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Research Article

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Comparative study on wastewater treatment using activated sludge process and extended aeration sludge process

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ABSTRACT

Every human being needs water for all their purposes and generates wastewater after the usage. The regulatory agencies are stringently forcing the local bodies, industries, and major organizations to control the quality of wastewater before discharging into the environment. Hence the necessity arises to treat the wastewater before it is discharged. The authority and the planner must know the various parameters and characteristics of wastewater, the constituent present in it and method of treatment technologies available before designing the treatment plants. There are various methods available for wastewater treatments like Activated Sludge Process, Trickling Filter, Extended Aeration Sludge Process, Aerated Lagoon, Oxidation Ditch, Waste Stabilization Pond, Up-flow Anaerobic Sludge Blanket, Membrane Bio-Reactor, Moving Bed Bio-film reactor, Sequential Batch reactor and Rotating Biological Contact-discs. In this paper, a comparative study has been carried out to evaluate the performance (like Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand, Total Suspended Solids and other main constituents), installation, operation, maintenance cost comparison for the Activated Sludge Process(ASP) and Extended Aeration Sludge Process (EASP) is taken up to control the discharge limits. The average test results showed that the removal efficiency of BOD and TSS from the domestic wastewater in EASP is more than 96% and superior compared to ASP technology.

Key words: Waste Water, Activated Sludge Process, Extended Sludge Process, BOD, TSS.

INTRODUCTION

In society every community consumes water for various domestic, industry, agricultural activities etc., and produces both liquid and solid wastes and air emissions.

In the past, more money has been spent for the research and development of sewage treatment process and sludge management, which resulted in a rapid growth in technology for improved process design. Laboratory and pilot plant studies are utilized to develop process design parameters and kinetic coefficients. Now, great emphasis is given to energy conservation, operation and maintenance of treatment plants to optimize the treatment costs. The aim of the project is to study and compare two different technologies such as Activated sludge process (ASP) & Extended Aeration Sludge process (EASP) in wastewater treatment by analyzing the performance in the removal of Biochemical Oxygen Demand (BOD) and Total Suspended Solids (TSS), the main constituents that are to be controlled before discharging the effluent into the environment by testing the raw sewage and treated waste water at frequent intervals [1-4].

STUDY AREA
Sewage Treatment Plant – Perungudi. Chennai

The Sewage Treatment Plant located at Perungudi, Chennai is a unit using as Activated Sludge Process (ASP) Technology to treat the waste water generated from the South Chennai Since 2006. The process flow diagram of ASP Technology is given in Fig. 1

