International Journal of Scientific Research in Multidisciplinary Studies
Vol.5, Issue.8, pp.45-48, August (2019)

Research Paper
E-ISSN: 2454-9312
P-ISSN: 2454-6143

Treatment of Domestic Wastewaters Using Activated Sludge Process - A Case Study

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Available online at: www.isroset.org

Received: 28/Jul/2019, Accepted: 21/Aug/2019, Online: 31/Aug/2019

***Abstract*—** Wastewater is the by-product of municipal, agricultural and industrial activities. Removal of organic matter is essential to treat the water and meet the acceptable quality standards in order to prevent from water pollution. The purpose of this paper is to summarize the research work on study of effectiveness of Activated Sludge Process (ASP) at laboratory scale basis to remove the organic matters. ASP is the biological aerobic wastewater treatment that uses microorganisms to biologically oxidize the organic pollutants. This method uses naturally occurring bacteria and protozoa, thus it is eco- friendly as well as economical. From the experimental observation, it was found that about 52% of the BOD has been reduced through secondary treatment process, chlorides content reduced about 70%, acidity of water is reduced to 12 mg/L and DO of water is 12. The treated water can be discharged into stream or used in construction activities. Based on the performance of ASP in treating domestic effluent, this can be found as cost effective, effectiveness, good quality in effluent treatment, efficient removal of BOD and COD.

Keywords—Activated Sludge Process, Eco-friendly, Aerobic Treatment, Organic Matter, Microorganism

I. INTRODUCTION

Wastewater is a combination of water and water-carried wastes originating from households, commercial and industrial amenities and institutions. Untreated wastewater generally contains high level of organic material, numerous pathogenic microorganisms, nutrients and toxic compounds leading to environmental pollution and health hazards. So, the wastewater must be treated appropriately before its final disposal, which leads to protection of the environment with public health and socioeconomic concerns [2].

Sewage is a dilute mixture of the various types of wastes from the residential, public and industrial places. The sewage pollutant causes undesirable changes and it affects the land, water and air or the environment. In the modern living the heavy industrialization and increase of population increases the rate of water pollution. Therefore, the need of water pollution control has drawn the attention of the concerned department. The characteristics and composition of sewage is mainly depending on the type of source [3]. The main source of water pollution in domestic wastes are human excreta, kitchen wastes, gardening and washing etc.,

II. WASTEWATER VOLUME IN INDIA

Urban areas in India generate about 5 billion liters per day of wastewater in 1947 which has Increased to about 30 billion liters per day in 1997 (Winrock International, India 2007). According to the Central Pollution Control Board (CPCB), 16BLD of wastewater is generated from Class-1 cities (population >100,000), and 1.6BLD from Class-2 cities (population 50,000-100,000). Of the 45,000 km length of Indian rivers, 6,000 km have a bio-oxygen demand above 3 mg/l, making the water unfit for drinking (CPCB 1998). An estimated 80% of wastewater generated by developing countries, especially China and India, is used for irrigation (Winrock International India 2007).

In India, where wastewater is mainly used in agriculture, a policy framework covering the issues associated with this practice is lacking. Strauss and Blumenthal (1990) estimated that around 73,000 ha were irrigated with wastewater in India. However, Buechler and Mekala (2003: 939) estimated that even just along the Musi River that runs through Hyderabad city in Andhra Pradesh State, and the canals and tanks off this river approximately 40,000 ha of land were irrigated with urban and industrial wastewater diluted with fresh river water especially during the monsoon season. Untreated wastewater from domestic, hospital and industrial areas pollute rivers and other natural water bodies [4]. More than 80% (only 4,000 Million Liters per Day [MLD] out of 17,600 MLD wastewater generated in India is treated) of wastewater generated is discharged into natural water bodies without any treatment due to lack of infrastructure and resource for treatment (Winrock International India2007).

Farmers have customary rights to any water that flows through the river and it should be the responsibility of the irrigation and water authorities to maintain the quality of this water to ensure the sustainable use of this water [5]. Achievement of a safe and healthful workplace is the responsibility of an organization, the people residing in the place and the workers who are given the charge to protect the environment. Waste disposal and minimization and pollution prevention should be the preferable approach.

III. STUDY AREA

Channasandra Village of Whitefield is 24 km from Bangalore centre. Due to good transport infrastructure and software companies, it is observed as the major business hub for neighbouring small villages and towns. It has both railway as well as road transport connectivity, which is an additional attraction by the people to settle down or looking for accommodation. This leads to increase in source of wastewater generation through domestic activities and commercial development.

IV. METHODOLOGY

Sewage treatment is the process of removing contaminants from wastewater and household sewage. It includes Physical, chemical, and biological processes to remove contaminants from wastewater. Sewerage implies the collection of wastewaters from occupied areas and conveying them to some point of disposal after treatment. Sewage is liquid, consists of any one or a mixture of liquid waste origins from urinals, latrines, bathrooms, kitchens of a dwelling, commercial building or institutional buildings. Storm sewage is a liquid flowing in sewer during or following a period of rainfall and resulting there from. A Separate Sewer System is the sewerage system in which the domestic sewage is not carried with the storm water in the rain season. The liquid wastes will require treatment before they are discharged into the water body or otherwise disposed of without endangering to the public health or causing offensive conditions. Relevant details should be given including experimental design and the technique (s) used along with appropriate statistical methods used clearly along with the year of experimentation (field and laboratory).

