IJCRT.ORG ISSN : 2320-2882
INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)
An International Open Access, Peer-reviewed, Refereed Journal

A REVIEW ON DOMESTIC WASTEWATER (SEWAGE) TREATMENT PARAMETERS AND TECHNOLOGIES

Ritesh Rangari[1] Jayant Ramteke[2] Hiradas Lilhare[3]

[1]*M. Tech. student, Department of Civil Engineering, Swami Narayan Siddhant Institute of Technology, Kalmeshwar, Nagpur, Maharashtra, India*

[2]*Professor, Department of Civil Engineering, Department of Civil Engineering, Swami Narayan Siddhant Institute of Technology, Kalmeshwar, Nagpur, Maharashtra, India*

[3]*Assistant Professor, Department of Civil Engineering, Department of Civil Engineering, Swami Narayan Siddhant Institute of Technology, Kalmeshwar, Nagpur, Maharashtra, India*

Abstract: As a result of growing civilization and industrialization, water demand has been increased enormously. The water demand in future cannot be met if we rely only on fresh water sources. 80% of the generated wastewater meets the natural streams without any treatment, which create hazard to the ecosystem. A sewage treatment plant not only treats the wastewater, it can also make the treated wastewater available for reuse, giving it an advance tertiary treatment. STP contains various units performing complex operations. It is certainly important to understand the operational conditions and flow pattern to design a most efficient and economical plant. In this paper an attempt has been made to study various units and their operations in a sewage treatment plant.

Index Terms - **Sewage, Wastewater, Treatment Plants, Treatments Technologies**

I. INTRODUCTION

In India water for domestic use is generally provided to residences in urban areas by a reticulated supply, managed by a local or statutory authority. In rural and isolated locations, where potable water cannot be supplied from a reticulated supply, water may be individually sourced from ground or surface waters. Wastewaters which are then generated by domestic residences is generally collected by a reticulated sewerage system and treated at a wastewater treatment plant, or treated and disposed of on-site, where the wastewaters are generated. As India is one of the most urbanised countries in the world, the majority of domestic residences are provided with a reticulated water supply and serviced by a sewerage system managed by a local or statutory authority.

Sewage if disposed without treatment causes nuisance. Sewage treatment is the way of expelling contaminants from wastewater, essentially from domestic areas sewage. Physical, synthetic and natural procedures are utilized to expel contaminants and create treated wastewater that is more secure for the earth. A by-product of sewage treatment is generally a semi-strong waste or slurry, called sewage sludge. The sludge needs to undergo proper treatment before disposal on land or water.

In India, water is supplied at a rate of 135 lpcd in general. However 80-85% of which gets converted to domestic wastewater. The wastewater is collected through the wastewater collection infrastructure laid by the urban local body or municipal authority and taken to the nearby sewage treatment plant. Since the wastewater generation pattern varies for every hour of the day also the volume varies seasonally, special care is to be taken while calculating the flow for designing the treatment facilities. In this paper, an attempt has been made to briefly describe the various processes involved in wastewater treatment plant.

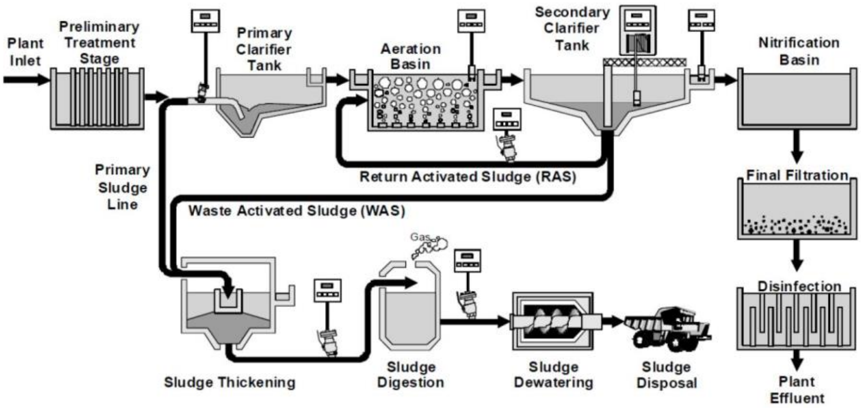

Figure 1: Typical Treatment Flow-Chart for Sewage Treatment Plant (Shobhan M. et al.)

