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NUTRIENT REDUCTION DURING TREATMENT OF WASTE WATER; A CASE STUDY OF KOTRA SEWAGE TREATMENT PLANT, BHOPAL (INDIA)

Kalpana Kumari Thakur[1], Shailbala Singh Baghel[1] and Avinash Bajpai[2]
[1]Department of Chemistry, Sarojini Naidu Govt. P.G. College, Bhopal, (M.P), India
[2]Makhanlal Chaturvedi University, Bhopal, (M.P), India
Email: ktthakurkalpana99@gmail.com

Abstract: International studies on the nitrates and phosphates in the surface waters of various water bodies have drawn the attention of scientists around the globe. The nitrate and phosphate are two important constituents that immensely help in the growth of the plants where they present. Their presence in water bodies will excessively promote the growth of aquatic weeds and polluting our water resources. In present study sample of waste water from different stages of Kotra Sewage Treatment Plant (STP) situated at Bhopal, Madhya Pradesh were analyzed quarterly for nitrate & phosphate from March 2012 to February 2013 by using standard methods. The result obtained indicates that the sewage treatment plant was effective in reducing nitrate & phosphate concentration and treated water can be used for secondary purposes like industrial cooling, gardening, irrigation, domestic activities etc.
Keywords: Immensely, constituents, aquatic weeds, STP, irrigation etc.

INTRODUCTION

Waste water is water that contains waste from homes or industry. At a wastewater treatment plant, water is filtered and treated to make the water clean enough to return to a river or lake. The natural process of eutrophication is accelerated when inorganic plant nutrients, such as phosphorus and nitrogen, enter the water from sewage and fertilizer runoff. The washing of large amounts of clothes by dhobis, laundry workers, and the continued entry of domestic sewage in some areas are posing pollution problems (Benjamin et. al., 1996) [1]. Presence of nitrate in water indicates the final stage of mineralization (Nemaet al.,1984) [2]. Sewage discharges are a major component of water pollution, contributing to oxygen demand and nutrient loading of the water bodies; promoting toxic; algal blooms and leading to a destabilized aquatic ecosystem (DWAF, 1995, Morrison et. al., 2001)[3, 4]. Nutrient removal poses a special challenge for waste water treatment plants (WWTPs) because of the additional costs associated with complex treatment technology required to produce effluent containing low nutrient concentrations (Ko et. al., 2004; Olivieri et. al., 2005; Muga and

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Mihelcic 2008) [5,6,7]. The raw sewage is the source of nitrates and phosphates in the water (Aggarwal et al., 2000) [8]. High levels of pathogens may result from inadequately treated sewage discharges. Waste water stabilization pond is considered as the most appropriate system to treat the increasing flows of urban waste water in tropical and subtropical regions of the world (Ensink et. al., 2007) [9]. Industrial wastewaters are treated partially before their discharge into sewers, or else are treated separately through suitable treatment processes so that the treated effluent is safe (Punamia and Ashok, 1998) [10]). In developed countries, older cities with aging infrastructure may have leaky sewage collection systems (pipes, pumps, valves), which can causes anitary sewer overflows.

MATERIAL & METHODS

The sewage treatment plant under study is geographically located at Kotra, Bhopal, Madhya Pradesh, India within the geographical coordinates of 23^{o} 15' 44'' N, 77^{o} 28' 23'' E. Kotra sewage treatment plant receives the wastewater generated in Nehru Nagar, Kotra Sultanabad and adjoining areas. Kotra sewage treatment plant is designed to treat 10.0MLD sewage. Kotra STP is based on stabilization techniques using anaerobic and facultative ponds.

Waste water samples were collected quarterly from different stages of sewage treatment plant from May 2012 to February 2013. Samples were collected in glass containers, pre-cleaned by washing with non-ionic detergents, rinsed with tap water, 1:1 hydrochloric acid and finally with deionised water. Samples were analyzed to determine the reduction efficiency of sewage treatment plant for nutrients with special reference to nitrate and phosphate by using standards methods prescribed by the APHA (APHA, 1998) [11].

RESULTS AND DISCUSSION

Waste water samples were collected quarterly from different stages of Kotra sewage treatment plant, Bhopal. The results showing variation for nitrate & phosphate are summarized in Table 1.

Table 1: Nutrient variation at different stages of Kotra STP from March 2012 to February 2013

S. N	Parameters	Sampling Stations	(Mar-May 2012)	(Jun-Aug 2012)	(Sept-Nov 2012)	(Dec-Feb 2013)
1	Nitrate	S1	35	30	33	32
		S2	33	28	31	30
		S3	30	25	29	28
		S4	28	24	27	25
		S5	26	20	24	22
		S6	23	17	21	19
		S7	20	16	18	17
		S8	18	15	17	16
2	Phosphate	S1	9.5	7	8.2	7.5
		S2	9	6.5	7.5	6.8
		S3	8.6	6	7	6.1
		S4	7.8	5.2	6.6	5.7
		S5	7.1	4.5	6	5.3
		S6	6.5	4	5.5	4.7
		S7	5.6	3.8	4.8	4.2
		S8	5.1	3.2	4.5	3.7

