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A Review of Sewage Treatment Plant with Modern Technologies

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Abstract- **A sewage treatment plant is quite necessary to receive the domestic and commercial waste and removes the materials, which pose harm for public. Its objective is to produce an environmentally safe fluid waste stream (or treated effluent) and a solid waste (or treated sludge) suitable for disposal or reuse (usually as farm fertilizer). The growing environmental pollution needs for decontaminating wastewater result in the study of characterization of wastewater, especially domestic sewage. In the past, domestic wastewater treatment was mainly confined to organic carbon removal. Recently, increasing pollution in the wastewater 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. Sewage / wastewater treatment consist of different processes, which protect the environment & human through cleansing the water pollutant. In history, people used difference method of treatment for purification of water, which get advance by advancement in technological world.**

Index Terms- **Sewage Treatment Plant, Domestic and Commercial Waste, Water Quality, Pollution**

I. INTRODUCTION

In general, the sanitation field seems to live the life of an orphan in many Pacific Island Countries. In many cases, this important sector of public health has been left alone when major upgrading projects improved the water supply systems in many countries and provinces. This ignored the downstream effect of improved water supply, that of increased discharges into rivers or aquifers.

deliver the expected outcome. Without pretending to reflect, the complexity of sanitation projects three principal reasons may be held accountable for the non-delivery problems:

- The technology was not appropriate,
- The beneficiary was not involved and consulted sufficiently, and
- The responsibilities within government were not resolved to ensure the necessary support.

During the last years, many rural areas were provided with some kind of water supply system. The availability of water leads to wider spread use of flush toilet systems. These systems mainly use simple toilets to discard the wastewater either directly into the porous underground or into simple holes. At the same time, many villages still supplement their water supply from shallow wells, which are often located in the direct neighbourhood of the toilets. Even if landowners consider the possible contamination of their well through their own toilet and locate them far apart, they cannot avoid the location of their neighbour's toilet close to their well. A similar risk of water body contamination occurs where villages situated on the banks of a small estuary/lagoon discharge their wastewater without treatment. It is expected that Small Scale Wastewater Treatment Plants (SSWTP), under certain circumstances, are the solution for these problems. More specifically the SSWTP technology could be applied where,

- conventional sewage is simply too costly,
- environmental conditions require a high effluent quality,
- conventional on-site treatment proved to be of low community acceptance,
- Low technology solution, such as composting toilets seem to be inappropriate.

A supply of clean water is an essential requirement for the establishment and maintenance of diverse human activities. Water resources provide valuable food through aquatic life and irrigation for agriculture production. However, liquid and solid wastes produced by human settlements and industrial activities pollute most of the water sources throughout the world.

Due to massive worldwide increases in the human population, water will become one of the scarcest resources in the 21st century (Day D., 1996). In the year 2015, the majority of the global population (over 5 billion) will live in urban environments (UN, 1997). By the year 2015, there will be 23 megacities with a population of over 10 million each, 18 of which will exist in the developing world (Black, 1994). Central to the urbanization phenomena are the problems associated with providing municipal services and water sector infrastructure, including the provision of both fresh water resources and sanitation services. Currently, providing housing, health care, social services, and access to basic human needs infrastructure, such as clean water and the disposal of effluent, presents major challenges to engineers, planners and politicians (Black, 1994; Giles and Brown, 1997). As human numbers increase, greater strains will be placed on available resources and pose even greater threat to environmental sources. A report by the Secretary-

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General of the United Nations Commission on Sustainable Development (UNCSD, 1997) concluded that there is no sustainability in the current uses of fresh water by either developing or developed nations, and that worldwide, water usage has been growing at more than three times the world's population increase, consequently leading to widespread public health problems, limiting economic and agricultural development and adversely affecting a wide range of ecosystems.

