



Correlation between Microbial Quality and Organic Content in the Effluent of an Activated Sludge Wastewater Treatment Plant

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Authors

Mostafaii Gh.R.¹ PhD,
Miranzadeh M.B.* PhD,
Khodadadi R.² MSc,
Iranshahi L.² MSc,
Alinejad A.³ MSc,
Hakimi N.² MSc

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ABSTRACT

Aims Regarding water as the main source of brio, not only its quantity and being availability is vital, but also its quality must be considered. This study was done in order to determine the correlation between physicochemical BOD5 and microbiological parameters (FC and TC) in the Kashan University of Medical Sciences wastewater effluent of activated sludge system.

Materials & Methods This descriptive study was done from July to October 2012 at Kashan University of Medical Sciences. A total number of 130 samples were taken on different days of the week over a 4-month period from effluent, randomly. All of the taken samples were transferred to the water and wastewater laboratory for analysis, immediately. The SPSS 16 software and regression test for were used to analyze the obtained data, ultimately.

Findings The mean value for BOD5 was $11.27 \pm 5.43 \text{ mg/L}$. The mean value of TC was $\log 1.62 \pm 0.32$. A linear correlation ($F=312.9$; $p < 0.001$) was observed between TC and BOD5. The mean value of FC was $\log 1.42 \pm 0.31$. A linear correlation ($F=298.3$; $p < 0.001$) was observed between FC and BOD5.

Conclusion BOD5 parameter can be used to predict the wastewater quality instead of TC and FC.

Keywords Biological Oxygen Demand Analysis; Water Pollution; Waste Water

*Environmental Health Department, Health Faculty, Kashan University of Medical Sciences, Kashan, Iran

¹"Social Determinants of Health Research Center" and "Environment Health Department, Public Health Faculty", Kashan University of Medical Sciences, Kashan, Iran

²Environmental Health Department, Health Faculty, Kashan University of Medical Sciences, Kashan, Iran

³Environmental Health Department, Health Faculty, Shahid Beheshti University of Medical Sciences, Tehran, Iran

Correspondence

Address: No. 1, Shabnam 4 Alley, Police Square, Kashan, Iran
Phone: +983155540111
Fax: +983155540111
miranzadehm@ymail.com

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Introduction

Recently, consuming water increasing factors and the resulted sewerage due to daily growth of population and increase in life style standards caused irrecoverable damages to human's environment [1-3]. Regarding water as the main source of brio, not only its quantity and being availability is vital, but also its quality must be considered. Water sources polluting, especially superficial waters mainly resulted from urban and industrial polluted sewerage evacuation has reduced the quality of these sources extremely. Sewerage filtration to reduce mal effects of sewerage evacuation to environment and to promote public health state in societies should be considered as well [4-7]. The output of this filtration can be reused mostly for agricultural usages surely [8].

Different biological processes are used to eliminate sewerage polluting materials. Activated Sludge Process (ASP) is one of the most common Wastewater Treatment Plants (WWTPs) to filter sewerage polluting materials [6]. Reusing of sewerage in arid and semi-arid regions has higher importance owing to lack of water sources and also drought, hereby effluent is usually used for limited and unlimited irrigation and so on according to reuse the standards [9-15]. Most often, sewerage reuse in arid and semi-arid regions to irrigate in agriculture has been known as a useful solution to surmount water lack, whereas using wastewater to irrigate even lead to hygienic problems [16-20].

Microbial contaminants such as Total Coliform (TC) and Fecal Coliform (FC) have been known as indices based on World Health Organization (WHO). Therefore, surveying of TC and FC parameters and also Biological Oxygen Demand (BOD₅) as wastewater qualitative indices is introduced as an important and basic priority in reusing the effluent [21-24]. Wastewater microbial indices experiment ought to be done routinely and also observing wastewater health standards is pivotal since reuse of wastewater is being increased in undeveloped countries.

In accordance to the findings of other researchers, there is a correlation between microbial and physicochemical parameters in activated sludge and waste stabilization pond system effluent [21-22].

Due to using Research Center of Kashan University of Medical Sciences (KAUMS) effluent for agriculture, hereby this research aimed to determine effluent quality, and the correlation between BOD₅ physicochemical and microbial parameters in KAUMS effluent. So predicting its value by BOD₅ parameter as wastewater quality (via Coliforms experiment) is inaccessible. This study was done in order to determine the correlation between physicochemical BOD₅ and microbiological parameters (FC and TC) in the KAUMS wastewater effluent of activated sludge system.