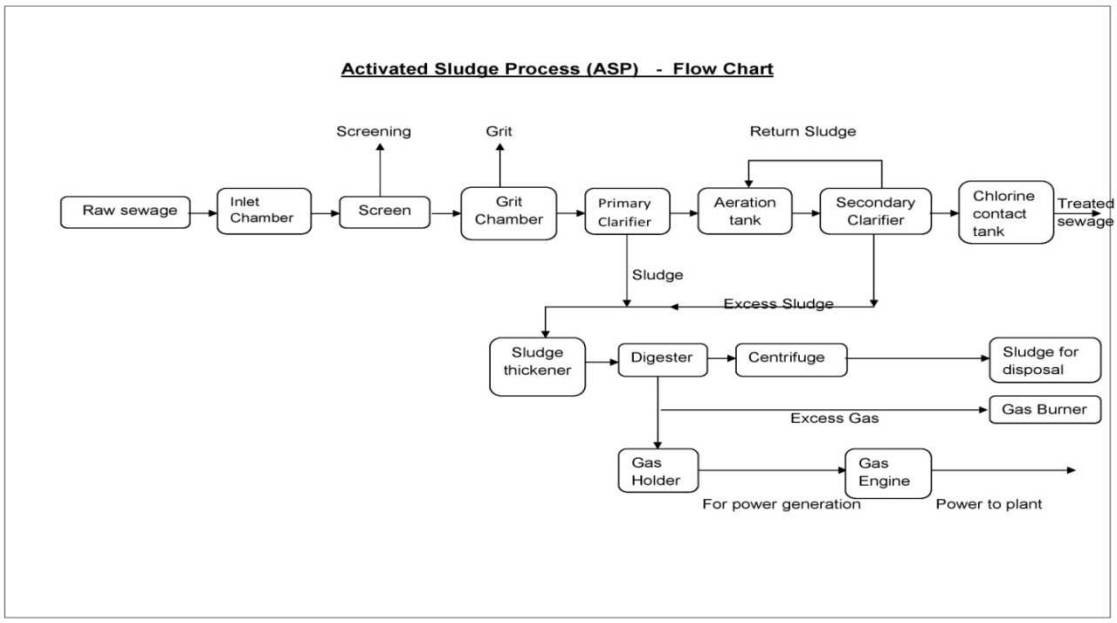

Fig 1 Process Flow Diagram of ASP Technology

Sewage Treatment Plant – Onamancherry:
The Sewage Treatment Plant located in, Tamil Nadu Police Training Academy at Onamancherry, Chennai is a unit using EASP Technology to treat the waste water generated from the Police Training Academy Centre, The process flow diagram of EASP Technology is given in Fig. 2

The process flow diagram of ASP Technology provided in sewage treatment plant at Perungudi is given in Fig.1

The activated sludge process was so named because it involved the production of an activated mass of microorganisms capable of stabilizing a waste under aerobic conditions. In the aeration tank, contact time is provided for mixing and aerating influent wastewater with the microbial suspension, generally referred to as Mixed Liquor Suspended Solids (MLSS) or Mixed Liquor Volatile Suspended Solids (MLVSS). Mechanical equipment is used to provide for mixing and transfer of oxygen into the process. The mixed liquor flows to a clarifier where the microbial suspension is settled and thickened. The settled biomass, described as activated sludge because of the presence of active microorganisms, is returned to the aeration tank to continue biodegradation of the influent organic material. A portion of the thickened solids is removed daily or periodically as the process produces excess biomass that would accumulate along with the non-biodegradable solids contained in the influent wastewater [1].

The domestic waste water generated from South Chennai area is collected in a pumping station. The waste water is pumped to the treatment plants and treated in three stages. 1. Preliminary treatment, 2.Primary Treatment, 3.Secondary Treatment. In preliminary treatment the floating impurities like paper, plastic, cotton, rubber, wood, dried leaves etc are removed. In Primary treatment, primary clarifier is used to remove the large suspended, organic solids by sedimentation in settling basins and removal of oil and grease by skimmer arm arrangement. And in secondary treatment, using secondary clarifier, aeration is provided .Here oxygen from air is consumed for bacterial multiplication, which consumes organic and suspended impurities from sewage and purifies it. In secondary clarifier the effluent is allowed for 2 hours for detention period. Micro organic impurity called Biomass settles, part of it is sent to aeration tank to carry out Activated Sludge Process and the remaining to digestion tank. The secondary treated effluent is treated in maturation pond or shallow depth pond for reduction of fecal coliform. Additional units function to separate organic and suspended solids from primary clarifier, is then let into digesters' for digestion and removal of gaseous impurities and generate the Bio gas and used for electricity power production.

3.2.2. EXTENDED AERATION

The flow scheme of the extended aeration process and its mixing regime are similar to that of the completely mixed process except that primary settling is omitted. The process employs low organic loading, long aeration time, high MLSS (Mixed Liquor Suspended Solids) concentration and low F/M (Food Micro Organisms ratio). The BOD removal efficiency is high. Because of long detention in the aeration tank, the mixed liquor solids undergo considerable endogenous respiration and get well stabilized. The excess sludge does not require separate digestion and can be directly dried on sand beds. Also the excess sludge production is a minimum [2].