Although India occupies only 3.29 million km2 geographical area, which forms 2.4% of the world's land area, it supports over 15% of world's population. The population of India as of March 1, 2001 was 1,027,015,247 persons (Census, 2001). India also has a livestock population of 500 million, which is about 20% of world's total livestock. However, total annual utilizable water resources of the country are 1086 km3, which is only 4% of world's water resources (Kumar et al., 2005).Total annual utilizable resources of surface water and ground water are 690 and 396 km3, respectively (Ministry of Water Resources, 1999). Consequent to rapid growth in population and increasing water demand, stress on water resources in India is increasing and per capita water availability is reducing day by day. In India per capita surface water availability in the years 1991 and 2001 were 2300 m3 (6.3 m3/day) and 1980 m3 (5.7 m3/day) respectively and these are projected to reduce to 1401 and 1191 m3 by the years 2025 and 2050, respectively (Kumar et al., 2005). Total water requirement of the country in 2050 is estimated to be 1450 km3, which is higher than the current availability of 1086 km3

II. METHODOLOGY

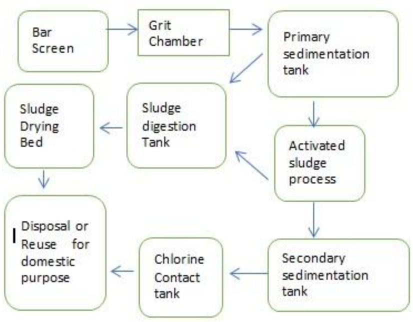

Figure 1.Flow Diagram of STP (Sewage Treatment Plant)

Classification of Sewage Treatment Plant Methods

PRELIMINARY SEWAGE TREATMENT

This treatment reduces the BOD of the wastewater, by about 15 to 30%. Examples of preliminary operations are:

- Screening provided for the removal of debris and rags.
- Grit chamber provided for removal for the elimination of coarse suspended matter that may cause wear or clogging of equipment.

PRIMARY SEWAGE TREATMENT

In primary treatment, a portion of the suspended solids and organic matter is removed from the wastewater. This removal is usually accomplished by physical operations such as sedimentation in Settling Basins. The liquid effluent from primary treatment, often contains a large amount of suspended organic materials, and has a high BOD (about 60% of original). The organic solids, which are separated out in the sedimentation tanks (in primary treatment), are often stabilized by anaerobic decomposition in a digestion tank or are incinerated, the residue is used for landfills or as a soil conditioner. The principal function of primary treatment is to act as a precursor to secondary treatment.

SECONDARY SEWAGE TREATMENT

Secondary treatment involves further treatment of the effluent, coming from the primary sedimentation tank and is directed principally towards the removal of biodegradable organics and suspended solids throughbiological decomposition of organic matter, either under aerobic or anaerobic conditions. In these biological units, bacteria will decompose the fine organic matter, to produce a clearer effluent. The treatment reactors, in which the organic matter is decomposed (oxidized) by aerobic bacteria are known as Aerobic biological units; and may consist of:

(i)Aeration tank: The activated sludge process is the most common option in secondary treatment. Aeration in an activated sludge process is based on pumping air into a tank, which promotes the microbial growth in the wastewater. The microbes feed on the organic material, forming flocs which can easily settle out.

(ii)Secondary sedimentation tank: They are used to settle out the biological material flowing from the secondary treatment.

TERTIARY/ ADVANCED SEWAGE TREATMENT AND WASTEWATER RECLAMATION

Advanced wastewater treatment, also called tertiary treatment is defined as the level of treatment required beyond conventional secondary treatment to remove constituents of concern including nutrients, toxic compounds, and increased amounts of organic material and suspended solids and particularly to kill the pathogenic bacteria.

(i)Sludge digestion Tank: Sludge digestion is a biological process in which organic solids are decomposed into stable substances.

(ii)Chlorine contact tank: To remove harmful pathogenic bacteria and make it possible for human touch.