Materials & Methods

This descriptive study was done from July to October 2012 at KAUMS wastewater treatment plant. A total number of 130 samples were taken on different days of the week over a 4-month period from effluent, randomly [25].

This treatment plant is extended aeration Activated Sludge Process (ASP) with mean flow rate of 300meter³/day. Its divisions included manual bar screen (spacing between bar 20mm), aeration tank (a reinforced concrete rectangular tank with 24min aeration time), secondary sedimentation (hydraulic retention time of 4 hours), and disinfection unit, in which disinfection of the Chlorine dosage was 3.2±0.5mgL⁻¹ with 13min retention time. For BOD₅ test, 2liter polyethylene bottles and for FC and TC tests, sterilized glass bottles with 300ml capacity were used.

All of the taken samples were transferred to the water and wastewater laboratory for analysis, immediately. All of the studied BOD₅, TC, and FC parameters were examined according to the latest edition of "Standard Methods" [25].

To analyze the obtained data, the SPSS 16 software and regression test (for analyzing the correlation between the BOD₅ and each TC and FC) were used.

Findings

The highest and lowest values for BOD₅ were 24 and 4mgL⁻¹, respectively with the mean value of 11.27±5.43mgL⁻¹.

The mean value of TC was log1.62±0.32. The highest value of TC was log2.43 or

269MPN/100ml and its lowest value was log1.18 or 15MPN/100ml. A linear correlation ($F=312.9$; $p<0.001$) was observed between TC and BOD₅ (Figure 1).

The mean value of FC was log1.42±0.31. The

highest value of FC was log2.28 or 190MPN/100ml and its lowest value was log0.85 or 7MPN/100ml. A linear correlation ($F=298.3$; $p<0.001$) was observed between FC and BOD₅ (Figure 2).

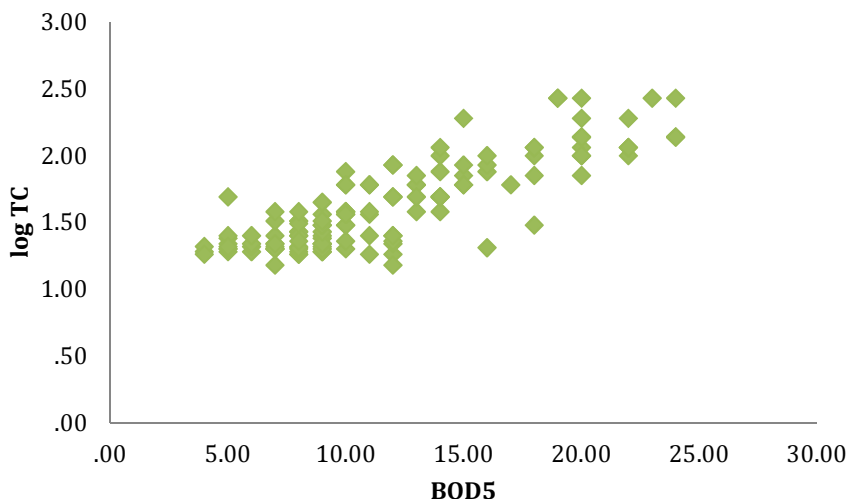


Figure 1) Correlation between TC and BOD₅ in the Waste Water Treatment Plant effluent of KAUMS

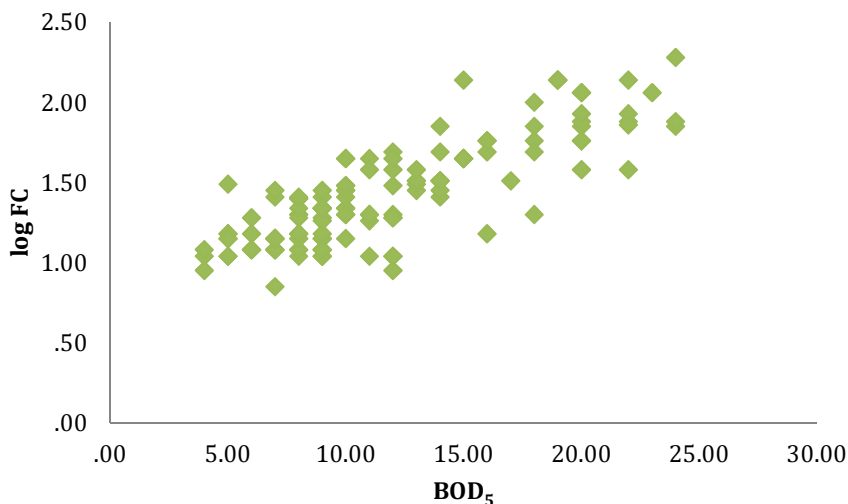


Figure 2) Correlation between FC and BOD₅ in the Waste Water Treatment Plant effluent of KAUMS

