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Evaluation of raw wastewater characteristic and effluent quality in Kashan Wastewater Treatment Plant

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Abstract. Due to the lack of water in arid and semi-arid areas, reuse of wastewater can be a suitable way to compensate for water scarcity. Therefore, in this research, evaluation of the quality of wastewater of Kashan Treatment Plant to use for irrigation was studied. This descriptive cross-sectional study was conducted in 2016. pH, TSS, TDS, turbidity, COD, BOD5, Total Kjeldahl Nitrogen, Total Phosphorus, Total Coliform, fecal coliform, nematode eggs of inlet and outlet of wastewater treatment plant in Kashan were studied. Mean and standard deviation and wastewater quality parameters before and after treatment were tested with SPSS 22 (2014) software. The mean wastewater output of COD, BOD5, TSS, TDS and turbidity were respectively 86.6, 41.2, 11.11, 1095 mgL-1 and 17.5 NTU and the pH was equal to 7.22. Also, the average of Total Kjeldahl Nitrogen and phosphorus were 22.4 and 2.2 mgL-1 respectively. The mean of Total Coliform and fecal coliform were 225, 161 MPN / 100 ml respectively. In addition, no nematode eggs were found in final effluent. The results indicated that the treatment plants had a significant role in the control of microbial and organic pollution load of wastewater. Also, it is concluded that all parameters were in accordance with the standards of Iran's Department of Environment, so, it can be used for unrestricted irrigation.

Keywords: sewage; treatment; reuse; agriculture

1. Introduction

Wastewater is a mixture of liquids or feces from living places of human beings, institutions and industrial and commercial centers, along with groundwater, surface water and floods (Atharizade and Miranzadeh 2015). Around 80% of water used in urban areas reappears as wastewater (Waghmare *et al*. 2010). The quality of wastewater can be defined by physical, chemical and biological properties. Physical parameters include color, odor, temperature, solids, turbidity, oil and grease (Haghighi *et al*. 2017). Chemical parameters related to the amount of wastewater organic matter, include Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD), Total Organic Carbon (TOC) and Total Oxygen Demand (TOD). Inorganic chemical parameters include salinity, hardness, pH, acidity, alkalinity, iron, manganese, chloride, sulfate, sulfide, heavy metals, nitrogen and phosphorus, while bacterial parameters include coliforms, fecal coliforms, specific pathogens and viruses (Wong *et al*. 2014, Hoseindoost *et al*. 2014, Mostafaii *et al*. 2017).

Urban wastewater treatment plant is designed to reduce BOD, TSS and nitrogen and phosphorus contamination, as well as the removal of pathogen microorganisms. Many organisms, including bacteria, aquatic insects, viruses, protozoa, fungi and Helminth, cause the most concern in the wastewater treatment plant (Kokkinos *et al*. 2015, Dehghani *et al*. 2007, Dehghani *et al*. 2014a, Dehghani *et al*. 2016a). Among the pathogens of organisms, parasite eggs are inactive agents. High concentrations of parasite eggs and larvae of insects, such as mosquitoes, are found in urban sewage, causing parasitic and viral diseases (Yaya-Beas *et al*. 2015, Dehghani *et al*. 2014b, Dehghani *et al*. 2012a). Another major source of water pollution is the use of pesticides that are used in the health or agricultural sector, which, in any case, the entry of these hazardous materials into wastewater can lead to serious problems in re-use of water and soil. Water pollution to pesticides can cause important diseases such as cancers or MS (Miranzadeh *et al*. 2011a, Dehghani *et al*. 2012b, Dehghani *et al*. 2016b, Dehghani *et al*. 2013, Zarrintab *et al*. 2016). About 1.2 billion people live in areas of natural water scarcity and it is expected that in 2025, 1.8 billion people live in countries and regions with a lack of absolute water (Ferro *et al*. 2015, Miranzadeh *et al*. 2011b, Dehghani *et al*. 2015). Increased water scarcity in arid areas, is now a known problem because all the living creatures depend on the water for survival. Researchers consider sewage reuse as an essential component of Integrated Water Resources Management Policy. In the Middle East and North Africa, access to renewed water has reached to 1,500 cubic meters