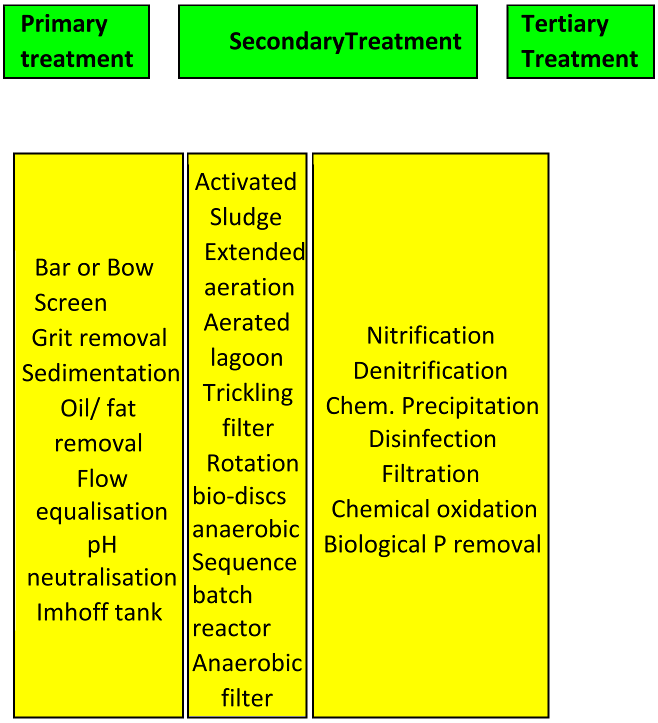

Figure 2. Gives an overview on technologies and their categorisation

Constructed wetlands Aquaculture

III. Experimental results

A. Planning and Implementing Wastewater Reuse Appropriate Technology

A functional and sustainable wastewater management scheme begins at the household level and is largely dependent on the "software" or the human component (Khouri*et al.*, 1994). Only when perception of needA Case Study on Reduction of Accidents through Improvement of Geometric Design and perhaps, anticipation for a wastewater reuse system has been internalized at the neighbourhood/user level, will planning and implementation be successfully executed (Khouri*et al.*, 1994). Local level support of a treatment and recovery scheme can, in turn, catalyse pro-active institutions and vertical support from governments. Once the software component has been integrated into project development, the "hardware" or technological component can act to promote a comprehensive, integrated, and sustainable wastewater treatment and recovery strategy for the community - if it is well selected and "appropriate". Several features characterise an appropriate wastewater treatment technology that can be a sustainable amenity to a community. Denny, (1997) has stated that wastewater treatment technologies in the developing world must have one overriding criterion: the technology must be cost-effective and appropriate. The following considerations should be made regarding the appropriateness of technologies:

- The scheme or technology should be a felt priority in public or environmental health, and both centralised and de-centralised technologies should be considered (Veenstra and Alaerts, 1996).
- The technology should be low-cost and require low energy input and mechanisation, which reduces the risk of malfunction (Frijns and Jansen, 1996; Boller, 1997).
- The technology should be simple to operate, be "local" labour intensive, maintained by the community not rely on expensive chemical inputs, such as chlorine, for tertiary pathogen reductions to meet quality guidelines, and should be able to recover resources (Mara and Cairncross, 1989; Frijns and Jansen; 1996; Boller, 1997).

The technology should be capable of being incrementally upgraded as user demand or quality standards and treatment guidelines increase (Boller, 1997).

Public acceptance of reuse projects is vital to the overall future of wastewater reuse and the consequences of poor public perception could jeopardise future wastewater reuse projects (Asano and Levine, 1996). The selection of any treatment technology must be accompanied in advance by a detailed examination of the self-sufficiency and technological capacity of the community. The treatment alternatives must be manageable by the local community. (Boller 1997) suggests that skilled operation and maintenance are essential to attain satisfactory performance and that technologies must require the lowest level of maintenance and control. The overriding criterion is that the system must be capable of achieving acceptable levels of pathogen reductions to facilitate the recovery of effluent for irrigation and organic soil amendment (Yu *et al.*, 1997).

