



ISSN Print: 2394-7500
ISSN Online: 2394-5869
Impact Factor: 5.2
IJAR 2015; 1(8): 635-637
www.allresearchjournal.com
Received: 02-05-2015
Accepted: 05-06-2015

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Treatment Efficiency Study of Nizwa New Sewage Treatment Plant

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Abstract

Water is life. There is a huge gap between supply and demand of safe drinking water due to population explosion. There is a need to recycle and reuse waste water to meet the growing demand for water. In some developed countries like Malaysia, waste water is being converted in to drinking water. Nizwa new sewage treatment plant has a modified activated sludge process to improve treatment efficiency. The sewage after removing suspended solids enters aeration tank. High capacity surface aerators are supplying oxygen to activate the sludge. In secondary treatment coagulation is by-passed. Aeration tank outlet enters clarifier. The clarifier outlet water is passed through membranes. The waste water from membrane filter is recycled back in to process. Sewage treatment plant BOD and COD removal efficiency is 99%, Nitrate-nitrogen is 80% and TDS efficiency is 50%. The treatment efficiency of Nizwa new STP is rated as excellent.

Keywords: Efficiency, Membrane, Nizwa, STP, Study, TDS

1. Introduction

Nizwa is popularly known as Islamic capital of Oman. It is situated at 22.9333° N latitude and 57.5333° E longitude. The population of Nizwa is 86,619. Due to rapid urbanization, new sewage treatment plants are coming up to treat effectively the domestic waste water. Nearly 6,000 cubic meters per day waste water is being treated at Nizwa new STP. New technologies such as membrane bioreactor technology in sewage treatment plant reduced the faecal bacteria in treated sewage, (Rahzia, 2012) [2]. The treated water from membrane filtration do not require chlorination or UV sterilization. The sewage and its sludge contain both organic and inorganic compounds. Low polycyclic aromatic hydrocarbons are also present in the sewage sludge. These can also be successfully treated by aerobic bioreactors (Sandeep Kumar Gautam *et al.* 2013) [3]. Strategies for wastewater reuse can successfully improve urban water management (Jhansi & Mishra, 2013) [4]. Sometimes waste water stagnates in pools from which it leaches into the groundwater table and contaminates underground aquifers (Namasivayam Vasudevan *et al.* 2014) [1].

The main objective of this article is to calculate treatment efficiency of Nizwa new STP. To calculate efficiency of treatment six important parameters were selected. They are pH, TDS, BOD, COD, NO₃ and TSS.

2. Methodology

Waste water samples were collected before treatment and after treatment and analyzed for pH, Conductivity, Total dissolved Solids (TDS), BOD, COD, nitrate-nitrogen and TSS. STP treatment efficiency was calculated based on TDS, BOD, COD, Nitrate-nitrogen and TSS. The samples were analyzed using standard methods for examination of water and waste water (APHA Publication). The maximum permissible limits for sewage treated water for Sultanate of Oman and minimum percentage of reduction for efficiency calculation are as given in Table 1.

Table 1: Maximum permissible limits for treated sewage

S. No	Parameter	Maximum permissible limit	Minimum % of reduction as per UNESCO standards
1	pH	6.0 to 9.0	-----
2	TDS	500 mg/l	-----
3	BOD	15 mg/l	70-90%
4	COD	125 mg/l	75%
5	Nitrate as NO ₃	50mg/l	70-80%
6	TSS	15 mg/l	90%

The efficiency calculation formula is as given below.

$$\% \text{ Efficiency} = \frac{\text{Inlet value in mg/l} - \text{Outlet value in mg/l}}{\text{Inlet value in mg/l}} \times 100$$

3. Results & Discussions

Total dissolved solids (TDS) values are calculated based on conductivity values in microchips/cm. The principle source of sewage water is from falaj daris and desalinated water. Both are soft waters. Hence a factor of 0.5 was multiplied with conductivity values to get TDS value. (Sunil Kumar Tank, 2013) [5]. The average raw sewage analysis for TDS, BOD, COD, NO₃ and TSS are less when compared with general sewage water. This is due to dilution of raw sewage with membrane filter waste water.

