbents varied for different metals.

The conclusion and limitations derived from present study and scope for future investigations form the subject matter of chapter-V.