Technological Options For Sewage Treatment

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Abstract— The crisis triggered by the rapidly growing population and industrialization with the resultant degradation of the environment causes a grave threat to the quality of life. In this paper a review has been taken over various aspects of sewage problems & its treatment. The Evaluating Treatment Facility Options are discussed & Possible Treatment options are illustrated. Options for low- and middle-income communities, Aerobic versus anaerobic treatment, aquatic Treatment Technologies options are discussed in the paper.

Keywords—Technological Options, Sewage Treatment, sewage Pollution, Sewage Treatment Plant, Sustainable Treatment, Reuse of water. Aerobic & anaerobic treatment, mechanical technologies.

INTRODUCTION

Pollution in its broadest sense includes all changes that curtail natural utility and exert deleterious effect on life. The crisis triggered by the rapidly growing population and industrialization with the resultant degradation of the environment causes a grave threat to the quality of life. Degradation of water quality is the unfavorable alteration of the physical, chemical and biological properties of water that prevents domestic, commercial, industrial, agricultural, recreational and other beneficial uses of water. Sewage and sewage effluents are the major sources of water pollution. Sewages mainly composed of human fecal material, domestic wastes including wash-water and industrial wastes. The growing environmental pollution needs for decontaminating wastewater result in the study of characterization of waste water, especially domestic sewage. In the past, domestic waste water treatment was mainly confined to organic carbon removal. Recently, increasing pollution in the waste water leads to developing and implementing new treatment techniques to control nitrogen and other priority pollutants. Sewage Treatment Plant is a facility designed to receive the waste from domestic, commercial and industrial sources and to remove materials that damage water quality and compromise public health and safety when discharged into water receiving systems. It includes physical, chemical, and biological processes to remove various contaminants depending on its constituents. Using advanced technology it is now possible to re-use sewage effluent for drinking water.

SELECTION OF APPROPRIATE SEWAGE TREATMENT TECHNOLOGY

One of the most challenging aspects of a sustainable sewage treatment system (either centralized or decentralized) design is the analysis and selection of the treatment processes and technologies capable of meeting the requirements. The process is to be selected based on required quality of treated water. While treatment costs are important, other factors should also be given due consideration. For instance, effluent quality, process complexity, process reliability, environmental issues and land requirements should be evaluated and weighted against cost considerations. Important considerations for selection of sewage treatment processes are Quality of Treated Sewage, Power requirement, Land required, Capital Cost of Plant, Operation & Maintenance costs, Maintenance requirement, Operator attention, Resource Recovery etc. [1]

EVALUATING TREATMENT FACILITY OPTIONS:

Many times the treatment facilities are adopted from general recommendations which are not based on specific conditions of the selected case. No one recommends treatment technology that meets the specific conditions and treatment objectives of every community. To choose the right treatment technology, a community must evaluate many factors.

• Regulatory requirements: Local, state and national treatment standards; county or local land use plans and ordinances.

• Community characteristics: location and distribution of customers, Population trends, desired character of the community such as rural, urban, open space, etc.

Physical conditions: soil conditions, spaces available, Topography, surface & groundwater conditions, wastewater generation, climatic condition, esthetics and appearance.

• Financial factors: Capital costs, operation & maintenance costs, income levels, financial reserves and capacity

SUSTAINABLE TREATMENT AND REUSE OF WASTEWATER

The uncontrolled disposal to the environment of municipal, industrial and agricultural liquid, solid, and gaseous wastes constitutes one of the most serious threats to the sustainability of human civilization by contaminating the water, land, and air and by contributing to global warming. [2]

With increasing population and economic growth, treatment and safe disposal of wastewater is essential to preserve public health and reduce intolerable levels of environmental degradation. In addition, adequate wastewater management is also required for preventing contamination of water bodies for the purpose of preserving the sources of clean water. [2]

SUITABLE TREATMENT OPTIONS:

A key component in any strategy aimed at increasing the coverage of wastewater treatment should be the application of appropriate wastewater treatment technologies that are effective, simple to operate, and low cost (in investment and especially in operation and maintenance). Appropriate technology processes are also more environment-friendly since they consume less energy and thereby have a positive impact on efforts to mitigate the effects of climate change. Also, with modern design, appropriate technology processes cause less environmental nuisance than conventional processes—for example they produce lower amounts of excess sludge and their odor problems can be more effectively controlled.

Appropriate technology unit processes include the following:[2]

- Preliminary Treatment by Rotating Micro Screens;
- Vortex Grit Chambers;
- Lagoons Treatment (Anaerobic, Facultative and Polishing), including recent developments in improving lagoons performance;
- Anaerobic Treatment processes of various types, mainly, Anaerobic Lagoons, Upflow Anaerobic Sludge Blanket (UASB) Reactors, Anaerobic Filters and Anerobic Piston Reactor (PAR);
- Physicochemical processes of various types such as Chemically Enhanced Primary Treatment (CEPT); (vi) Constructed Wetlands;
- Stabilization Reservoirs for wastewater reuse and other purposes;
- Overland Flow;
- Infiltration-Percolation;
- Septic Tanks; and
- Submarine and Large Rivers Outfalls.