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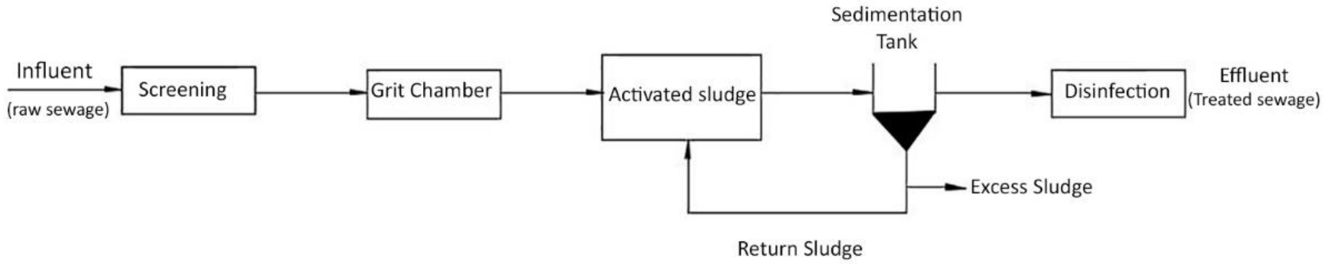

Fig. 1 Stages of sewage treatment in the Kashan Sewage Treatment Plant

per person per year, compared to an average of 7,000 cubic meters per person per year in other parts of the world and it is expected to reach to below 700 cubic meters per person per year in 2025 which is very worrying (Abdoulkader *et al*. 2015, Teoh *et al*. 2011, Rabbani *et al*. 2016). This could result in savings of about 20 million cubic meters of fresh water, which represents 4.3% of the total water needed for irrigation (Agrafioti and Diamadopoulos 2012, Rabbani *et al*. 2013, Rabbani *et al*. 2008). Treated wastewater also boosts crop yields and reduces chemical fertilizers. The advantage of using treated wastewater as an alternative to water and its impact on the product yields has been proven in various studies (Urbano *et al*. 2017, Yasmeen *et al*. 2014, Gatta *et al*. 2016).

In order to reduce the impact of wastewater reuse, many countries have adopted standards and guidelines, especially based on FAO, USEPA, WHO and Iran guidelines. That Standard values for BOD, COD, TSS, turbidity, pH, Total Coliform, Fecal coliform and nematode eggs parameters are 100, 200,100 mgL-1,50 NTU,6-8.5 ,1000. 400 MPN / 100 ml and 1 N/L respectively by Iran. The standard value by USEPA for Fecal Coliform is 200 MPN / 100 ml also BOD Values for raw and processed products are 10 and 30 mgL-1 respectively. And standard value for Fecal Coliform by WHO is 1000 MPN / 100 ml. TKN and TP parameters do not have standard for irrigation in agriculture from the perspective of Iran's Department of environment, USEPA, WHO and FAO.

Several studies have been carried out to evaluate the quality of wastewater of treatment plants for irrigation in the world, among them we can refer to the study of Kokkinos *et al*. (2015) in which it indicates that in assessing three Greek treatment plants, most of the outlet samples from all three wastewater treatment plants were not suitable for irrigation based on BOD and TSS values. The study of Al-Hammad *et al*. (2014) in the sewage treatment plant in Saudi Arabia has shown that the turbidity, TSS, COD and BOD5 parameters and the total number of coliforms and Fecal Coliforms were higher than the authorized limit. Özkan *et al*. (2012), in assessing the Turkish wastewater treatment plant, showed that the BOD5 and COD values were allowed. As a result, the performance of this plant has been evaluated as excellent. The study of Alderson *et al*. (2015) found that the wastewater treatment plant in Brazil has the ability to provide suitable wastewater for reuse in agriculture. The study by Bourazanis and Kerkides (2015) has evaluated the efficiency of the Sparta-Greece treatment plant as suitable. The study of Kaboosi (2016) at Bandar Gaz showed that the treated wastewater is suitable for irrigation according to national and international standards. Considering that no research has been carried out to evaluate the wastewater of treatment plant in Kashan, this research was conducted to evaluate the quality of wastewater of treatment plant in Kashan for use in irrigation.

2. Materials and methods

The city of Kashan with an area of about 4392 square kilometers is located in the northern part of Isfahan province. The first modulus of the treatment plant based on the process of activated sludge-extended aeration with a capacity of 6600 cubic meters per day (current inlet discharge of treatment plant 60 liters per second) is constructed in southern Kashan. The outlet wastewater from the first module of the aforementioned treatment plant is without removal of nutrients and based on the disinfection by chlorine compounds. Figure 1 shows the stages of sewage treatment in the Kashan Sewage Treatment Plant. The sampling was carried out in three months of August, September and October at two locations of the inlet and outlet of the treatment plant. A total of 72 experiments were conducted for COD, BOD_5, TSS and TDS and turbidity and 36 tests for Total Kjeldahl Nitrogen and Total Phosphorus and 54 experiments for total coliform and Fecal Coliform and 18 for live nematodes. Sampling of the COD, BOD_5, TSS, TDS, turbidity, pH, Total Kjeldahl Nitrogen, Total Phosphorus, total coliform, Fecal Coliform parameters were grab and live nematodes were composite. All experiments were performed according to the standard method book (APHA 2012) and the experiment of egg nematode was also done according to the method of Bailenger (Rachel *et al*. 1996). After collecting the mean and standard deviation, wastewater quality parameters before and after treatment were tested by SPSS 22 (2014) software.