The preliminary treatment involves Screens, Grit chamber and skimming tank. Screens remove the large floating objects i.e. plastic, rags and other trash coming along the sewage. The wastewater also contains fat, oil and grease (FOG) which interrupts the biological processes. The skimming tank is provided to remove these elements floatation method. While the grit chamber is used to remove the gravel, grit and more or less fine particles. After the preliminary treatment sedimentation tank is provided as a part of primary treatment, which removes settleable solids under the action of gravity. Around 20-30% of the BOD load is removed during this stage. Once the preliminary and primary treatments are over the wastewater then undergoes secondary treatment. In general secondary treatment of domestic wastewater involves biological processes. Here the micro-organisms are used to decompose the biodegradable organic matter present in wastewater. Depending on the bacterial community the processes can be aerobic or anaerobic. Once the secondary processes are completed the treated wastewater goes for tertiary treatment for reuse purpose or simply disposed in a receiving water body.

II. The characteristics of wastewater

The first important information we should have for the design of wastewater treatment system is to know about the strength and characteristics of the wastewater to be treated. The strength of wastewater is normally expressed in terms of pollution load, which is determined from the concentrations of significant physical, chemical and biological contents of the wastewater (Davis and Cornwell, 2008).

Characteristics of wastewater depend on the quality of water used by the community, conservation practice and culture of population, type of industries present and treatment given by industries and their wastewater. Many of the above parameters are interrelated. For example, the concentration of dissolved gases and microbial activities in wastewater are affected by temperature.

One of the most important physical characteristics of wastewater is its content of solids, which consists of floating matter, sediment, suspended material and soluble matter. Other physical properties are temperature, colour and degree of turbidity. In addition, for chemical characteristics, it includes organic materials and inorganic substances.

Organic substances consist of a mixture of carbon, hydrogen, oxygen, and sometimes nitrogen, as well as other important elements such as sulphur, phosphorus and iron. Regarding to organic substances, many inorganic indicators of wastewater are important for the development and control of wastewater quality standards. Concentrations of inorganic compounds are increased due to the natural evaporation process, which disposes of some of the water, leaving the inorganic materials in the wastewater.

III. VARIATION OF DIFFERENT PARAMETERS IN SEWAGE TREATMENT PLANT (STP)

3.1. pH

pH plays very important role in biological treatment as it contains micro-organisms which are sensitive towards extreme acidic and basic conditions. When the study was conducted in a batch reactor mode the pH value at the inlet of the sewage treatment plant observed between 6.2 and 6.9 and at the outlet it was found between 7.1 and 7.5. This increase in pH was taken place due to cyclic activated sludge treatment process (Kulkarni et al., 2016). In another study conducted for membrane bioreactor the pH at inlet and outlet of the reactor was found constant between 6.5 and 8.5 (Ashok et al., 2016).

3.2. Biological Oxygen Demand (BOD)

The domestic wastewater contains high percentage of organic matter. In one of the studies conducted for sewage treatment plant analysis the BOD value at the inlet and outlet of the plant was found as 198.67 mg/l and 30-20 mg/l respectively (Patil et al. 2018). Another study was organized on evaluation of biological approach for the effluent treatment, it states that the BOD at the inlet was 225mg/l and at the outlet was 9mg/l (Rajkumar, 2016)

3.3. Dissolved Oxygen (DO)

In general, presence of BOD in the wastewater proposes the absence of DO. To decompose the organic matter in wastewater micro-organisms consumes dissolved oxygen provided naturally or artificially. The study result of decentralized wastewater treatment facility states that the DO at inlet was below than the detection limit and at the outlet it was increased to 2 mg/l (Bhagwatkar et al., 2017).

3.4. Chemical Oxygen Demand (COD)

A study conducted on evaluation and assessment of performance wastewater treatment plants concludes that the COD at the inlet is 315.1 to 365.6 mg/l and at the outlet is 51.2 to 56.0 mg/l (Dahamsheh and wedyan, 2017). The study of treatment efficacy of algae-based sewage treatment plant tabulates the results as COD at the inlet is 458.7 mg/l and at the outlet is 208 mg/l (Durga et al. 2013).