OPTIONS FOR LOW- AND MIDDLE-INCOME COMMUNITIES:

Most wastewater treatment processes have been developed in temperate, Northern climates. Applying them in most developing countries will have three main disadvantages:

■ High energy requirements;

■ High operation and maintenance requirements, including production of large volumes of sludge (solid waste material);

■ They are geared towards environmental protection rather than human health protection. for example, most conventional wastewater treatment works do not significantly reduce the content of pathogenic material in the wastewater.

AEROBIC VERSUS ANAEROBIC TREATMENT:

Most conventional wastewater treatment processes are ‘aerobic’ in this the bacteria used to break down the waste products take in oxygen to perform their function. This result in the high energy requirement, it needs supply of oxygen and a large volume of sludge is produced. This makes the processes complex to control, and costly. The bacteria in ‘anaerobic’ processes do not use oxygen. Excluding oxygen is easy, and the energy requirements and sludge production is much less than for aerobic processes — making the processes cheaper and simpler. Also, the temperature in which the bacteria like to work is easy to maintain in hot climates [3]

MECHANICAL TREATMENT TECHNOLOGIES

Mechanical systems utilize a combination of physical, biological, and chemical processes to achieve the treatment objectives. Using essentially natural processes within an artificial environment, mechanical treatment technologies use a series of tanks, along with pumps, blowers, screens, grinders, and other mechanical components, to treat wastewaters. Flow of wastewater in the system is controlled by various types of instrumentation. Sequencing batch reactors (SBR), oxidation ditches, and extended aeration systems are all variations of the activated-sludge process, which is a suspended-growth system. The trickling filter solids contact process (TF-SCP), in contrast, is an attached-growth system. These treatment systems are effective where land is at a premium.[4]

AQUATIC TREATMENT TECHNOLOGIES

Facultative lagoons are the most common form of aquatic treatment-lagoon technology currently in use. The water layer near the surface is aerobic while the bottom layer, which includes sludge deposits, is anaerobic. The intermediate layer is aerobic near the top and anaerobic near the bottom, and constitutes the facultative zone. Aerated lagoons are smaller and deeper than facultative lagoons. These systems evolved from stabilization ponds when aeration devices were added to counteract odors arising from septic conditions. The aeration devices can be mechanical or diffused air systems. The chief disadvantage of lagoons is high effluent solids content, which can exceed 100 mg/l. To counteract this, hydrograph controlled release (HCR) lagoons are a recent innovation. In this system, wastewater is discharged only during periods when the stream flow is adequate to prevent water quality degradation. When stream conditions prohibit discharge, wastewater is accumulated in a storage lagoon. [4]

Constructed wetlands, aquacultural operations, and sand filters are generally the most successful methods of polishing the treated wastewater effluent from the lagoons. These systems have also been used with more traditional, engineered primary treatment technologies such as Imhoff tanks, septic tanks, and primary clarifiers. Their main advantage is to provide additional treatment beyond secondary treatment where required. In recent years, constructed wetlands have been utilized in two designs: systems using surface water flows and systems using subsurface flows. Both systems utilize the roots of plants to provide substrate for the growth of attached bacteria which utilize the nutrients present in the effluents and for the transfer of oxygen. Bacteria do the bulk of the work in these systems, although there is some nitrogen uptake by the plants. The surface water system most closely approximates a natural wetland. Typically, these systems are long, narrow basins, with depths of less than 2 feet, that are planted with aquatic vegetation such as bulrush or cattails. The shallow groundwater systems use a gravel or sand medium, approximately eighteen inches deep, which provides a rooting medium for the aquatic plants and through which the wastewater flows. [4]

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CONCLUSION

The growing environmental pollution needs for decontaminating wastewater result in the study of characterization of waste water. The Important considerations for selection of sewage treatment processes are Quality of Treated Sewage, Power requirement, Land required, Capital Cost of Plant, Operation & Maintenance costs, Maintenance requirement, Operator attention, Resource Recovery etc. The appropriate technology processes cause less environmental nuisance than conventional processes—for example they produce lower amounts of excess sludge and their odor problems can be more effectively controlled. Most conventional wastewater treatment processes are 'aerobic' in this the bacteria used to break down the waste products take in oxygen to perform their function. This result in the high energy requirement, it needs supply of oxygen and a large volume of sludge is produced. Mechanical treatment technologies use a series of tanks, along with pumps, blowers, screens, grinders, and other mechanical components, to treat wastewaters. Flow of wastewater in the system is controlled by various types of instrumentation.

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