A Study on Improvement of Wastewater Disposal System in Jaffna Municipal Council Area, Jaffna Sri Lanka

T.D.Denagama[1] & P.Gajenthiran[2], R.Sivakumar[2]
[1]Department of Construction Technology, University of Vocational Technology, Sri Lanka.
[2]Department of Construction Technology, University of Vocational Technology, Sri Lanka.

ABSTRACT

Jaffna Municipal Council is the heart of Jaffna district with a land area of around 20.20 km^2 and 27,820 families are living at present. JMC is maintaining the groundwater recharging ponds, wastewater disposal systems and drainages. At present storm water drainage is using as wastewater drainage and using as a wastewater collecting tank. Therefore, wastewater treatment is needed to provide a quality and affordable environment. A detailed literature review was carried out to understand the reasons for this problem and how to overcome them. A survey with a questionnaire and wastewater testing analysis was carried out. According to the analysis majority of the people are using open dug well, therefore, groundwater should be protected and 55.83% of the lands are 10-20 perches and some main parameters were above the standard level. Based on the findings of the feasibility study centralized conventional wastewater treatment plant with tertiary or advanced treatment is very much feasible. The common conventional process with advanced treatment was used and the treatment plant was designed to 17900 m^3/day to accommodate 109,535 people. The total cost of the project is 473 million. With the propose system waste water quality will be well below the required standard levels. A wastewater treatment plant is most important for JMC to reduce environmental pollution and reduce groundwater pollution and maintain the groundwater table.

Keywords: Environmental Pollution, Flow Diagram, Groundwater, Project Cost, Wastewater Treatment

Introduction

The millennium goal is access to adequate sanitation for 90% of the population of Sri Lanka by 2015 and 100% by 2025 (Kumaratathna, 2012). Jaffna Municipal Council plays a major role in Jaffna District. Jaffna Municipal Council area located in the heart of Jaffna district with a land area of around 20.20 km^2. 27,820 families are living at present in this municipal council area (Chief Accountant, 2018). Jaffna Municipal Council is maintaining the groundwater recharging ponds, wastewater disposal systems, and drainages.

South and West part of the Jaffna Municipal Council is covered by the sea. There are 40 ponds were located in the Jaffna Municipal Council area and these are using for groundwater recharge, agricultural purposes, and recreational facilities (Rajeswaran, 2006). Now, storm water drainages are using to discharge wastewater and finally discharge into the ponds and lagoons (Rajeswaran, 2006). Jaffna town area is mostly affected by wastewater disposal without treatment. As a result, some ponds located in the town area are using as wastewater collecting tanks. Now it looks like a septic tank. This created bad environmental conditions in the town area and people who are living in Jaffna town facing many problems due to this activity.

Figure 1 Research location

OBJECTIVES

– To identify the factors and reasons affecting the wastewater disposal problem in Jaffna Municipal Council area.

– To design a suitable wastewater treatment plant to overcome the wastewater disposal problem in Jaffna Municipal Council area

LITERATURE REVIEW

Peoples who are living in developing countries face a lot of problems in sewage management (Wenchuan, Kaba, & Thengolose, 2015). In Sri Lanka, effective wastewater collection and treatment is a critical problem (Wikramanayake & Corea, 2003). Jayalal and Niroshani (2012) found 30 million cubic meters of wastewater is produced by major industrial parks of Sri Lanka and approximately 10 percentage of wastewater produced by industries are discharged without any treatment into the surface water sources.

A well-designed storm water drainage system is available in the Jaffna town area and at present, this is using for wastewater disposal (Rajeswaran, 2006). Rajeswaran (2006) says the rainwater collecting ponds are charged with wastewater and now acting as a septic tank. Wastewater cannot be disposed into the ground surface when a high density of building area, high water table, and poor soil and septic tank with soakage pit is most feasible if space is available but secondary and tertiary treatment should be the need for discharge into the surface sources or reuse (Wikramanayake & Corea, 2003).

Population growth and industrialization are degradation of various ecosystems and in the case of ocean and river are polluted, such pollution is primarily caused by the discharge of inadequately treated industrial and municipal wastewater (Chan, Chong, Law, & Hassell, 2009). Raina and Alam (2014) elaborates population growth, lack of education, and backwardness are the main reasons for the problems in wastewater management.

