Data Article

Data on effluent toxicity and physicochemical parameters of municipal wastewater treatment plant using Daphnia Magna

Fathollah Gholami-Borujeni a,*, Fatemeh Nejatzadeh-Barandozi b, Hamed Aghdasi c

a Department of Environmental Health Engineering, Health Sciences Research Center, Addiction Institute, Mazandaran University of Medical Sciences, Sari, Iran
b Department of Horticulture, Faculty of Agriculture, Khoy Branch, Islamic Azad University, Khoy, Iran
c Department of Environmental Health Engineering, School of Health, Urmia University of Medical Sciences, Urmia, Iran

ARTICLE INFO

Article history:
Received 6 May 2018
Received in revised form
10 June 2018
Accepted 19 June 2018
Available online 28 June 2018

Keywords:
Wastewater
Effluent
Acute toxicity
Daphnia Magna
Physicochemical parameter

ABSTRACT

Toxicity of Municipal Wastewater Treatment Plant Effluent (MWWTPE) was evaluated using bioassay with Daphnia Magna (D. Magna). Acute toxicity tests were performed on effluent samples of Urmia municipal wastewater treatment plant (Biolac system) according to the USEPA methods and 24, 48, 72, and 96 hr lethal concentration 50% (LC50) were calculated by application of Probit analysis. Also interrelationship between main effluent physicochemical parameters of wastewater (BOD5, COD, and TSS) and 24hr-LC50 were studied. Results showed that the effluent was safe to be discharged to the surface water in regard to physicochemical parameters and acute toxicity unit (TUa), according to the standards of Iranian Department of Environment (DOE). Relationship between effluent COD and 24hr-LC50 show that, increase in effluent COD resulted in increase in wastewater toxicity and there was not relationship between BOD5, TSS and toxicity of effluent.

© 2018 Published by Elsevier Inc. This is an open access article under the CC BY license (http://creativecommons.org/licenses/by/4.0/).
### Specifications Table

| Subject area          | chemistry, biology |
|-----------------------|--------------------|
| More specific subject area | Bio-assay of municipal wastewater treatment plants with D. Magna |
| Type of data          | Table, image, figure |
| How data was acquired | Laboratory Bio-assay examination of Urmia Wastewater treatment plant effluent, BOD5, COD and TSS of MWWTP effluent. Electron microscope equipped with camera was used to detection of D. Magna morphology changes |
| Data format           | Raw and analyzed |
| Experimental factors  | LC50 (Lethal Concentration 50%), (BOD5), (COD), (TSS) |
| Experimental features | For (QA/QC) of Bio- assay with D. Magna, All experiments were performed according to the standard method [1,2]. Temperature of ambient test was measured during the experiments, culture medium of D. Magna were prepared according to the guideline [2], All experiments are repeated three times and average of data were report. It has been used as a standard test organism in U.S. Environmental Protection Agency (EPA), OECD, and International Organization for Standardization (ISO) standard protocols. |
| Data source location  | MWWTPE of Urmia, Iran |
| Data accessibility    | All data is included in this article |

### Value of the data

- These data provide the toxicity of Urmia Wastewater treatment plant effluent (Biolac lagoon) and relationships between BOD5, COD and TSS and LC50
- **Bio-Assay method with D. Magna may be applied to quality control of MWWTPE before discharge to the aquatic ambient as valuable tools for bio-monitoring of wastewater treatment plant effluent, as it is highly sensitive to pollutants**
- These data are valuable to researchers investigating LC50 related to the bio-chemical parameters of WWTPs effluents.

### 1. Data

Chemical characteristics of Urmia wastewater treatment plant are presented in Table 1. The data of 24, 48, 72, and 96 h toxicity test of Urmia wastewater treatment plant effluent are presented at Fig. 1. In this Figure, lethal concentration 50 (LC50) of UWWTPE for 24, 48, 72, and 96 h exposure time are presented. This figure also presents the highest and lowest levels for 95% confidence. As well, a regression analysis was performed to examine possible correlations between exposure time and LC50. LC50 of Urmia wastewater treatment plant effluent was between 594 to 326 ml/l from exposure time of 24 to 96 h. Correlations between exposure time and LC50 show that there is non-linear regression between exposure time and LC50 (R-squared is 0.97).

According to the light microscope images of D. Magna, large amounts of dark material were found in the gut tract of D. Magna after effluent wastewater exposure but not in the control. According to these images (Fig. 2), D. Magna after 96 h exposure time was destructed. The acute toxicity test were carried out to evaluate the inter-relationship between physicochemical parameters of effluent and toxicity of Urmia wastewater treatment plant effluent at various operational condition of wastewater treatment plant with different Biochemical Oxygen Demand (BOD5); (20–40 mg/l); Chemical Oxygen Demand; (COD) (30–50 mg/l); Total Suspended Solids (TSS); (15–25 mg/l) concentrations. These results are presented in Figs. 3–5. In addition, Relationship between BOD5 and 24h-LC50 are presented in Fig. 3. According to the results, there is no direct relationship between BOD5 concentration and...
2. Experimental design, materials, and methods

2.1. Wastewater treatment plant

Wastewater treatment system in the city of Urmia (One of the great western cities of Iran in west Azarbaijan province) that designed to serve 950,000 persons was selected to toxicity evaluation. Wastewater flow is about 77,000 m³/day mainly of domestic origin. This system consists of 2 mechanical coarse screening, Flow meter, Grit chamber, Biolac lagoon that have 5 part (Phosphor removal, Aeration, Sedimentation, Secondary aeration, Clarifier) and disinfection. In recent years to access the reclamation strategy for the Urmia Lake, these effluents were discharge to the lake. According to the Iranian Department of Environment (DOE) report this wastewater treatment plant effluents have standards for discharge to surface water.
2.2. Sampling

Samples were collected at different operational conditions from effluent of wastewater treatment plant in Jun 2015 based on the grab sampling, also known as a catch sampling that consists of a single sample taken at a specific time. All samples were collected and transport to laboratory according to the standards.