3. Results

The results of study showed that the average of three months of the inlet and outlet pH of the treatment plant was 6.71 and 7.22, respectively. The average input and output turbidity are 87.28 NTU and 17.53 NTU. The average of three-month input and output TSS is 72.68 and 11.11 mgL^{-1}. The average of the total three months of the inlet and outlet total dissolved solids are 1038 and 1095 mgL^{-1} (Table 1).

Table 1 Inlet and outlet wastewater characteristics (average ± standard deviation) during the study

Parameters	Outlet	Inlet $\bar{X} \pm S.D$	Unit $\bar{X} \pm S.D$
COD	86.62 ± 23.33	292 ± 88.39	mgL^{-1}
BOD_5	41.22 ± 13.13	141.01 ± 34.56	mgL^{-1}
Turbidity	17.53 ± 10.93	87.28 ± 31.35	NTU
TDS	1095.47 ± 412.64	1038.69 ± 344.10	mgL^{-1}
TSS	11.11 ± 3.36	72.68 ± 21.02	mgL^{-1}
pH	7.22± 0.5	6.71 ± 0.24	-
Total Coliform($\times 10^3$)	0.225 ± 0.106	1421.11 ± 909.29	MPN/100
Fecal Coliform($\times 10^3$)	0.161 ± 0.049	486.66 ± 178.46	MPN/100
Total Kjeldahl Nitrogen	22.42 ± 2.81	41.02 ± 5.87	mgL^{-1}
Total Phosphorus	2.28 ± 0.5	3.15 ± 0.51	mgL^{-1}
Nematode eggs	0 ± 0	0.1 ± 0.33	N/l

In addition, according to the monthly changes table, the average input TDS for the months of September and October was higher than in August, which is equal to 1112 and the average TDS of the August output is lower than in the other two months, which is 931 mgL^{-1} (Table 2). The average of the total three-month input and output BOD_5 in the treatment plant is 141.01 and 41.22 mgL^{-1} respectively. The highest input BOD_5 was in October and the lowest output BOD_5 was the August, which was 175 and 30 mgL^{-1} respectively. Also, average output pH in August, September and October was 7.7 and 7.5, respectively. The highest average outlet turbidity in October and the lowest turbidity outlet in September, respectively, were equal to 30 NTU and 10 NTU. The average monthly changes of TSS indicate that the highest and lowest TSS inputs and outputs were in September compared to August and October, which is respectively 84 and 9 mgL^{-1}. The average of three months of input and output COD are 292 and 86 mgL^{-1} respectively. The average COD before treatment in August, September and October are 254, 231 and 389 mgL^{-1}, respectively. The average COD after treatment in August, September and October were 69, 74 and 116 mgL^{-1}, respectively, which the highest amount before and after the treatment is related to October (Table 2). The average of three-month Total Kjeldahl Nitrogen inlet and outlet are 41 and 22 mgL^{-1} respectively. The highest and lowest input and output TKN was related to August, which was 41.4 and 20.9, respectively. The total inlet and outlet phosphorus are equal to 3.1 and 2.2 mgL^{-1} and comparison of the monthly average shows that the highest Total Phosphorus inlet is in August and the lowest amount of output is in September equal to 3.4 and 2 mgL^{-1}, respectively. The average 3 months input and output of total coliform is equal to 1421 $\times 10^3$ and 225 MPN / 100 ml, respectively. The average inlet of September was more than two other months, which was equal to 2466 $\times 10^3$ MPN / 100 ml and the average outlet in October was less than the other two months, which is equal to 156 MPN / 100 ml. The mean of three months of input and output Fecal Coliform is equal to 486.6 $\times 10^3$ MPN / 100 ml and 161 respectively. The mean of the inlet and outlet Fecal Coliform of the three months of August, September and October shows that the highest amount of inlet Fecal Coliform was observed in August (643 $\times 10^3$ MPN / 100 ml) and the October output was lower than in the other two months (151 MPN / 100 ml).

The average of the total three months of outlet of nematode eggs is equal to 0.1 and zero, respectively. The average monthly variation of nematode eggs shows that only nematode was observed in August and its value was 0.33 (Table 2).