Rajeswaran (2006) concluded through their study the quality of the groundwater in the Jaffna district is depending on the method of wastewater disposal. Rajeswaran (2006) identified the long term protection method is sewerage system including a treatment plant with tertiary treatment should be constructed and the treated water is reused for irrigation purposes. Constructed wetland is a reliable wastewater treatment method and it can be applied to all types of wastewater including sewage and require very low or zero energy input (Vymazal, 2010).

METHODOLOGY

Secondary data and information on the area were collected from various organizations such as the divisional Secretariat of Jaffna, Nallur and Jaffna Municipal Council. Three different locations of wastewater samples (at the inlet, over-flow outlet were selected to identify the wastewater quality. A well-structured questionnaire was prepared to identify influential reasons and suggestions. The questions of the questionnaires were close ended and personally administrated. A questionnaire survey with a 5-point Likert Scale was chosen to identify the objectives.480 participants were selected from each GN divisions (48×10). The data collected from the questionnaire survey were analyzed according to the mean value by mean value theory. The weighted average mean value on each variable was calculated and assigned in descending order. Based on the questionnaire survey and water testing reports, the first three solutions were selected, and

through the feasibility study the most appropriate method was selected.

FINDINGS

QUESTIONNAIRE SURVEY

As per the questionnaire survey, 74.79% of residences have open dug wells, and 22.08% of residences have tube wells and 3.13% of people are using pipe water. It is clear that the majority of the people are depending on groundwater sources. Another main factor is land extent land belongs to 55.83% of people were 10-20 perches. Percentages of land extent which are 6-10 perches, less than 6 perches was 18.96%, and 16.88% respectively. As per the SLS 745 part II, a lot of difficulties in locating the septic tank and soakage pit within the premises. Most of the people are discharging wastewater without treatment into the public drain.

The survey revealed that, the reasons for the wastewater disposal problem and solutions to overcome the problem. The main reason was land space not available for onsite wastewater treatment, because most of the land extent are 10-20, 6-10, and less than 6 perches and JMC town are is a highly populated town in Jaffna District. Therefore, the building was closely constructed to each other. Other main reasons were no wastewater treatment plant and pipe the sewage system.

Reasons

1. Land space not available for waste water treatment
2. Closely constructed buildings (High density)
3. There is no wastewater treatment system
4. There is no pipe sewerage system
5. No Public awareness
6. Population growth
7. Lack of education about wastewater treatment
8. Poor construction standards

The first recommendation to overcome the problem is a centralized conventional wastewater treatment plant with tertiary treatment. This solution is cost effective. However, this is the most suitable method to overcome the problem. Other solutions are septic tank and soakage pit and Municipal wastewater should be treated and disposed into the recharging pond to maintain the groundwater table.

Recommendations

Following are the conclusions derived through the survey about solutions to overcome the problem.

1. Centralized conventional wastewater treatment plant with tertiary treatment

1. On-site system (septic tank and soakage pit)

3. Municipal wastewater should be treated and disposed into the recharging pond to maintain the groundwater table
4. Constructed wetland

WASTEWATER QUALITY ANALYSIS

Three different locations mostly stagnated wastewater in JMC area were selected for testing. Most request parameter for wastewater treatment was tested and analyzed compare with Central Environmental Authority effluent standards.

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Table 1 Results of Waste Waster Quality

No	Parameters	Results			Effluent Standard for Inland Surface Waters	Effluent Standard for Marine Coastal Areas	Units
		Location 1	Location 2	Location 3			
		Ariyakulam	Rajendra road, Kurunagar	Infront of Library			
1	Colour	800	670	45			Pt/Co unit
2	Turbidity	416	325	36.8			NTU
3	COD	155	174	289	250	250	mg/L
4	BOD^{20}_{5}	67	81	160	30	100	mg/L
5	DO	47	39	70			mg/L
6	TSS	30	36	53	50	150	mg/L

The wastewater testing revealed that BOD values are 67, 81 and 160 mg/l. All samples were above the effluent limits for discharged into Inland Surface Waters by CEA. This represents a potential loss of dissolved oxygen in the wastewater and the COD values are 155, 174 and 289 mg/l. Two samples were below the effluent limits for discharged into Inland Surface Waters by CEA and one sample is more than the limit. A high COD level means a high amount of oxidable organic material in the sample. It will reduce dissolved oxygen and reduction of DO can lead to anaerobic condition. As per results location 3 waste water quality is reduced due to high possibility of adding heavy load of pollution due to the library.

