International Journal of ChemTech Research
CODEN (USA): IJCRGG, ISSN: 0974-4290, ISSN(Online):2455-9555
Vol.9, No.05 pp 327-331, 2016

An Investigation of Water Compounds Behavior in Drinking Water Treatment Technology for Environmental Impact Assessment (EIA) Strategy: A Case Study on Surabaya

Mohammad Razif[1,*] and Satria Fadil Persada[2]

[1]Department of Environmental Engineering, Faculty of Civil Engineering and Planning, Institut Teknologi Sepuluh Nopember, Surabaya 60111, Indonesia
[2]Department of Business Management, Faculty of Industrial Technology, Institut Teknologi Sepuluh Nopember, Surabaya 60111, Indonesia

Abstract : Surabaya has several rivers in some locations are used as the source of raw water. Ensuring the water quality for drinking usage is one of the most important parameters that the producer must aware in order to provide a good water for citizens of Surabaya. Furthermore, the entire locations use a similar type of drinking water treatment plant. This study aims to investigate the water compound behavior in the drinking treatment plant in order to describe the characteristic of the drinking water. Three parameters, namely biochemical oxygen demand (BOD), chemical oxygen demand (COD) and total suspended solids (TSS) will be measured. A structural equation modeling (SEM) technique will be used to show the correlation patterns of BOD, COD and TSS on the debit water. A technology selection that can produce a good drinking water meeting the standard qualifications set by the Surabaya's government is highly suggested as the preferred strategy.
Keywords : Surabaya, River, Water Compounds, Drinking Treatment Plant.

Introduction

Environmental issues caused by human activities are inevitable situation that every city in the world must deal with. In more specific to the river point of view, the daily activities such as home waste and industry are usually caused damages and contaminations[14-19] to the river. A lot of approaches were conducted to maintain and to reduce the river degradation quality[1-5]. In some cases, the minimum standard of pollution is set by the local government, including the standard quality of drinking water in Surabaya.

The producer of drinking water is managed by the Surabaya state enterprises, namely the Drinking Water Company (*Perusahaan Daerah Air Minum*). The company uses Surabaya's rivers as the raw material to distribute the clean drinking water to Surabaya citizens, which is approximately more than 3 million population. In more detail, 6 drinking water treatment plants have been used in plenty numbers of years to convert the water river into the drinking water. The 6 drinking water treatment plants are located in two sites, which are 3 units at Karangpilang and 3 other units at Ngagel. Previous research conducted by Razif et al., [3] tried to analyze the quality of water, namely biochemical oxygen demand (BOD), chemical oxygen demand (COD) and total suspended solids (TSS) and projecting it with system dynamics for 5 year projection. However, it is still unrevealed how the characteristic and the correlation between the measured parameters to the debit of water. The present research, therefore, will measure the characteristic of BOD, COD and TSS and its correlation to

debit water. By understanding the correlation of each parameter, a better environmental impact assessment (EIA) strategy can be performed such as selecting the proper filter and the exact best type of drinking water treatment plant.

Materials and Methods

Two qualitative data sampling were taken at two site locations near Karangpilang Dam and Ngagel Dam for every month from year 2010 to 2012[3]. The sampling consists of BOD, COD, TSS and debit water. The collected data were examined in the laboratory and the details are shown in Table 1.

Table 1 Sampling of wastewater compounds.

No.	BOD (mg/l)	COD (mg/l)	TSS (mg/l)	Debit (m3/s)
1	5.76	12.40	102.90	31.97
2	4.85	11.00	216.00	16.75
3	3.19	13.56	114.60	31.84
4	3.07	9.26	88.00	35.26
5	6.03	28.37	793.30	25.09
6	3.47	13.27	85.30	15.86
7	3.91	12.75	70.00	13.26
8	4.18	16.13	87.00	14.26
9	4.45	14.22	110.00	26.27
10	9.02	46.50	813.30	19.65
11	5.39	30.19	290.00	9.95
12	6.47	28.72	314.00	11.90
13	6.47	38.62	608.30	11.16
14	3.38	15.58	59.00	25.11
15	4.77	19.31	149.00	16.76
16	4.95	20.06	118.70	8.25
17	4.18	18.10	104.00	11.15
18	3.41	14.05	46.70	11.33
19	3.18	10.32	38.00	33.08
20	2.93	11.59	25.00	12.70
21	2.30	9.86	34.70	8.02
22	2.31	10.16	26.50	14.49
23	2.47	11.66	35.00	11.82
24	3.88	14.09	52.00	38.51
25	4.36	18.01	187.00	9.45
26	2.42	8.19	57.00	8.18
27	5.31	15,92	139.00	26.92
28	2.86	11.81	106.00	18.80
29	4.29	21.41	254.00	55.50
30	11.94	32.00	32.00	27.51
31	2.52	7.59	32.00	9.48
32	2.38	5.41	18.00	46.63
33	2.05	9.05	14.70	18.71
34	3.10	13.19	20.50	64.08
35	3.90	15.66	23.50	40.11
36	3.41	16.75	1000.00	35.28