A. Sewage Treatment

The treatment of sewage consists of many complex functions. The degree of treatment is depending upon the characteristics of the raw inlet sewage as well as the required effluent characteristics [12,13].

Treatment processes are often classified as:

1. Preliminary treatment: This treatment is consisting of solely in separating the floating materials like tree branches, paper, pieces of rags wood, etc., and heavy settleable inorganic salts [14,15,16].

2. Primary treatment: It consists of removal of large suspended organic solids. It is usually accomplished by sedimentation settling basins. The liquid effluent from the primary treatment often contains a large amount of suspended organic material.

3. Secondary treatment: Here the effluent from primary treatment is treated through biological decomposition of organic matter which is carried out either by anaerobic or aerobic conditions.

4. Tertiary treatment: The purpose of tertiary treatment is to provide a final treatment stage to raise the effluent quality before it is discharged to the receiving environment.

B. Field Scale Model of Wastewater Treatment Plant

An attempt is made to develop an efficient wastewater treatment plant of activated sludge process. Activated sludge process falls under secondary treatment of wastewater.

C. Activated Sludge Process

Secondary treatment process is done by activated sludge process and consists of two tanks. One is for aeration tank where microorganisms are grown and second one is a clarifier where the settling of impurities takes place [6].

Air is aerated to the aeration tank by using air compressor, which enhance the microbial activity and oxidize the organic matter present in sewage [7].

Sludge which developed in aeration tank is separated in secondary clarifier.

Sludge collected in clarifier is called activated sludge; some amount of this activated sludge is added to aeration tank along with raw sludge. This process is called activated sludge process [8].

D. Process Description

Raw sewage was made to pass through sieves which act as screen chamber and it is passed into primary sedimentation tank, where heavier organic and inorganic particles are settled at the bottom of tank due to gravitational force. Then the water was subjected to secondary treatment process which is basically activated sludge process [9]. Where air is aerated using air pump and the microorganisms present in sewage get activated. The microorganisms basically break-up the organic compounds into carbon dioxide. They also reduce the nitrates and phosphates for their growth. Along with these matters they also utilize the trace elements like potassium, magnesium and iron while calcium, sodium and silica may be necessary for the growth of the microorganism.

The settled impurities are removed in the form of activated sludge in the clarifier tank. At the exit of the clarifier there is an ultra-filter provided in order to prevent flow of cultured microorganisms out of the clarifier [10]. There is a recycling stream from the clarifier to the aeration tank in order to achieve maximum removal of the undesired components.

This completes the secondary treatment [11]. The equipment's and utilities used are (1) Rectangular tank (2 no), (2) Pipe (2 m), (3) Water tap (4 no), (4) Water bottle (1 no), Air pump, Sieve and Thin member.

Fig.1. Complete Setup of Plant

Fig. 2. Initial Stage

Fig. 3. Middle Stage

Fig. 4. Lower Stage

V. RESULTS AND DISCUSSION

The following tables details the wastewater quality parameters before and after treatment with and without ASP [1].

Table 1 – Wastewater Quality Parameters Before Treatment

Parameter	Unit	Value (near bus stand)	Permissible limits
pH	-	8.72	6.5-8.5
TURBIDITY	(NTU)	42	10
ACIDITY	(mg/L)	96	-
ALKALINITY	(mg/L)	580	300-600
CHLORIDES	(mg/L)	432	250
DO	(mg/L)	8.76	5
BOD	(mg/L)	139	-

Table 2 - Wastewater Quality Parameters After Treatment

Parameter	Units	Limit	Raw sample	Without activated sludge	With activated sludge
pH	-	6.5-8.5	8.72	7.5	7.7
TURBIDITY	NTU	10	42	12.2	10.1
ACIDITY	mg/L	-	96	72	12
ALKAILINITY	mg/L	200-600	580	54	48
CHLORIDES	mg/L	250	432	394.43	234.25
DO	mg/L	-	8.76	10.64	12
BOD	mg/L	-	139	104.6	78.4

VI. CONCLUSION

In the present study, treating sample of sewage generated from Channasandra region is treated with Activated Sludge Process (Secondary treatment process). We found that, in ASP about 52% of the BOD has been reduced only by secondary treatment process and turbidity of water is reduced due to settling process in clarifier. Chlorides content is reduced about 70%, acidity of water is reduced to 12 mg/L, so this water can be used for construction work. DO of water is 12, so it can be discharged into stream. The cost of treatment plant by activated sludge process is about 5-6 Million liters per day. This treated water will reduce the ground water and treated sludge will be very much useful for increasing the fertility of the soil. This treated water can be effectively used for gardening and other purposes such as flushing toilets, fountain for parks and washing floors etc.,

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