3.5. Total Dissolved Solids (TDS)

The result of experimentation undertaken on performance evaluation of sewage treatment plant states that the TDS at the inlet is 497.78mg/l and at the outlet is 434.01mg/l (Negi and Sahu, 2015). The study of treatment efficiency of algae-based sewage treatment plants represents the results as TDS at the inlet is 782 mg/l and at the outlet is 859 mg/l (Durga et al., 2013).

IV. Treatment Technologies used for Sewage Treatment

4.1 Activated Sludge Process (ASP)

Activated-sludge technique, a sewage-treatment process in which sludge, the amassed, microbe's rich deposits of settling tanks and basins, is seeded into the approaching wastewater and the blend agitated for a few hours (4-8 hours) within the sight of an adequate air supply. Suspended solids and numerous organic solids are adsorbed by the sludge, while organic matter is oxidized by the microorganisms. The measures of air and sludge utilized can be differed to control the level of treatment got. The sludge is then isolated out in a settling tank (Akshey Bhargava, 2016).

Activated sludge plant involves:

1. Wastewater aeration in the presence of a microbial suspension,
2. Solid-liquid separation following aeration,
3. Discharge of clarified effluent,
4. Wasting of excess biomass, and
5. Return of remaining biomass to the aeration tank.

4.2 Extended Aeration (EA)

The conventional activated sludge plant has been modified to eliminate the primary sedimentation tank, and sludge digestion tank, in a process called Extended Aeration, which aims at providing an aeration tank with a longer aeration time. It is more economical for upto 1.5 lakh population, than a conventional activated sludge plant (Mohammad S. et.al. 2018).

4.3 Moving Bed Biofilm Reactor (MBBR)

It's a mix of activated sludge process (suspended growth) and bio filter processes (attached growth). Moving Bed Biofilm Reactor (MBBR) process utilizes the entire tank volume for biomass development. It utilizes basic drifting media, which are transporters of attached growth of biofilms. Biofilm carrier movement is caused by the disturbance of air bubbles. This minimal treatment framework is viable in the expulsion of BOD as well as nitrogen and phosphorus while encouraging successful solids separation (Daniel V. et. al. 2014)

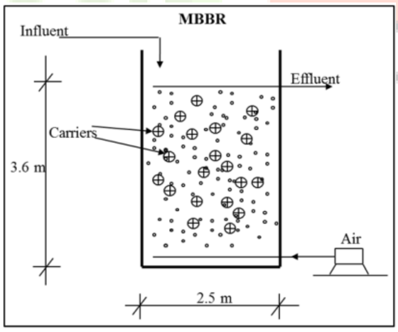

Figure 2: Typical Representation of Moving Bed Biofilm Reactor

4.4 Sequential Batch Reactor (SBR)

The sequencing batch reactor (SBR) process is a progressive suspended growth (activated sludge) process in which each major progress occurs in a common tank in sequential order. The aggregate five phases happen in a single reactor by which way it diminishes the impression. SBRs can be designed and operated to enhance removal of nitrogen, phosphorus, and ammonia, despite clearing TSS and BOD. The five stages of SBR are:

- **Fill:** Wastewater fills the tank, mixing with biomass that settles in the midst of the past cycle.
- **React:** Air is added to the tank to enable biological growth and felicitate waste diminishment.
- **Settle:** Mixing and Aeration quit in the midst of this stage to empower solids to settle.
- **Draw:** Clarified water is discharged.
- **Idle:** Sludge can be removed in the midst of this stage.

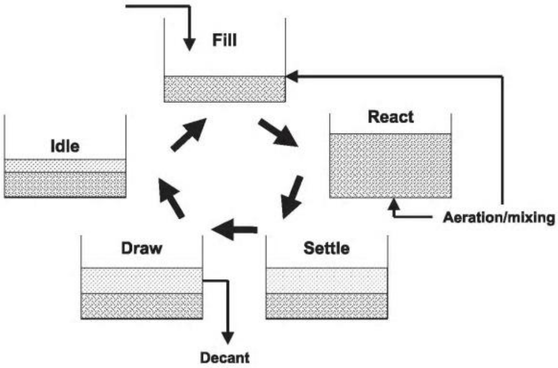

Figure 3: Typical Cycle in SBR (USEPA 1999)

V. Discussion

This report is a review of variety of options that may be employed in the treatment, recovery and reuse of wastewater. It has been seen that a variety of options are feasible for wastewater treatment in the developing world. Every method has got its own pros and cons subject to conditions, hence multiple treatment methodologies can be clubbed together to achieve higher efficiencies. Biological treatment technologies are considered viable because of their low capital costs, their ease of maintenance, their potentially longer life-cycles and their ability to recover a variety of resources including: treated effluent for irrigation, organic humus for soil amendment and energy in the form of biogas.