Table 1: Overview of the wastewater treatment technology types in the selected countries

Country	Treatment type
Jordan	Activated sludge Biofiltrataion Stabilization ponds Extended aeration
Turkey	Activated sludge/extended aerated Trickling filter Stabilization ponds
Lebanon	Grit and scum removal
Palestine	Extended aeration Stabilization ponds Oxidation ditches Anaerobic Rock filter Imhoff tank and trickling filter Anaerobic sludge stabilization

A number of conventional treatment technologies have been considered for treatment of wastewater contaminated with organic substances. Commercial activated carbon is regarded as the most effective material for controlling the organic load. However due to its high cost and about 10-15 % loss duringregeneration, unconventional adsorbents like fly ash, peat, lignite, wood, saw dust etc. have been used for the removal of refractory materials, (Pandey et al., 1985) for varying degree of success. Ionic liquids holds promise to provide better alternative to the toxic solvents, (Sheldon et al., 2001)

The removal of organic material by adsorption has recently become the subject of interest of several workers, Nelson et al. (1969); Eye et al. (1970); Johnson et al.(1965); Deb et al.(1966); Gupta et al.(1978,1990); Mott et al. (1992); Viraraghavan et al.(1994). They have explored the use of fly ash as an adsorbent for treatment of wastewater to remove toxic compounds and colour. Pandey et al. (1985) has proposed a method for removal of copper from wastewater by taking fly ash as an adsorbent. Johansson et al. (1998); and Drizo et al. (2006) have proposed the use of active filtration through alkaline media for the removal of phosphorus from domestic wastewater. Ozone is a very good oxidizing agent due to its high instability (reduction potential 2.07 V) when compared to chlorine (1.36 V) and (1.78V). It has potential to degrade large number of pollutants like phenols, pesticides and aromatic hydrocarbons and is used since the early 1970s in wastewater treatment (Robinson *et al.* 2001, Özbelge et al. 2002, Peratitus*et al.* 2004) . The major drawback of the use of this method is, ozone has short half-life, it decomposes in 20 minutes so require continuous ozonation and making this method expensive to apply, (Slokar et al., 1998, Robinson *et al.*, 2001).

Anaerobic wastewater treatment is a biological wastewater treatment without the use of air or elemental oxygen. Applications are directed towards the removal of organic pollutants in wastewater, slurries and sludge. Complete replacement of aerobic with anaerobic technology is not yet possible as the effluent quality of anaerobic treatment systems is not up to par. The anaerobic treatment is considered as a pre-treatment technique and has been applied in Colombia, Brazil, and India, replacing the more costly activated sludge processes. There are different types of digesters available, some have been proven effective over time, and others are still being tested. One of the most suitable digesters for tropical conditions is the UASB (Up flow Anaerobic Sludge Blanket).
Harada et al. (2007, 2006, 2005, and 2002) has proposed a self-sustainable sewage treatment system with the combination of UASB as pre-treatment unit and an aerobic reactor down flow Hanging Sponge (DHS) reactor as a post treatment unit. The proposed anaerobic-aerobic bio conenoses of UASB and DHS fulfill the need for a simplified treatment system for developing countries because of its low cost, and operational simplicity, along with sustainability of the system as a whole.

IV. Conclusion

Wastewater treatment involves a variety of processes performed at different levels of treatment. Either the basic form of treatment is the breaking down of organic waste by bacteria aerobically or anaerobically or a combination of both which occurs in secondary treatment. Primary treatment offers the settlement of solids. Tertiary treatment involves the removal of phosphorus, nitrogen and toxic substances. Pathogen removal occurs throughout treatment but becomes more effective mostly at tertiary levels through the use of UV rays and chlorination. The higher the treatment efficiency the better the quality of effluent produced.

- Considering the population growth, recently awarded municipality status and industrialization it is now high time to install STP.
- Proposed STP design is functional, efficient, easy to operate.
- A Detailed RCC design of units is prepared based on which detailed estimation has been worked out of proposed STP, which seems reasonable.