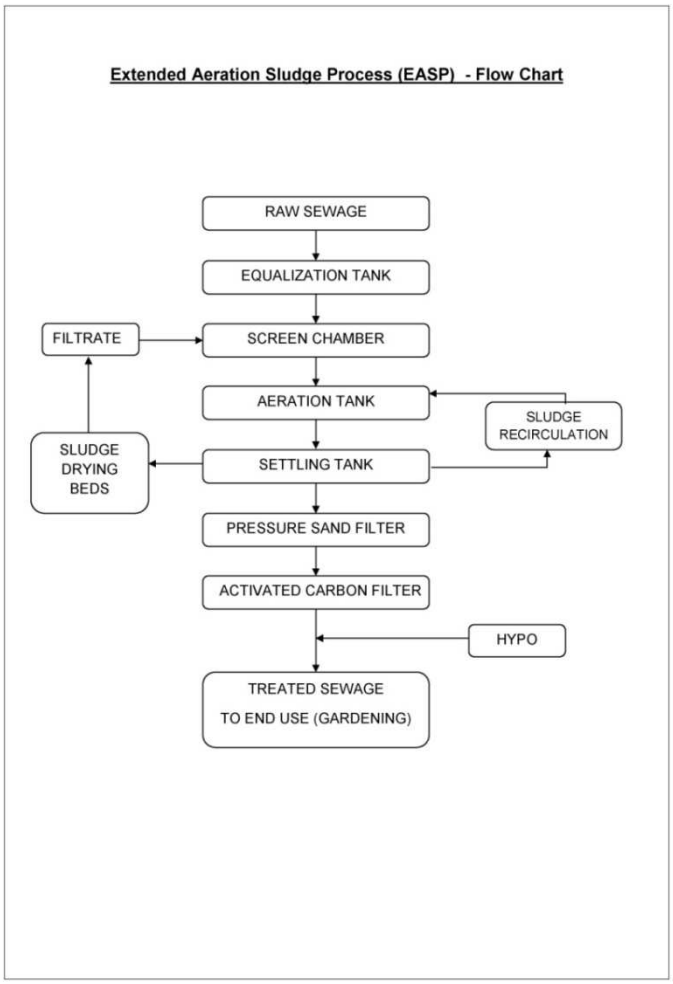

Fig. 2 Process Flow Diagram of EASP Technology

Methods and Analysis

The raw sewage collection at the entry point of the treatment plant i.e. before the screen chamber and the exit point i.e. in the inlet of treated effluent collection sump. The samples have been tested in the ISO certified state level water testing laboratory of Tamilnadu Water Supply and Drainage Board, Chennai. The key parameters of the raw wastewater and the treated effluent such as Bio-Chemical Oxygen Demand on 5th Day (BOD_5), Chemical Oxygen Demand (COD), Total suspended solids (TSS), Total Dissolved Solids (TDS), pH, Choloride, Sulphate, Phosphate, Turbidity, and Nitrate, have been analyzed on the various days and working conditions. The parameters have been analysed on the samples at the laboratory as per the time limit prescribed by the CPHEEO norms and the the samples were collected in frequent interval.

RESULTS AND DISCUSSION

WASTEWATER AND TREATED EFFLUENT QUALITY IN STUDY AREA

The key parameters of the raw wastewater and the treated effluent such as Bio-Chemical Oxygen Demand on 5th Day (BOD_5), Chemical Oxygen Demand (COD), Total suspended solids (TSS), Total Dissolved Solids (TDS), pH, Chloride, Sulphate, Phosphate, Turbidity, and Nitrate, were analyzed on the various days. The Tables 1 and 2 contain the Analysis Report. The working conditions and comparisons are tabulated in Table 3.