Fig. 2. Light microscope images (40× magnifications) of *D. Magna* exposed to at different exposure time of Urmia wastewater treatment plant effluent.
2.3. Propagation and culture of D. Magna

D. Magna was collected from a natural pond. Initially one of the isolated D. Magna was cultured. In the next step, the re-cultured D. Magna was used to prepare the final culture. For this reason, 100 ml of the final culture was poured into special bottles. Then, one single D. magna was added to each bottle.

![Graph](image_url)

**Fig. 3.** Interrelationship between concentration of BOD$_5$ and toxicity of Urmia wastewater treatment plant effluent.

![Graph](image_url)

**Fig. 4.** Interrelationship between concentration of COD and toxicity of Urmia wastewater treatment plant effluent.

![Graph](image_url)

**Fig. 5.** Interrelationship between concentration of TSS and toxicity of Urmia wastewater treatment plant effluent.

2.3. Propagation and culture of D. Magna

D. Magna was collected from a natural pond. Initially one of the isolated D. Magna was cultured. In the next step, the re-cultured D. Magna was used to prepare the final culture. For this reason, 100 ml of the final culture was poured into special bottles. Then, one single D. magna was added to each bottle.
To support the growth of *D. Magna* during the day after the initial culture, one mg of dry yeast was added to each bottle every other day. Identification of *D. Magna* was carried out according to the US-EPA [4,5].

In order to determine of LC50, different concentrations (sample and distilled water) of effluent were prepared using distilled water. The effluent samples were used at 20%, 30%, 40%, 50%, 60% and 70% and control samples according to the EPA recommendations for a toxicity test [4,6]. Ten *D. Magna* were added to each dilution and the results of *D. Magna* mortality were recorded after exposure time. For each exposure time (24, 48, 72, and 96 h) this process was repeated. Observations were made after 24, 48, 72, 96 h intervals. The results of experiments were acceptable only in cases where *D. Magna* in the blank tubes were observed to have a mortality rate of less than 10% [7]. It should be noted that temperature was checked regularly using a thermometer in the culture medium. Temperature of ambient test was measured during the experiments, culture medium of *D. Magna* were prepared according to the guideline [2]. All experiments are repeated three times and average of data were report. An aerator pump was used to provide oxygen.

### 2.4. Statistical analysis

LC50 and their corresponding 95% confidence intervals were calculated by probit analysis (SPSS 16 version). Acute toxic unit (TUa) of effluent wastewater treatment plant was calculated as following equation [3,8]:

$$\text{TUa} = \frac{100}{\text{LC50} \times (\text{v/v})}$$

(1)

Toxicity classification is reported as follows:

- No acute toxicity: TUa < 0.4
- Slight acute toxicity: 0.4 < TUa < 1
- Acute toxicity: 1 ≤ TUa < 10
- High acute toxicity: 10 ≤ TUa < 100
- Very high acute toxicity: TUa ≥ 100

Each species endpoint per effluents solution sample was compared to the corresponding reference sample mean using a Students’ t test. The difference was significant than p < 0.05.
Transparency document. Supporting information

Transparency data associated with this article can be found in the online version at https://doi.org/10.1016/j.dib.2018.06.076.

References

[1] M. Dehghani, E. Nikfar, A. Zarei, N.M. Esfahani, The effects of US/H2O2 processes on bisphenol-A toxicity in aqueous solutions using Daphnia magna, Desalination water Treat. 68 (2017) 183–189.
[2] M. Dehghani, P. Mahdavi, I. Tyagi, S. Agarwal, V. Kumar Gupta, Investigating the toxicity of acid dyes from textile effluent under UV/ZnO process using Daphnia magna, Desalination Water Treat. 57 (2016) 24359–24367.
[3] G. Persoone, B. Marsalek, I. Blinova, Törökne, D. Zarina, L. Manusadzianas, G. Nalecz-Jawecki, L. Tofan, N. Stepanova, L. Tothova, A practical and user-friendly toxicity classification system with microbiotests for natural waters and wastewaters, Environ. Toxicol. 18 (2003) 395–402.
[4] A.D. Eaton, L.S. Clesceri, Standard Methods for the Examination of Water and Wastewater, 22nd ed, American Water Works Association (AWWA), Washington, DC, 2012.
[5] F. Gholami-Borujeni, A.H. Mahvi, S. Nasseri, M.A. Faramarzi, R. Nabizadeh, M. Alimohammadi, Enzymatic treatment and detoxification of acid orange 7 from textile wastewater, Appl. Biochem. Biotechnol. 165 (2011) 1274–1284.
[6] F. Gholami-Borujeni, M.A. Faramarzi, F. Nejatzadeh-Barandozi, A.H. Mahvi, Oxidative degradation and detoxification of textile azo dye by horseradish peroxidase enzyme, Fresenius Environ. Bull. 22 (2013) 739–744.
[7] H. Movahedian, B. Bina, G. Asghari, Toxicity evaluation of wastewater treatment plant effluents using Daphnia magna, Iran. J. Environ. Health Sci. Eng. 2 (2005).
[8] K.B. Workagegn, Toxicity evaluation of wastewater treatment plant of textile effluent using fish: nile tilapia Oreochromis niloticus, Int. J. Aquac. 3 (2013).