Survey of Wastewater Stabilization Pond Potential in Meeting Environmental Standards

PEIRAVI ROYA¹, RAHMATIYAR HADI², ALIDADI HOSSEIN³, MOHAMMAD VAHEDIAN⁴

¹,²,³,⁴ Mashhad University of Medical Sciences, Mashhad, Iran

Published online: 21 June 2015


To link to this article: http://kkgpublications.com/wp-content/uploads/2015/12/IJAPS-50003.pdf

PLEASE SCROLL DOWN FOR ARTICLE

KKG Publications makes every effort to ascertain the precision of all the information (the “Content”) contained in the publications on our platform. However, KKG Publications, our agents, and our licensors make no representations or warranties whatsoever as to the accuracy, completeness, or suitability for any purpose of the content. All opinions and views stated in this publication are not endorsed by KKG Publications. These are purely the opinions and views of authors. The accuracy of the content should not be relied upon and primary sources of information should be considered for any verification. KKG Publications shall not be liable for any costs, expenses, proceedings, loss, actions, demands, damages, expenses and other liabilities directly or indirectly caused in connection with given content.

This article may be utilized for research, edifying, and private study purposes. Any substantial or systematic reproduction, redistribution, reselling, loan, sub-licensing, systematic supply, or distribution in any form to anyone is expressly verboten.
Survey of Wastewater Stabilization Pond Potential in Meeting Environmental Standards

PEIRAVI ROYA1, RAHMATIYAR HADI2, ALIDADI HOSSEIN3, MOHAMMAD VAHEDIAN4

1,2,3,4 Mashhad University of Medical Sciences, Mashhad, Iran

Keywords: Effluent Performance Stabilization Pond Wastewater Treatment

Abstract. Industrial development and urban sprawl, has led to the production of huge volumes of wastewater. Wastewater is harmful to human and has adverse effects on natural environment. With regard to importance of human health and protecting sources from pollution, this study was carried out to evaluate the wastewater stabilization pond performance, Olang treatment plant, Mashhad. The characteristic of inputting raw wastewater introduces the wastewater as a much polluted one. The ratio at input channel was 0.56. The average concentration of BOD5, COD and TSS in effluent was 75±30.67, 145±19.46 and 86±13.28 mg/L respectively in the first year and 83±14.0, 146±23.7 and 109±14.7 mg/L respectively in the second year. The treatment plant efficiency for these parameters was 79.7±10.7, 82.5±4.5 and 77.1±3.9% for the first and 82.7±5.11, 82.8±3.82 and 78.4±3.93% for the second period. The effluent can be used for agriculture irrigation because its characteristics are accordance with the standards of Iranian Department of Environment.