4. Discussion

The results of research showed that the average total of three months of the inlet and outlet pH of the treatment plant was 6.71 and 7.22, respectively, which is consistent with the studies by Karef *et al*. (2014) in Algeria and Ilias *et al*. (2014) in Greece. The outlet pH values of the Kashan Wastewater Treatment Plant are close to the study of Nakib *et al*. (2016) in Kola Treatment Plant in Algeria and Hamoda *et al*. (2015) in Kuwait. The results of study showed that inlet and outlet turbidity is equal to 87.28 NTU and 17.53 NTU, respectively. The average of the three-month inlet and outlet TSS is 72.68 and 11.11 mgL^{-1} respectively. Studies by Hamoda *et al*. (2015) and Moghadam *et al*. (2015) in Isfahan showed that the output turbidity was 43 NTU and 30 NTU, respectively, which is higher than the outlet turbidity of Kashan Treatment Plant. Also, studies by Melgarejo *et al*. (2016) in Mexico showed that the outlet turbidity was less than the value obtained from the Kashan Treatment Plant, which was equal to 4.8 NTU. According to the results, the amount of TSS after treatment is close to the results obtained from Al-Shammari *et al*. (2013) in Kuwait and Vera *et al*. (2013) in Chile, which is 13.74 and 13.55 mgL^{-1}, respectively. Also, the output TSS corresponds to the results obtained by Nakib *et al*. (2016) in Algeria and Azgin *et al*. (2015) in Turkey, which is equal to 14.8 and 20 mgL^{-1} respectively. High levels of TSS cause blockage of irrigation water nozzles (Müller and Cornel 2016).

The mean of post treatment TDS is similar to that of Al-Hammad *et al*. in Egypt (2014) and Mahghoub *et al*. (2016) in Egypt, the values of which were 1220 and 1137 mgL^{-1} respectively. Similarly, the results of Tanyol *et al*. (2016) in Turkey showed that the total dissolved solids were less than the results of the outlet of Kashan's treatment plant, which is 510 mgL^{-1}. The effluent BOD_5 was close to the results of Azgin *et al*. (2015) and Hidri *et al*. (2014), whose values were 20 and 22 mgL^{-1} respectively. Also, the outlet of the treatment plant is approximately the same as the results obtained from Kaboosi (2016), which is equal to 44 mgL^{-1}. The results indicated that the outlet BOD_5 was less than the amount recommended by the Iran's Department of Environment for reuse in irrigation. But the plant has not been able to comply with USEPA's allowable BOD for irrigation of raw and processed products, with an authorized value of 10 and 30 mgL^{-1} respectively. Also, the results of the total three-month inlet COD indicate that in terms of sewage intensity, it is among poor sewages (Metcalf and Eddy 2003). Also, the results of outlet COD of Kashan's treatment center correspond to the studies conducted by

Table 2 Inlet and outlet wastewater characteristics (average ± standard deviation) during the study (August, September and October)

Parameters	August		September		October	
	inlet	outlet	inlet	outlet	inlet	outlet
COD	254.3 ± 31.2	69.3 ± 6	231.8 ± 72.6	74 ± 9.5	389.3 ± 52.9	116.5 ± 11.2
BOD_5	130.1 ± 15.1	30.7 ± 2.7	117.8 ± 33.1	35.9 ± 4.7	175 ± 22.3	56.9 ± 9.9
TSS	57.1 ± 7.9	11.7 ± 2.6	84.5 ± 29.5	9 ± 3.6	76.3 ± 6.3	12.5 ± 2.8
TDS	890.6 ± 170.9	931.3 ± 215.7	1112.9 ± 314.6	1085.2 ± 435.8	1112.5 ± 461.1	1269.8 ± 492.5
pH	6.7 ± 0.1	7 ± 0.07	6.6 ± 0.3	7 ± 0.08	6.7 ± 0.2	7.5 ± 0.7
Turbidity	60 ± 15.9	11.2 ± 5.9	113.5 ± 28.1	10.4 ± 3.2	88.2 ± 22.7	30.8 ± 6.5
TKN	41.4 ± 8.02	20.9 ± 2.6	40.7 ± 6.8	23 ± 3.1	40.8 ± 2.3	23.2 ± 2.7
TP	3.4 ± 0.4	2.2 ± 0.7	2.8 ± 0.5	2 ± 0.1	3.2 ± 0.4	2.5 ± 0.2
TC	1333.3 ± 230.9	0.200 ± 0.07	2466.6±404.1	0.320 ± 0.1	463.3 ± 251.4	0.156 ± 0.04
FC	643.3 ± 184.7	0.173 ± 0.06	483.3 ± 137.9	0.160 ± 0.04	333.3 ± 46.1	0.151 ± 0.05
Nematode	0.33 ± 0.5	0	0	0	0	0