Typically, about 60 percent of the suspended solids in municipal wastewater are settable. TSS values are 30, 36 and 53 mg/l. Two samples were below the effluent limits. Values were less due to sedimentation into the ponds and drainages and samples, which were collected from pond and drainage, had fewer amounts of turbidity. Because pond and drainage acting as a sedimentation tank. The sedimentation process will be reduced the turbidity level. Therefore conventional wastewater treatment plant with tertiary or advanced treatment is most appropriate to treat the wastewater.

SELECTION OF SUITABLE METHOD AND DESIGN WASTEWATER TREATMENT PLANT

Through the above analysis, three alternatives were selected and a suitable one was selected through feasibility analysis. Based on the findings of the feasibility study centralized conventional wastewater treatment plant with tertiary or advanced treatment is very much feasible. According to the Central Environmental Authority regulations, it is a prescribed project. Therefore, Am Environmental Impact Assessment was done. According to the Leopold matrix, negative impacts and mitigatory measures were proposed. The project will be done according to environmental management and monitoring plans.

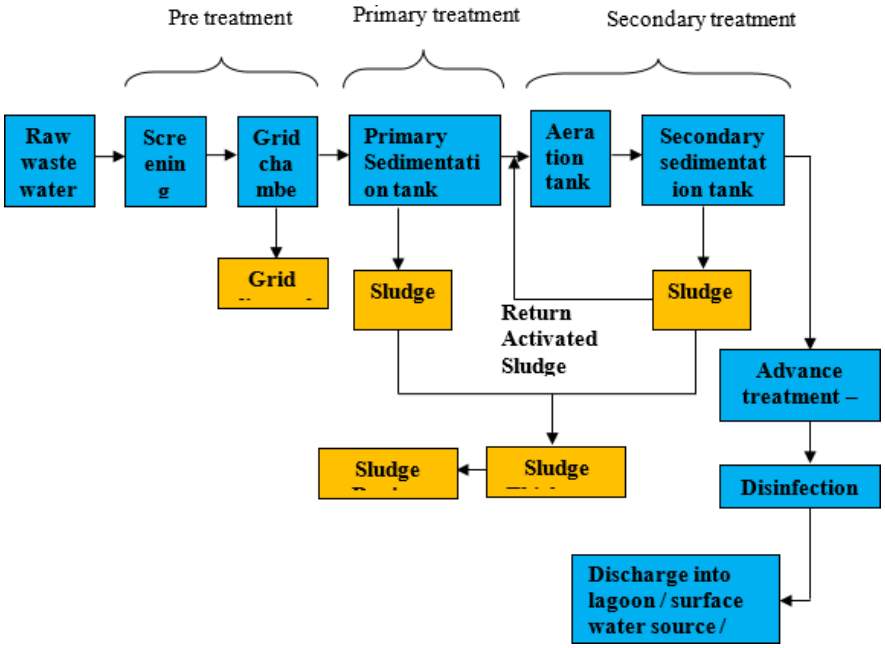

Figure 2 Flow diagram of wastewater treatment plant

The treatment process was selected through the wastewater sample analysis report. Wastewater treatment plant design should be based on the characteristics of the raw wastewater and the required degree of treatment. The treatment plant was designed to 17900 m^3/day to accommodate 109,535 people and non domestic centers in the JMC area. Each processing unit was designed to treat wastewater to discharge surface water bodies. The total cost of the project is 473 million.

CONCLUSION

Through the above report, Discharge of wastewater without treatment draining to storm water drainage would have significant adverse impacts on the water environment. Currently many environmental pollutions, unhealthy conditions, diseases, water pollution, economic reduction by recreational facilities, and main groundwater pollution in the Jaffna town area due to this activity. All the treatment units were necessary for the treated wastewater to meet the standards for effluent regulations for surface disposal. Hence conclude that the wastewater treatment plant can provide an environmentally friendly, cost effective production of the product and most probably socially and environmentally acceptable. Suggested waste water treatment plant operation needs to be monitored and check for discharged water quality in desired intervals.

RECOMMENDATIONS

There should be a policy to be formed for better management operations of the unit process. Because proper supervision and management is reduced to environmental pollution through the process and JMC should be prepared public awareness programme about the treatment.

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