Tables 1 Analysis Report on samples collected from 26.11.2012 to 17.12.2012 at Tamil Nadu Police Academic Traning Center, Onamancherry, Chennai (EASP Technology)

Sl.No	Parameters Analyzed	Raw Sewage				Treated Effulent			
		1	2	3	4	1	2	3	4
1	BOD_5 (mg/L)	50	46	48	41	2	2	2	2
2	COD (mg/L)	153	123	103	143	3	7	5	8
3	TSS (mg/L)	39	36	31	37	2	2	2	3
4	TDS (mg/L)	672	742	1138	596	622	636	1078	552
5	pH	6.99	7.23	7.69	6.98	7.02	7	7.22	6.99
6	Chloride (as CI) (ppm)	89	180	153	78	85	87	134	71
7	Sulpahte (ppm)	46	76	112	56	44	49	96	54
8	Phosphate (ppm)	32.31	3.03	2.25	2.59	9.99	1.02	0.82	0.89
9	Turbidity(NTU)	20.6	22.6	19.6	18.4	4.8	4.2	3.2	2.6
10	Nitrate (mg/L)	43	30	31	30	14	7	5	5

Tables 2 Analysis Report on samples collected from 26.11.2012 to 17.12.2012 at STP Plant at Perungudi, Chennai. (ASP Technology)

Sl.No	Parameters Analyzed	Raw Sewage				Treated Effulent			
		1	2	3	4	1	2	3	4
1	BOD_5 (mg/L)	142	96	182	120	8	7	17	24
2	COD (mg/L)	412	289	440	424	32	22	42	70
3	TSS (mg/L)	42	14	18	32	4	2	2	3
4	TDS (mg/L)	688	782	776	792	552	578	426	484
5	pH	8.11	7.24	7.83	7.56	8.01	7.06	7.92	7.21
6	Chloride (as CI) (ppm)	396	302	396	381	148	162	346	366
7	Sulpahte (ppm)	148	182	142	176	92	79	88	81
8	Phosphate (ppm)	41.62	2.59	2.96	4.21	11.14	0.47	0.81	0.44
9	Turbidity(NTU)	36	18.9	19.4	17.1	14	3.8	4.1	3.2
10	Nitrate (mg/L)	12	46	7	11	3	7	2	8

Table 3. Comparison of ASP and EASP on Waste Water Treatment

Sl.No.	Activated Sludge Process	Extended Aertion Sludge Process
1.	Primary settling tank, Aeration tank, Secondary settling tank, Sludge Thickener, Digester (Optional), Centrifguge (Optional) Sludge disposal, Gas production Gas Stripping and utilization	Aeration Tank, Secondary settling tank sludge drying bed, Sludge disposal
2.	4-6 hrs detention in aeration tank. (Volume of aeration tank is less	18-22 hrs detention in aeration tank (Volume of aeration tank is high)
3.	Due to less volume less aeration time the MLSS concentration sludge will be more. Hence further process of sludge digestion etc., can be provided optionally and Methane gas can be produced.	Due to high aeration time most of MLSS will be utilized by the microorganisms. Hence the necessity of further sludge process does not arise.
4.	Primary settling tank,Sludge thinker, Digestion process, Centrifuge,etc., additional components causes capital cost will be more, more land area is also required.	Only aeration tank size will be more.
5.	Capital cost-High	Comparatively less
6.	Land area-High	Comparatively less
7.	Electrical Energy cost-medium	Electrical Energy cost-High
8.	Establishment – High	Establishment-Low
9.	Maintenance problem high, since so many components involved.	Comparatively less
10.	Above 20 MLD only bio gas production and Electrical power generation is economical	Not applicable.

CONCLUSION

From the present investigations, the following points can be considered

1. The treatment of Domestic sewage with Extended Aeration Sludge Process (EASP) is an effective and economical technology.
2. The land area required is minimum and installation cost, operation and maintenance cost is minimum. Since the primary settling tank, sludge digester etc., are not required in this process.
3. Due to high aeration time, most of MLSS will be utilized by the microorganisms. Hence the necessity of further sludge process does not arise.

For that it is recommended to utilize EASP technology for the treatment of domestic sewage in the industrial areas also.

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