INTRODUCTION

Waste generation in huge amounts is the inevitable result of the development of modern societies. Wastewaters are hazardous for human life and have adverse effects on natural environment. Thus preserving the natural environment, and water resources and preventing them from being contaminated by wastes generated through human activities, has a vital importance and wastewater treatment before discharge and disposal to surface water resources is necessary. There are different methods for wastewater treatment that mainly classify into two categories: conventional methods that require high energy and unconventional methods that rely on natural processes. Conventional treatment systems are including trickling filters, activated sludge, rotating biological contactors (RBC), and aeriation lagoons and unconventional methods that are also called eco-technologies generally include wetlands and stabilization ponds. Among these technologies stabilization pond systems are recommended for developing countries. The stabilization pond system is considered as one of the best and most preferred methods of municipal wastewater treatment in tropical and subtropical regions of the world. These ponds relying on simple and accessible technologies as an efficient and inexpensive method, particularly in regions with suitable climatic conditions and enough cheap land can be used for treating wide ranges of industrial wastewaters. Other advantages of this method are its dependence on natural energy resources, organic and hydraulic shock loads acceptability and being capable of producing a high quality effluent. The system overall consists of a series of anaerobic, facultative and complementary ponds, with wastewater retention time about 5 to 20 days and depending on the pond type, depth is usually one to three meters, in which various contaminants are removed from the wastewater stream during the chemical and biological processes. [1] In their study showed "agricultural land irrigation with olang treatment plant effluent compared with well water had better effect in the wheat yield and if a continuous monitoring is done effluent can be a good alternative to water 3 in order to irrigate". [2] in evaluating the performance of activated sludge treatment plant placed in Zanjan city showed that the system was efficient and effluent in terms of the studied parameters: Biochemical oxygen demand (BOD5), Chemical oxygen demand (COD), and Total suspended solids (TSS) has accordance to the standards. The performance of Hamadan Bou Ali town treatment plant in removal of BOD5, COD, and TSS was measured by [3] and it was 92, 90, and 74 percent, respectively. [4] in assessment the performance of anaerobic stabilization pond in the removal of phenol from oil refinery wastewater Kermanshah showed that the efficiency of system in removal of phenol, TBOD5, and TCOD was 89.82, 71.75, and 74.99 percent respectively. They also pointed that anaerobic stabilization ponds in the removal of phenol and other organic compounds in the oil refinery wastewater have high efficiency. In a two-year study conducted by [5] in Bolivia, They found that the efficiency of wastewater treatment lagoon systems (facultative with complementary) was proportional to the expected amount and the system performance in BOD5, COD,
and TSS removal was shown to be in these ranges: 78-98, 70-99.7, and 74-97% respectively. The volume of wastewater flow inputting to Mashhad Olang wastewater treatment plant is 25,000 / (cubic meters per day). It includes the following units: screening, Parshall flume channel, anaerobic digestion pits, facultative and complementary lagoons. Inputting flow after crossing the screening unit and Parshall flume channel goes to anaerobic digestion pits that are embedded in the floor of the facultative lagoons. Wastewater flows among these pits are upward and eventually begin to enter the facultative lagoons. Retention times of these pits are approximately 18 hours. There are 4 facultative lagoons with a total hydraulic retention time of 16 days. The number of complementary lagoons is 2 and the hydraulic retention time is 5 days. Finally the treatment plant effluent is discharged into Kashafrood River, and in downstream it is used for irrigation of agricultural lands by farmers. Mashhad the center of the Razavi Khorasan Province is a metropolis in northeastern Iran. 4 According to the last General Population and Housing Census in 2011 Mashhad population as the second most populous city in Iran after Tehran are 2,766,258. It also welcomes over 32 million home visitors and more than one million foreign visitors annually. Therefore, protecting the environment and preserving and providing the supplies for drinking, industrial, and agricultural water and preventing them from being contaminated by wastes of human activities, is important. In this regard, the reuse of treated wastewater in agriculture and industry Compliance with health and environmental regulations would be an effective step to cover the water needs of these sectors. The aim of this study was to evaluate the performance of Mashhad Olang stabilization pond wastewater treatment system and the quality of effluent On the basis of the parameters recommended by the Iranian Department of Environment (IDE) and, if necessary, provide appropriate proposals to upgrade the system.

MATERIALS AND METHODS
This cross-sectional study is done on the raw wastewater inputting to Mashhad Olang treatment plant and its effluent during a two-year period from 21-3, 2011 to 20-3, 2013(these dates are equal to the first month of spring to last month of winter in Iran). With regard to IDE standards and former same studies; to evaluate the performance of treatment plant three parameters include Biochemical oxygen demand (BOD5), Chemical oxygen demand (COD), and Total suspended solids (TSS) selected. In the mentioned period weekly sampling from both input and output carried and samples for analyze transferred to water and wastewater chemical lab of Mashhad Health College. All the sampling, sample transfer and analysis are done according to standard methods. At the end of any month results into a monthly mean recorded. Eventually the results of 96 sample analysis from input and output earned. After specifying the amounts of considered parameters the removal efficiency of them by ponds 5 determined, then data were analyzed by SPSS and One-way Anova and One sample t- test at a significant level of 0.05. Consequences compared with IDE standards.