Wang *et al*. (2015), Azgin *et al*. (2015) and Karef *et al*. (2014), whose values are 80, 70 and 72. The amount of nitrogen and phosphorus obtained in this study was approximately the same as the results of Wang *et al*. (2015) and Azgin *et al*. (2015), which is 22.6, 15 mgL^{-1}, respectively. Similarly, the results of Sun *et al*. (2016) studies in China showed that total outlet phosphorus was 0.7 mgL^{-1}. Nitrogen and phosphorus parameters do not have standard for irrigation in agriculture from the perspective of Iran's Department of Environment, USEPA and FAO.

One of the most important concerns in reuse of waste water is the microbiological quality that can increase the likelihood of spreading diseases (Ajonina *et al*. 2015). The mean of Total Coliform outlet for three months showed that it was close to the results of Hamoda *et al*. (2015) and Elmeddahi *et al*. (2016) which are 300 and 200, respectively. Also, according to comparing the results with the effluent standards shows that the effluent wastewater from the treatment plant could comply with the permissible limit recommended by the Iran's Department of Environment, which is equal to 1000 MPN / 100 ml. Also, the comparison of Fecal Coliform after treatment with the results obtained by Hamoda *et al*. (2015) showed that the amount of Fecal Coliform was equal to 15 MPN / 100 ml and there was no Fecal Coliform in Elmeddahi *et al*. (2016) studies. The outlet coliform with authorized standards is less than that of Iran's Department of Environment and the World Health Organization. It is also lower than the limit defined by USEPA. Also, the average of outlet nematode eggs was similar to the results obtained by Ilias *et al*. (2014) and Moghadam *et al*. (2015) in Isfahan Wastewater Treatment Plant and Sharafi *et al*. (2015) in western Guilan, Iran. Removal of nematode eggs occur in the active sludge process in a secondary sedimentation tank, which is eliminated by adhering to activated sludge flocs (Sharafi *et al*. 2015, Tonani *et al*. 2011).

5. Conclusions

The results indicated that the treatment plants had a significant role in the control of microbial and organic pollution load of wastewater. Also, the results of study were showed that the average effluent parameters of TSS, TDS, BOD_5, COD, Total Kjeldahl Nitrogen and Total Phosphorus and turbidity for three months were 11.1, 1095, 41.2, 86.6, 22.4, 2.2 mgL^{-1}, 17.5 NTU and the pH was equal to 7.22. Also, Total Coliform and Fecal Coliform are 225, 161 MPN / 100 ml as respectively. In addition, no nematode eggs were found in final effluent. Also, it is concluded that all parameters were in accordance with the standards of Iran's Department of Environment, so, it can be used for unrestricted irrigation.

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References

Abdoulkader, B.A., Mohamed, B., Nabil, M., Alaoui-Sossé, B., Eric, C. and Aleya, L. (2015), "Wastewater use in agriculture in Djibouti: Effectiveness of sand filtration treatments and impact of wastewater irrigation on growth and yield of Panicum maximum", *Ecol*. *Eng*., **84**, 607-614.

Agrafioti, E. and Diamadopoulos, E. (2012), "A strategic plan for reuse of treated municipal wastewater for crop irrigation on the Island of Crete", *Agric*. *Water Manage*., **105**, 57-64.

Ajonina, C., Buzie, C., Rubiandini, R. and Otterpohl, R. (2015), "Microbial pathogens in Wastewater Treatment Plants (WWTP) in Hamburg", *J*. *Toxicol*. *Environ*. *Health*, *Part A*, **78**(6), 381-387.

Al-Hammad, B., Abd El-Salam, M. and Ibrahim, S. (2014), "Quality of wastewater reuse in agricultural irrigation and its impact on public health", *Environ. Monitor. Assess.*, **186**(11), 7709-7718.

Al-Shammari, S.B., Al-Khali, B., Al-Sharifi, F. and Shahlam, A.M. (2013), "Quality assessment of treated wastewater in Kuwait and possibility of reuse it to meet growing water demand", *Desalination Water Treat.*, **51**(22-24), 4497-4505.

Alderson, M.P., dos Santos A.B. and Mota Filho, C.R. (2015), "Reliability analysis of low-cost, full-scale domestic wastewater treatment plants for reuse in aquaculture and agriculture", *Ecolog. Eng.*, **82**, 6-14.