- S_1: Entry
- S_2: Anaerobic Pond No.1
- S_3: Anaerobic Pond No. 2
- S_4: Facultative Pond No.1
- S_5: Facultative Pond No.2
- S_6: Facultative Pond No.3
- S_7: Rock filter
- S_8: Cascade

Nitrate

Nitrate, compound containing nitrogen, can exist in the atmosphere or as a dissolved gas in water, and at elevated levels can have harmful effects on humans and animals. Nitrate, compound containing nitrogen, can exist in the atmosphere or as a dissolved gas in water, and at elevated levels can have harmful effects on humans and animals. Nitrates in water can cause severe illness in infants and domestic animals. Common sources of excess

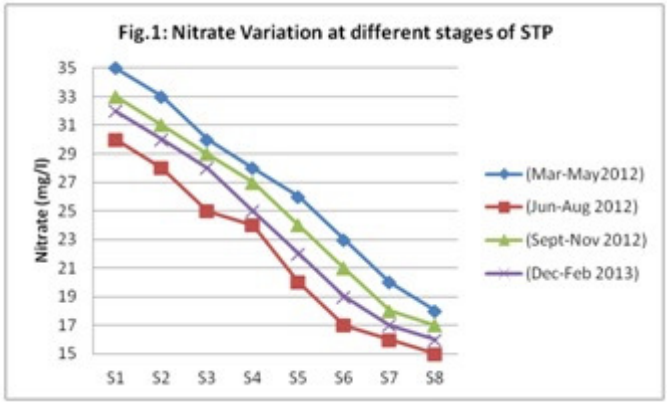

Fig. 1: Quarterly variation of nitrate concentration at different stages of STP

nitrate reaching lakes and streams include septic systems, animal feed lots, agricultural fertilizers, manure, industrial waste waters, sanitary landfills, and garbage dumps (MPCA, 2008) [12].Nitrate is the important pollution indicator parameter .It is the most oxidized and stable form of nitrogen. In the present study, nitrate concentration varied from 15.0 – 35.0 mg/l. The minimum value was observed at Cascade (S_8) during the month of Jun –Aug 2012 i. e. monsoon whereas maximum value was observed at Entry (S_1) during the month of Mar-May 2012 i.e. summer as shown in figure 1. Similar finding was also observed by (Dixit et. al., 2005; Verma et. al., 2013) [13] [14]. The standard drinking water quality guideline for nitrates is 40 ppm (American Public Health Association, 1985) [15]. Nitrate is usually derived from anthropogenic sources like agricultural field, domestic sewage and other waste effluents containing nitrogenous compounds (Das and Acharya, 2003) [16].

Phosphate

Phosphorus is a vital nutrient for converting sunlight into usable energy, and essential to cellular growth and reproduction. In present study, phosphate concentration varied from 3.2–9.5 mg/l. The minimum value was observed at Cascade (S_8) during the month of Jun –Aug 2012 i. e. winter whereas maximum value was observed at Entry (S_1) during the month of Mar – May 2012 i.e. monsoon as shown in figure 2. For phosphates, the U.S. Environmental Protection Agency (1976) [19] suggested that 0.08 ppm was the critical level for the occurrence of eutrophication in lakes and reservoirs. Similar finding was also reported by (Kushwah, 2012; Tamot & Sharma, 2006) [20, 21].

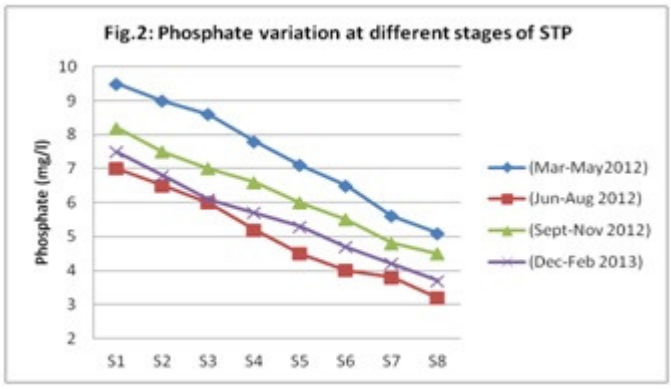

Fig.2: Quarterly variation of phosphate concentration at different stages of STP

The phosphate value was higher during summer seasons compared to other seasons, for the downstream and upstream of the discharge points. This could be attributed to phosphorous in runoff from domestic, municipal and agricultural waste following into rivers, as well as washing along the riverside with detergent (Correll, 1998) [22]. Detergent polyphosphate by hydrolysis in natural water (Allen and Kramer, 1972) [23] and this are the only directly utilizable form of soluble inorganic phosphorous (Wetzel, 1983) [24].

CONCLUSION

The present study clearly reveals that the Kotra sewage treatment plant shows its capability and effectiveness to reduce high nutrient load. Instead of discharging sewage water directly into the water bodies it is necessary to pass it through sewage treatment plant for reducing most of water pollutant. Sewage treatment plant is effective in nutrient reduction which reduces the algal blooming & also helps in reducing eutrophication. Thus, waste water treatment is necessary for improving water quality and this method must be adopted before discharging the sewage water into water bodies.

So, Kotra sewage treatment plant is effective in improving water quality by reducing nutrient concentration and the treated water can be used for secondary purposes like industrial cooling, gardening, irrigation and safe disposal in water bodies.

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