Source : Razif et al (2015)[3]

The sampling data of water in drinking water treatment plant were evaluated by using structural equation modeling (SEM) with AMOS software. The use of SEM has been used widely by many researchers for over a decade in describing the correlation between variables[6-13]. The developed model is presented in Figure 1. The details of hypotheses are defined as follows:

H1: BOD has a positive influence to a debit water.
H2: COD has a positive influence to a debit water.
H3: TSS has a positive influence to a debit water.

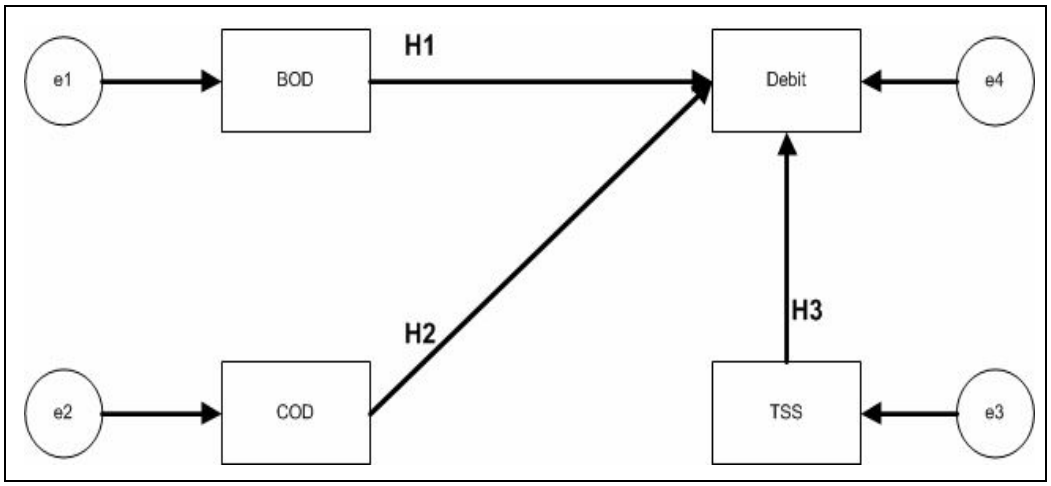

Figure 1. Structural model of drinking water parameter

Result and Discussion

The first analysis was a descriptive statistical analysis of water sampling data, where several descriptive items were shown in Table 2.

Table 2. Descriptive analysis

Variable	N	Mean	Minimum	Median	Maximum
BOD (mg/l)	36	4.24	2.05	3.89	11.94
COD (mg/l)	36	16.80	5.41	14.07	46.50
TSS (mg/l)	36	174.00	14.70	87.50	1000.00
Debit (m3/s)	36	13.98	8.02	17.73	64.08

The following analysis was a structural equation model for the model development and the result of the model is shown in Figure 2. The detail of explanation is described from Figure 3 to Figure 5.