Table 2. Design of units

Sr. no	Unit	Dimension	No.
1	Collection chamber	Dia– 6m, d-3	1
2	Approach channel	L– 2m,b0.675m, d–0.75m	2
3	Bar screen	Bar- 10*50mm, space– 25mm	2
4	Grit chamber	L– 20m, b- 1.5m, d-1m	2
5	Primary Sedimentation Tank	Dia– 24m, d- 5.95m	2
6	Aeration Tank	L-21m, b- 18.5m, d-4m	4
7	Secondary Sedimentation Tank	Dia– 24m, d- 5.95m	2
8	Chlorine contact tank	Dia-18M, D- 3M	1
9	Sludge digestion tank	Dia-21M, D- 8M	1
10	Filter press		2

Table 3. Estimation with help of detailed RCC design

Unit	No	Quantity of steel(kg)	Formwork (m^2)	Concrete Work (m^3)
Collection chamber	1	958.42	88.61	12.73
Approach channel	2	28.93	34	3.135
Grit chamber	2	397.292	43	8.5
Primary sedimentation	2	21820.66	1099.69	392.69

tank				
Aeration Tank	4	29568.98	631.7	396.55
Secondary sedimentation tank	2	21820.66	1099.69	392.69
Sludge digestion tank	1	44803.98	1658.66	1202.48
Chlorine contact tank	1	5260.37	861.06	69.05

Table 4. Costing of units

Sr. no	Unit	No	Material cost(INR)
1	Collection chamber	1	3,43,076/-
2	Approach channel	2	41,432/-
3	Bar screen	2	-
4	Grit chamber	2	1,37,690/-
5	Primary Sedimentation Tank	2	65,55,690/-
6	Aeration Tank	4	1,47,52,796/-
7	Secondary Sedimentation Tank	2	65,55,690/-
8	Chlorine contact tank	1	7,35,006/-
9	Sludge digestion tank	1	85,74,993/-
10	Filter press	2	5,90,000/-

*This cost includes concrete work, formwork and steel reinforcement with contractor’s profit.
Total Cost = Total cost - 38,246,941/-INR

REFERENCES

[1] Aqua Milieu Pty Ltd. Trading as Enviroflow, EnviroflowBiofilter Wastewater Treatment Plant Brochure.
[2] Del Porto D., SPC Workshop on The Soltran II Non Polluting Biological Toilet and Wastewater garden, Suva, Fiji, 25November 1996.
[3] Enviro-Technology Inc., 1998. Cromaglass Wastewater Treatment Systems
[4] Environment Equipment Pty Ltd. Rota-Loo Composting Toilet Brochure.
[5] Environment Equipment Pty Ltd. Biolet Composting Toilet Brochure.
[6] Gough I., Langford M., and Gough A. 1999. The Hybrid Toilet System: General Principles and System Design Drivers. Published by Lanfax Laboratories, Armidale NSW.
[7] Gough Plastics Australia, The Hybrid Toilet System Brochure.
[8] Khan, A.R. 1995. Appropriate Wastewater Treatment Processes for N-WFP, Pakistan, Master of Science Research of Loughborough University of Technology.
[9] Loetscher T., 1998. SANEX Sanitation Expert Systems
[10] Ludwig, S. 1998. DEWATS Decentralised Wastewater Treatment in Developing Countries, Bremen Overseas Research and development Association, Bremen.
[11] Mann, H.T., Williamson, D., 1982. Water Treatment and Sanitation, Intermediate Technology Publications 1973, 1979, 1982., Printed in England by The Russell Press Ltd., Nottingham.
[12] Mara, D. Sewage Treatment in Hot Climates, A Wiley Interscience Publication, John Wiley and Sons.
[13] Neptune Pacific Ltd., On-site and Small Community Sewage Management with the N-DN Biofilter Treatment Plant
[14] Pickford, J., 1991. The Worth of Water. Technical Briefs on health, water and sanitation. Intermediate Technology Publications 1991.103-105 Southampton Row, London, Printed by Russell Press Ltd., Nottingham.
[15] Sinclair, Knight, Merz, 1997 Review of Effluent Management Systems Castaway Resort