Discussion

The aim of this study was to determine the correlation between physicochemical BOD₅ and microbiological parameters (FC and TC) in the KAUMS wastewater effluent of activated sludge system. Similar results on ASP in different regions of India by Kazmi *et al.* represented a significant correlation between BOD₅/TC and BOD₅/FC parameters for municipal wastewater effluent in ASP that is compatible with our study findings [26].

Also, Rajeb *et al.* studying on the filled soil columns with filtrated sewerage by RBC systems demonstrate a positive and significant correlation ($r=0.82$) between BOD₅ and FC [26]. Goyal & Mohan in a research carried out on stabilization pond systems in Jodhpur, Rajasthan, India have observed a correlation between microbial and physicochemical parameters [27]. Sukias *et al.* in a study performed on sewerage optional lake microbial and physicochemical

parameters related to dairy farms in Six Waikato, New Zealand evinced a partial significant correlation (0.35) between FC and BOD₅ that is consistent with this study [28]. Also, Williams *et al.* studying on Wetland filtration systems observed that there is a relative high regression coefficient between Coliforms population and BOD₅ in sewerage [29].

Regarding performance of sewerage microbial deletion in soil filter systems Avinash *et al.* index a positive correlation between FC and BOD₅ [30]. A direct correlation between Coliform bacteria ratio and BOD₅ value (mgL⁻¹) has reported by Olutiol *et al.* studying on filtration system of sewage oxidation pond [31]. Also, Mungray *et al.* in a study performed on influent sewerage to ASP and Up flow Anaerobic Sludge Blanket (UASB) to determine a correlation between TC, FC, and BOD₅ parameters, illustrate a correlation between FC and BOD₅ parameters (-0.31). It seems that these findings are due to lower number of taken samples and lesser variation, qualitatively [32].

In addition to study on TC, FC, and BOD₅ parameters in WWTPs, a direct correlation between the studied parameters in superficial streams such as rivers and floodwaters has been proved in many researches which is salubrious with the findings of the present study [33-36]. Accordingly, R² values between BOD₅-TC and BOD₅-FC parameters were 0.95 and 0.98, respectively in Belay *et al.* study in determining the correlation between microbial and physicochemical parameters in Shinta River in North-West of Ethiopia [37]. Mumtaz *et al.* studying on superficial waters in Pakistan found that there is a significant correlation between logarithm value of Colony-Forming Unit (CFU) and BOD₅ values in superficial waters [38].

Drought is one of the most pivotal natural catastrophes that influence the societies' lives, directly, via limitation to access to water sources, gradually [39]. Iran is an arid and semi-arid country. The annual raining mean of Iran is approximately one-third of global annual raining mean, and in addition, drought was one of the main problems of Iran, recently [40, 41]. Kashan City is counted as semi-arid regions in Iran. Its annual raining mean is lesser than one-third of global annual raining

mean, so researches to survey this issue could have especial importance [42, 43].

According to the findings of this study, the mean value for BOD₅ parameter was 11mgL⁻¹, the mean value of Most Probable Number (MPN) for FC and TC was 26 and 41 (in 100ml of sample), respectively, that is lesser than authorized limits of the United States Environmental Protection Agency (USEPA or EPA) and WHO to reuse wastewater in irrigating and agriculture [44-46]. These values are lesser than (BOD<100mgL⁻¹, TC<1000MPN/100ml, FC<400MPN/100ml) authorized limit of Iran Department of Environment's standards to reuse of wastewater in irrigating and agriculture [47, 48]. Of limitations of this study were sampling at night; so, for composite samples were taken in day time, 8 AM to 4 PM. Regarding the low mean value of TC, FC, and BOD₅ parameters in this effluent, making appropriate solutions to use effluent in non-drinking usages is seemed to be necessary.

Conclusion

BOD₅ parameter can be used to predict the wastewater quality instead of TC and FC.

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