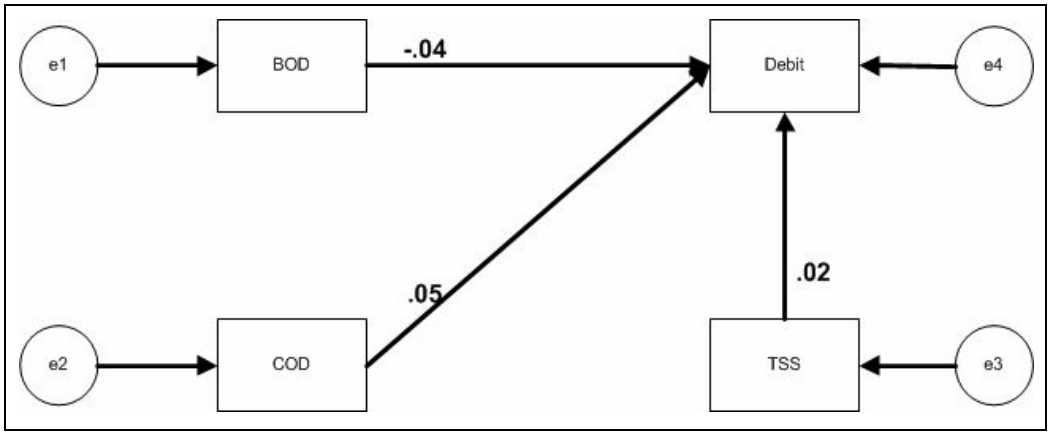

Figure 2. Structural model result of drinking water parameter

For the first correlation in Figure 3, it shows the BOD parameter has a negative value on water in drinking water treatment plant by the value of -0.04. This situation could occur when a Debit value elevated by 1, a BOD value declined by 0.04.

Figure 3. Correlation of BOD to Debit

The second correlation in Figure 4 from COD to Debit shows the positive value of 0.05. This situation indicates on every 1 point Debit addition, the COD value will added by 0.05 points.

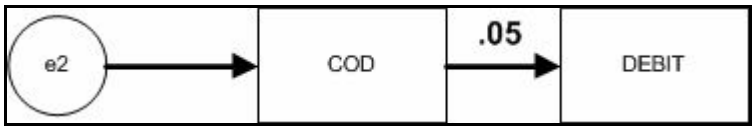

Figure 4. Correlation of COD to Debit

The third correlation from TSS to Debit in Figure 5 shows the positive value by 0.02, which indicates in every 1 value Debit increment, the TSS value will increase by 0.02 points.

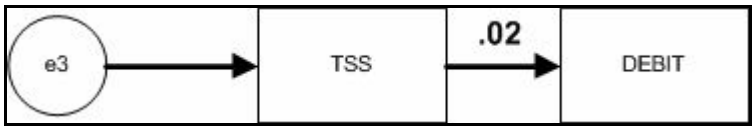

Figure 5. Correlation of TSS to Debit

The result could explain the compound behavior six parameters in drinking water treatment plant. Only one parameter shows a reverse result from the hypotheses. Hence, 2 out of 3 hypotheses were approved and the detail is shown in Table 3.

Table 3. Hypothesis result

Parameter	Correlation	Hypothesis	Note
BOD (mg/l)	-0.04	H1:Rejected	Reversed value
COD (mg/l)	0.05	H2:Accepted	-
TSS (mg/l)	0.02	H3:Accepted	-

Finally, this research describes the characteristic of BOD, COD and TSS in the drinking treatment plant. The situation of each compound, whether it increased or decreased, will have the same pattern. This can be used for EIA study to select the best filter for drinking water treatment plant technology consideration. A material selection of wastewater treatment plant that could reduce the parameter's value up to the standard quality is highly suggested.

Conclusions

The existing research targeted to investigate the compounds behavior characteristic in the water at Surabaya's drinking water treatment plant. Three parameters, namely BOD, COD and TSS were assessed against Debit parameter. A sampling data were used from two Dams' sites at Karangpilang and Ngagel in Surabaya city. The data was examined by structural equation modeling (SEM) and the SEM result shows the compounds behavior of BOD, COD, and TSS to a Debit water. Two out of three hypotheses were proven. The first rejected hypothesis indicates the BOD has a reverse behavior to the Debit condition. Finnaly, the result describes how the EIA planner and the the producer of drinking water should select the filter and the technology that could handle the compounds behavior to meet the standard qualifications. Some limitations need to be improved such as the add more data on the analysis. A technology selection that can produce a good drinking water meeting the standard quality set by the Surabaya's government is highly suggested as the preffered strategy.