APHA (2012), *Standard Methods for the Examination of Water and Wastewater,* 22nd Ed., American Public Health Association, Washington, DC, U.S.A.

Atharizade, M. and Miranzadeh, M.B. (2015), "Evaluation of efficacy of advanced oxidation processes fenton, fenton-like and photo-fenton for removal of phenol from aqueous solutions", *J. Chem. Soc. Pak.*, **37**(2), 266-271.

Azgin, Ş.T. and Peker, İ. (2015), "Assessment of wastewater treatment alternatives in metropolitan municipality district: A case study in Turkey", *Desalination Water Treat.*, **53**(3), 610-618.

Bourazanis, G. and Kerkides, P. (2015), "Evaluation of Sparta's municipal wastewater treatment plant's effluent as an irrigation water source according to Greek Legislation", *Desalination Water Treat.*, **53**(12), 3427-3437.

Dehghani, R., Aboutalebi, M., Barzegari, Z. and Ghanbari, M. (2014b), "Fauna and habitat of aquatic arthropods of Kashan in 2010", *Bangladesh J. Med. Sci.*, **13**(3), 306-310.

Dehghani, R., Limoee, M. and Zarghi, I. (2012b), "The review of pesticide hazards with emphasis on insecticide resistance in arthropods of health risk importance", *Sci. J. Kurdistan U. Med. Sci.*, **17**(1), 82-98.

Dehghani, R., Miranzadeh, M.B., Yosefzadeh, M. and Zamani, S. (2007), "Fauna aquatic insects in sewage maturation ponds of Kashan University of Medical Science 2005", *Pakistan J. Biol. Sci.*, **10**(6), 928-931.

Dehghani, R., Moosavi, G., Takhtfiroozeh, S.M. and Rashedi, G. (2016b), "Investigation of the removal of cyanide from aqueous solutions using biomass Saccharomyces cerevisiae", *Desalination Water Treat.*, **57**(56), 27349-27354.

Dehghani, R., Sabahi, M., Asgari, J., Rashedi, G., Heydari, F., Soheili, Z., Kazemi, V. and Afshari, N. (2013), "A survey on the application and storage conditions of pesticides in Kashan, Iran", *J. Occup. Health Epidemiol.*, **2**(1), 54-59.

Dehghani, R., Shahrisvand, B., Mostafaeii, G., Atharizade, M., Gilasi, H., Rezaee, M., Hoseindoost, G. and Takhtfiroozeh, S. (2016a), "Frequency of arthropoda in urban wastes compost process at laboratory condition", *J. Entomol. Res.*, **40**(4), 357-364.

Dehghani, R., Takhtfiroozeh, S.M., Kanani, F. and Aslani, S. (2014a), "Case report of Stomoxys calcitrans bites in residential area of Kashan, Iran", *J. Mazandaran U. Med. Sci.*, **23**(110), 257-261.

Dehghani, R., Younesian, M., Saharian, M., Gilasi, H. and Kazemi, V. (2015), "The evaluation of multiple sclerosis dispersal in Iran and its association with urbanization, life style and industry", *Iran. J. Public Health*, **44**(6), 830-838.

Dehghani, R., Akbari, H. and Vazirianzadeh, B. (2012a), "A prospective study on the seasonal frequencies of insect bites (Diptera: Culicidae and Phlebotominae) and the related environmental and protective method factors in the city of Kashan, central of Iran, 2009", *Pak. J. Med. Sci.*, **28**(1),158-161.

Elmeddahi, Y., Mahmoudi, H., Issaadi, A. and Goosen, M. (2016), "Analysis of treated wastewater and feasibility for reuse in irrigation: A case study from Chlef, Algeria", *Desalination Water Treat.*, **57**(12), 5222-5231.

Ferro, G., Fiorentino, A., Castro-Alferez, M., Polo-López, M., Rizzo, L. and Fernández-Ibánez, P. (2015), "Urban wastewater disinfection for agricultural reuse: Effect of solar driven AOPs in the inactivation of a multidrug resistant E. coli strain", *Appl. Catal. B: Environ.*, **178**, 65-73

Gatta, G., Libutti, A., Beneduce, L., Gagliardi, A., Disciglio, G., Lonigro, A. and Tarantino, E. (2016), "Reuse of treated municipal wastewater for globe artichoke irrigation: Assessment of effects on morpho-quantitative parameters and microbial safety of yield", *Scientia Horticulturae*, **213**, 55-65.

Haghighi, M., Rahmani, F., Dehghani, R., Tehrani, A.M. and Miranzadeh, M.B. (2017). "Photocatalytic reduction of Cr (VI) in aqueous solution over ZnO/HZSM-5 nanocomposite: Optimization of ZnO loading and process conditions", *Desalination Water Treat.* **58**, 168-180.