This paper examined different wastewater treatment alternatives with their emergent issues and technological options related to the scale of collection. There is increasing momentum developing behind the notion that recycling loops, from point of generation (the household) to point of treatment and reuse must be shortened.

VI. References

[1] A.H. Mahavi (2008) Sequencing batch reactor: A promising technology in wastewater treatment. Iran. J. Environ. Health Sci. Eng., Vol.5, No.2, 79-90.

[2] Akshey Bhargava (2016) Activated Sludge Treatment Process-Concept and System Design. International Journal of Engineering Development and Research, Volume 4, Issue 2, ISSN: 2321-9939.

[3] Ashok S.S., Kumar T. and Bhalla K. (2018) Integrated Greywater Management Systems: A Design Proposal for Efficient and Decentralised Greywater Sewage Treatment. 25th CIRP Life Cycle Engineering (LCE) Conference, Copenhagen, Denmark. Procedia CIRP 69, 609-614.

[4] Bhagwatkar A., Kamble S., More K. and Amup A.K. (2017) Decentralized wastewater treatment facility. International journal of engineering sciences & management, 3(4), 144-155.

[5] Dahamsheh A. and Wedyan M. (2017) Evaluation and assessment of performance of Al-Hussein bin Talal University (AHU) wastewater treatment plants. International Journal of Advanced and Applied Sciences, 4(1), 84-89.

[6] Daniel Vieira Minegatti de Oliveira, Marcio Dias Rabelo and Yuri Nascimento Nariyoshi (2014) Evaluation of a MBBR (moving bed biofilm reactor) pilot plant for treatment of pulp and paper mill wastewater. International Journal of Environmental Monitoring and Analysis, 2(4), 220-225.

[7] Davis, M.L. and Cornwell, D.A. (2008) Introduction to Environmental Engineering. McGraw-Hill Companies, New York.

[8] Durga Madhab Mahapatra, H. N. Chanakya and T. V. Ramachandra (2013) Treatment efficacy of algae-based sewage treatment plants. Environ Monit Assess.

[9] Kulkarni B., Wanjule R.V., and Shinde H.H. (2016) Study on Sewage Quality from Sewage Treatment Plant at Vashi, Navi Mumbai. ScienceDirect Materials Today, 5, 1859-1863. Mohammad Sadegh Nikmanesh, Hadi Eslami, Seyed Mojtaba Momtaz, Rahmatollah Biabani, Amir Mohammadi, Babak Shiravand and Tahereh Zarei Mahmoudabadi (2018) Performance Evaluation of the Extended Aeration Activated Sludge System in the Removal of Physicochemical and Microbial Parameters of Municipal Wastewater: A Case Study of Nowshahr Wastewater Treatment Plant. Journal of Environmental Health and Sustainable Development, 3(2), 509-17.

[10] Negi M.S. and Sahu V. (2015) Performance evaluation of 9 MLD sewage treatment plant at gurgaon and cost effective measures in treatment process. Civil Engineering and Urban Planning: An International Journal (CiVEJ), 2(3), 1-7.

[11] Patil Y., Raut Y., Patil Y. and Dhurve S. (2018) Design of sewage treatment plant units for st.john college campus. International Journal of Scientific Research Engineering & Technology (IJSRET), 7(3), 177-181.

[12] Rajkumar K. (2016) An Evaluation of Biological Approach for the Effluent Treatment of Paper Boards Industry - An Economic Perspective. J Bioremediat Biodegrad, 7(5), 1-13.

[13] Shobhan Majumder, Poornesh, Reethupoorna M.B. and Razi Mustafa (2019) A Review on Working, Treatment and Performance Evaluation of Sewage Treatment Plant. Journal of Engineering Research and Application, Vol. 9, 41-49.