The average values of sewage samples analysis before treatment are as shown in Table 2.

Table 2: Average sewage samples analysis before treatment

S. NO	Parameter	Before Treatment Units are mg/l except pH
1	pH	7.8
2	TDS	516
3	BOD	65
4	COD	163
5	NO ₃ -N	18
6	TSS	26

It was observed in some samples the BOD values are less than 1 mg/l. The activated sludge process with surface aerators is working very efficiently. The sludge volume in aeration tank is well maintained. The average analysis of treated sewage samples are much below permissible limits. The average values of treated sewage samples are as given in Table 3.

Table 3: Average sewage samples analysis after treatment

S. NO	Parameter	After Treatment Units are mg/l except pH
1	pH	8.1
2	TDS	214
3	BOD	1.5
4	COD	<10
5	NO ₃ -N	2.28
6	TSS	1.25

The treatment efficiency is calculated using standard formula. The efficiency can be calculated by using the same formula for different process equipment like aeration tank, clarifier and membrane filter.

The treatment efficiency of sewage plant is as given in table 4.

Table 4: Treatment efficiency

S. NO	Parameter	Treatment efficiency % except pH
1	pH	8.1
2	TDS	58
3	BOD	97
4	COD	94
5	NO ₃ -N	87
6	TSS	95

The TDS values before and after treatment are 516 mg/l and 214 mg/l respectively. The BOD values are 65 mg/l and 1.5 mg/l before and after treatment respectively. Similarly COD values are 163 mg/l and 9 mg/l. Nitrate nitrogen values are 18 mg/l and 2.28 mg/l. TSS values are 26 mg/l and 1.25 mg/l. All the five pollutant values before and after treatment are shown in Fig 1.

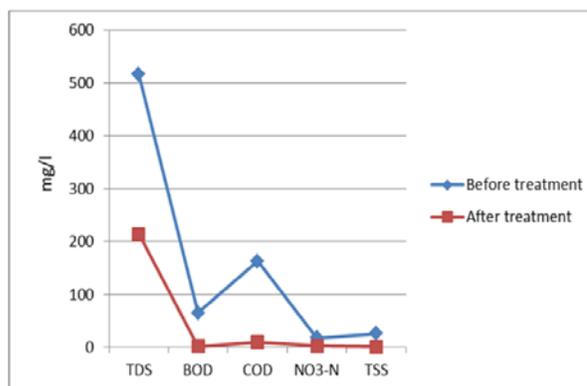


Fig 1: Graph showing parameters before and after treatment

Nizwa new STP treatment efficiency in % is as given in fig 2.

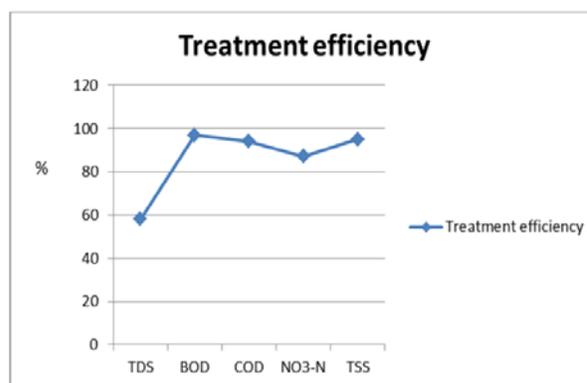


Fig 2: STP treatment efficiency

4. Conclusions

The Nizwa new STP treatment efficiency is in excellent condition. In aeration tank, the surface aerators are supplying sufficient quantity of oxygen to bacteria to reduce BOD and COD values. The clarifier is working very efficiently to separate sludge and clear water. The pollutants got diluted with membrane filter waste water. In some treated samples BOD values are less than 1 mg/l. This is due to final membrane filtration. Total Dissolved Solids, Chemical Oxygen Demand, Nitrate-Nitrogen and Total Suspended Values after treatment are below maximum permissible limits. The treated water can be used for gardening purpose.

5. References

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