Hamoda, M.F., Attia, N.F. and Al-Ghusain, I.A. (2015), "Performance evaluation of a wastewater reclamation plant using ultrafiltration and reverse osmosis", *Desalination Water Treat.*, **54**(11), 2928-2938.

Hidri, Y., Fourti, O., Eturki, S., Jedidi, N., Charef, A. and Hassen, A. (2014), "Effects of 15-year application of municipal wastewater on microbial biomass, fecal pollution indicators and heavy metals in a Tunisian calcareous soil", *J. Soils Sediment.*, **14**(1), 155-163.

Hoseindoost, G., Miranzadeh, M.B., Ahmadi, M., Hallajian, V., Borj, H.R.S. and Siaf, H. (2014). "A survey on nutrient removal in a combined wastewater treatment system in Kashan University of Medical Science, Iran". *Ecol., Environ. Conserv.* **20**(4), 1471-1477.

Ilias, A., Panoras, A. and Angelakis, A. (2014), "Wastewater recycling in Greece: The case of Thessaloniki", *Sustainability*, **6**(5), 2876-2892.

Kaboosi, K. (2016), "The assessment of treated wastewater quality and the effects of mid-term irrigation on soil physical and chemical properties (case study: Bandargaz-treated wastewater)", *Appl. Water Sci.*, **7**(5), 1-12.

Karef, S., Kettab, A. and Nakib, M. (2014), "Characterization of byproducts from wastewater treatment of Medea (Algeria) with a view to agricultural reuse", *Desalination Water Treat.*, **52**(10-12), 2201-2207.

Kokkinos, P., Mandilara, G., Nikolaidou, A., Velegraki, A., Theodoratos, A., Kampa, D., Blougoura, A., Christopoulou, A., Smeti, E., Kamizoulis, G., Vantarakis, A. and Mavridou, A. (2015). "Performance of three small-scale wastewater treatment plants. A challenge for possible re use", *Environ. Sci. Poll. Res.* **22**(22), 17744-17752.

Mahgoub, S., Samaras, P., Abdelbasit, H. and Abdelfattah, H. (2016), "Seasonal variation in microbiological and physicochemical characteristics of municipal wastewater in Al-Sharqiya province, Egypt (case study)", *Desalination Water Treat.*, **57**(5), 2355-2364.

Melgarejo, J., Prats, D., Molina, A. and Trapote, A. (2016), "A case study of urban wastewater reclamation in Spain: Comparison of water quality produced by using alternative processes and related costs", *J. Water Reuse Desalination*, **6**(1), 72-81.

Metcalf and Eddy, Inc. (2003), *Waste. Eng., Treat. Reuse*, McGraw-Hill, New York, U.S.A.

Miranzadeh, M., Hassanzadeh, M. and Dehqan, S. (2011a), "Determination of total dissolved solid (TDS), nitrate and fluoride in 24 brands of Iranian bottled waters", *J. Phys. Sci.*, **6**(22), 5128-5132.

Miranzadeh, M., Heidari, M. and Younesian, M. (2011b), "Survey of microbial quality of drinking water in rural areas of Kashan-Iran in second half of 2008", *Pakistan J. Biol. Sci.*, **14**(1), 59-63.

Moghadam, F.M., Mahdavi, M., Ebrahimi, A., Tashauoei, H. and Mahvi, A.H. (2015), “Feasibility study of wastewater reuse for irrigation in Isfahan, Iran”, *J. Sci. Res*, **23**(10), 2366-2373.

Mostafaii, G., Najafi, M., Moosavi, G., Rajaei, M., Moghadam, V. K. and Takhtfiroozeh, S.M. (2017), “Frequency of urban pests and pesticides consumption in the residential houses of the east of Tehran city-Iran”, *J. Ent. Res*. **41**(2), 125-132.

Müller, K. and Cornel, P. (2015), “Setting water quality criteria for agricultural water reuse purposes”, *J. Water Reuse Desalination*, **7**(2). 121-135.

Nakib, M., Kettab, A., Berreksi, A., Tebbal, S. and Bouanani, H. (2016), “Study of the fertilizing potential of the treated wastewater of the Kolea wastewater treatment plant (Algeria)”, *Desalination Water Treat*., **57**(13), 5946-5950.

Özkan, O., Oğuz, M. and Özdemir, Ö. (2012), “Characterization and assessment of a large-scale domestic advanced wastewater treatment plant in Turkey”, *Environ. Monitor. Assess*., **184**(9), 5275-5281.