References

1. Razif, M., Soemarno., Yanuwiadi, B., Rachmansyah, A. (2015). Effects of Wastewater Quality and Quantity Fluctuations in Selecting the Wastewater Treatment Plant: a Case Study of Surabaya's Mall. *International Journal of ChemTech Research 8(2) pp 534-540.*
2. Razif, M., Soemarno., Yanuwiadi, B., Rachmansyah, A., Persada, S.F. (2015) Prediction of Wastewater Fluctuations in Wastewater Treatment Plant by a System Dynamic Simulation Approach: a Projection Model of Surabaya's Mall. *International Journal of ChemTech Research 8(4) pp 2009-2018.*
3. Razif, M., Persada, S.F. (2015). The Fluctuation Impacts of BOD, COD and TSS in Surabaya's Rivers to Environmental Impact Assessment (EIA) Sustainability on Drinking Water Treatment Plant in Surabaya City. *International Journal of ChemTech Research 8(8) pp 143-151.*
4. Razif, M., Persada, S.F. (2015). An evaluation of Wastewater Compounds Behavior to Determine the Environmental Impact Assessment (EIA) Wastewater Treatment Plant Technology Consideration: a Case on Surabaya Malls. *International Journal of ChemTech Research 8(11) pp 371-376.*
5. Razif, M., Soemarno., Yanuwiadi, B., Rachmansyah, A., Belgiawan, P.F. (2015). Implementation of Regression Linear Method to Predict WWTP Cost for EIA: Case Study of Ten Malls in Surabaya City. *Procedia Environmental Sciences 28(2015) pp 158-165.*
6. Persada, S.F. (2016). Pro Environmental Planned Behavior Model to Explore the Citizens' Participation Intention in Environmental Impact Assessment: an Evidence Case in Indonesia. *Dissertation Book.*
7. Persada, S. F., Lin, S. C., Nadlifatin, R., & Razif, M. (2015). Investigating the citizens' intention level in environmental impact assessment participation through an extended theory of planned behavior model. *Global Nest Journal, 17(4), 847-857.*
8. Lin, S.C., Persada, S.F., Nadlifatin., R., Tsai, H.Y., Chu, C.H. (2015). Exploring the influential factors of manufacturers' initial intention in applying for the green mark ecolabel in Taiwan. *International Journal of Precision Engineering and Manufacturing-Green Technology, 2(4), 359-364*.
9. Jani, M. A., Sari, G. I. P., Pribadi, R. C. H., Nadlifatin, R., Persada, S. F. (2015). An Investigation of the Influential Factors on Digital Text Voting for Commercial Competition: A Case of Indonesia. *Procedia Computer Science, 72, 285-291*.
10. Nadlifatin. R., Razif, M., Lin, S.C., Persada, S.F., Belgiawan, P.F. (2015). An Assessment Model of Indonesian Citizens' Intention to Participate on Environmental Impact Assessment (EIA): a Behavioral Perspective. *Procedia Environmental Sciences, 28, 3-10.*
11. Nadlifatin. R., Lin, S.C., Persada, S.F., Razif, M. (2015). Investigating the Behavior of Citizens to Use ICT in Environmental Impact Assessment (EIA). *Open Access Journal of Information System,2015, 10-15.*
12. Lin, S. C., Persada, S. F., & Nadlifatin, R. (2014). A study of student behavior in accepting the Blackboard Learning System: A Technology Acceptance Model (TAM) approach. *In Computer Supported Cooperative Work in Design (CSCWD), Proceedings of the 2014 IEEE 18th International Conference pp. 457-462*.
13. Nadlifatin, R. (2014). An Investigation on Factors Influencing Students' Acceptance Towards Blackboard Learning System. *Thesis Book.*
14. R.Sudha, P. Premkumar, Lead Removal by Waste Organic Plant Source Materials Review, International Journal of ChemTech Research,2016, Vol.9, No.01 pp 47-57.
15. Kouame Kouame Victor, Meite Ladji, Adjiri Oi Adjiri, Yapi Dope Armel Cyrille, Tidou Abiba Sanogo, Bioaccumulation of Heavy Metals from Wastewaters (Pb, Zn, Cd, Cu and Cr) in Water Hyacinth (*Eichhornia crassipes*) and Water Lettuce (*Pistia stratiotes*), International Journal of ChemTech Research ,2016, Vol.9, No.02 pp 189-195.
16. Senthamil Selvan K, Palanivel M, A Case study approach on Municipal Solid Waste generation and its impact on the soil environment in Dharapuram Municipality, Tamilnadu, India, International Journal of ChemTech Research,2016, Vol.9, No.02 pp 196-204.
17. M. Mohamed Sihabudeen, A. Abbas Ali and A. Zahir Hussain, Removal of Heavy Metals from Ground Water using Eucalyptus Carbon as Adsorbent, International Journal of ChemTech Research ,2016, Vol.9, No.03 pp 254-257.
18. G.BabuRao, M. Krishna Prasad, K. Kishore Kumar, Biosorption of Copper (II) from Aqueous Solution using Oscillatoria.Splendida, International Journal of ChemTech Research,2016, Vol.9, No.03 pp 290-295.
19. A. Naga Babu, G.V. Krishna Mohan and K. Ravindhranath, Removal of Chromium (VI) from Polluted waters using Adsorbents derived from Chenopodium album and Eclipta prostrate Plant Materials, International Journal of ChemTech Research ,2016, Vol.9, No.03 pp 506-516.

*****