RESULTS
The raw wastewater characteristics indicate that the pollution is so high. The ratio at input channel is 0.56. The yearly mean concentration of studied parameters after presenting them in a monthly mean amount is reported in table1. As shown in the table1, in raw wastewater in the first year of study the maximum amount of TSS is 420 mg/l (in the first and the second months of summer in Iran), BOD5 maximum is 550 mg/l (in the third month of summer), and COD maximum is 1193mg/l (in the second month of spring). These maximum amounts in the second year of study for TSS, and COD are 813, 1008 mg/l respectively (shown in the first month of spring) and BOD5 is 650 mg/l (in the first month of autumn). In effluent at the first and the second year of study these amounts for TSS are 107 and 133, for COD are 187 and 185 and for BOD5 are 126 and 155 mg/l respectively. Average pH in raw wastewater in the first and second year was 7.82± 0.2 , 7.76 ± 0.05 respectively. About its effect on the removal efficiency of parameters determined that the amount of input had no statistically significant relationship in both years. In table 2 the mean and standard deviations of inputting and outputting parameters, also the removal efficiency of them are shown. As you can see the removal efficiency for TSS and BOD5 in the second year is a little more than the previous year, but for the COD the figure is almost equal. In table3 Results of One Way Anova statistical analysis introduce a significant relationship between the seasons and the removal efficiency just in the first year of study not the second. A comparison between the monthly mean amounts of parameters and the standard concentrations of them is demonstrated in figures 1 and 2. It can be seen that the parameters in the effluent complies with the standards in most months except for some months, which is slightly higher than the 6 standard. One Sample T-test showed significant correlation between the measured parameters and the defined effluent standards in both years (TSS, COD, and BOD5 = P Value< 0.001). But in the second year for TSS with a little difference there wasn’t a significant relationship (P Value = 0.052).

DISCUSSION AND CONCLUSION
Characteristics of the inputting raw wastewater indicate that the contamination is severe. The range of in municipal raw wastewaters is between 0.3-0.8. If this ratio goes higher than 0.5 or more in raw wastewater, it can easily be treated by biological processes. This ratio was 0.56 at the entrance to the plant. According to the various texts ponds can treat 70 - 80% of BOD5 of input samples that are not filtered, and to 90% of filtered samples. In this plant in the first year except the two first months of winter, in other months the BOD5 removal efficiency is between 70-91% and in the second is between 71.5-88.5%; Due to the decrease in temperature and sunny hours in the January and
February months, efficiency reduction is not unexpected in these months. In the [6] study on the sugar factory stabilization pond treatment plant in West Kenya, the results showed that seasonal variations have a significant impact on the removal of TSS load in raw wastewater. The impact of parameters variations on the removal efficiency of Yazd stabilization pond they found that Changes in pH, EC, and seasons have little effect on BOD5 and COD removal during the year (15), and about the season the results of their study are inconsistent with our study. Because of the presence of algae in the stabilization ponds TSS level in their effluent is higher than other treatment systems effluent. It is noteworthy that the quality of these suspended solids from algae in the effluent is such that is not only important for agriculture but also causes a significant increase in agriculture efficiency as a plant fertilizer and soil amendment. But In this study, the removal efficiency for TSS in ponds in 7 the first year months is nearly 70 to 84 % and in the second year the percent is 72 to 86. According to Figure 1, it is observed that the removal in the first year is able to better meet the TSS output standards; as mentioned in the results and statistical test concluded, and given that the changes not implemented in the plant, this change in TSS removal efficiency can be from the amount of input load to plant. It can be seen in table2 that the input annual mean for the TSS in the second period is more than 100 mg/l higher than the previous year. All the measured parameters in effluent are In accordance with IDE standards in the first year. The same condition can be observed in [7] study on the Zanjan city treatment plant and Nasr at al study on the stabilization ponds in Egypt. But [8] found a meaningful difference between the mean concentrations of TSS, BOD, and COD and Standards for effluent disposal into surface waters and agricultural use belongs to the IDE in their study. Application of stabilization ponds for wastewater treatment of Kermanshah city slaughterhouse. Mozab et al showed for BOD5, COD, and TSS 64,9,44,9, and 62.6% removal in a period of one year study in Yazd city treatment plant which all are lower than our removal efficiencies for these parameters. But in Bagheri et al study a better removal percent than this survey is evident. The amounts of BOD5, COD, and TSS in the effluent of Egyptian Sadat city stabilization pond were 49,135, and 61 mg/l, they are in less amounts of our study because of the low concentration of Incoming pollutants to the plant. Regarding the mentioned Issues we can conclude that this plant effluent is proper for use in irrigation and agricultural purposes. However the biological and microbial indicators were not investigated in this control. It is recommended that a study be done on the removal efficiency of microbial indicators and compared with the relevant standards. Continuous monitoring is appropriate, especially for the important factors that are listed in standards, principally in the seasons with the probability of efficiency falling.

REFERENCES