Rabbani, D., Bigdeli, M., Mahvi, A. and Akbari, H. (2013), “Simultaneous application of electrochemical and coagulation processes in surface water treatment”, *Life Sci. J*., **10**, 192-198.

Rabbani, D., Mahmoudkashi, N., Mehdizad, F. and Shaterian, M. (2016), “Green approach to wastewater treatment by application of Rosa damascena waste as nano-biosorbent”, *J. Environ. Sci. Technol*., **9**(1), 121-130.

Rabbani, D., Miranzadeh, M. and Motlagh, A. (2008), “Study for determination of industrial water corrosivity in Kashan Fajre Sepahan Galvanizing Mills during 2005-2006 Iran”, *Pakistan J. Biol. Sci*., **11**(1), 131-134.

Rachel, M. and Mara, D. (1996), *Analysis of Wastewater for Use in Agriculture-A Laboratory Manual of Parasitological and Bacteriological Techniques*, WHO, Geneva, Switzerland.

Sharafi, K., Moradi, M. Karami, A. and Khosravi, T. (2015), “Comparison of the efficiency of extended aeration activated sludge system and stabilization ponds in real scale in the removal of protozoan cysts and parasite ova from domestic wastewater using Bailenger method: A case study, Kermanshah, Iran”, *Desalination Water Treat*., **55**(5), 1135-1141.

Sun, Y., Chen, Z., Wu, G., Wu, Q., Zhang, F., Niu, Z. and Hu, H. (2016), “Characteristics of water quality of municipal wastewater treatment plants in China: Implications for resources utilization and management”, *J. Clean. Prod*., **131**, 1-9.

Tanyol, M. and Demir, V. (2016), “Correlations between some operation parameters and efficiency evaluation of domestic wastewater treatment plant in Tunceli (Turkey)”, *Desalination Water Treat*., **57**(58), 28115-28121.

Teoh, M.M., Wang, K., Bonyadi, S., Yang, Q. and Chung, T. (2011), “Emerging membrane technologies developed in NUS for water reuse and desalination applications: Membrane distillation and forward osmosis”, *Membr. Water Treat*., **2**(1), 1-24.

Tonani, K.A.A., Julião, F., Trevilato, T., Takayanagui, A., Bocio, A., Domingo, J., Susana, I. and Muñoz, S. (2011), “Behavior of metals, pathogen parasites and indicator bacteria in sewage effluents during biological treatment by activated sludge”, *Biol. Trace Elem. Res*., **143**(2), 1193-1201.

Urbano, V.R., Mendonça, T., Bastos, R. and Souza, C. (2017), “Effects of treated wastewater irrigation on soil properties and lettuce yield”, *Agric. Water Manag*., **181**, 108-115.

Vera, I., Sáez, K. and Vidal, G. (2013), “Performance of 14 full-scale sewage treatment plants: Comparison between four aerobic technologies regarding effluent quality, sludge production and energy consumption”, *Environ. Technol*., **34**(15), 2267-2275.

Waghmare, S., Masid, S., Rao, A.P., Roy, P., Reddy, A.V.R., Nandy, T. and Rao, N.N. (2010), “Municipal wastewater reclamation for non-potable use using hollow-fiber membranes”, *Membr. Water Treat*., **1**(3), 207-214.

Wang, X.H., Wang, X., Huppes, G., Heijungs, R. and Ren, N. (2015), “Environmental implications of increasingly stringent sewage discharge standards in municipal wastewater treatment plants: Case study of a cool area of China”, *J. Clean. Prod*., **94**, 278-283.

Wong, Y., V., Moganaragi and N. Atiqah, (2014), “Physico-chemical investigation of semiconductor industrial wastewater”, *Orient. J. Chem*. **29**(4), 153-165.

Yasmeen, T., Ali, Q., Islam, F., Noman, N., Sohail, M. and Tariq, M. (2014), “Biologically treated wastewater fertigation induced growth and yield enhancement effects in Vigna radiata L.”, *Agric. Water Manag*., **146**, 124-130.

Yaya-Beas, R.E., Ayala-Limaylla, C., Kujawa-Roeleveld, K., Van Lier, J.B. and Zeeman, G. (2015), “Helminth egg removal capacity of UASB reactors under subtropical conditions”, *Water*, **7**(5), 2402-2421.

Zarrintab, M., Mirzaei, R., Mostafaeim, G., Dehghani, R. and Akbarim, H. (2016), “Concentrations of metals in feathers of magpie (Pica pica) from Aran-O-Bidgol City in central Iran”, *B. Environ. Contam. Tox*., **96**(4), 465-471.

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