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Evaluation of Waste Water Treatment Toward Physical, Chemical, and Biology Parameters in WWTP Hasan Basry Banjarmasin, Indonesia 2016

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ABSTRACT

Wastewater is liquid or filth containing hazardous materials that can endanger human life and other living beings, and also destructive the environment. This research aim to analyze the differences in physical parameters (Temperature and TSS), chemical (pH, BOD, NO3-N, TF-P, oil and fat), and biology (E.Coli) before and after treatment. The research design is observational analytic through cross-sectional approach. The object used is domestic wastewater before and after treatment in WWTP Hasan Basry Banjarmasin of year 2016. This research use paired T-test and Wilcoxon test. The results in WWTP Hasan Basry showed that average value before and after treatment in TSS (p-value=0.000), pH (p-value=0.014), BOD (p-value=0.034), TF-P (p-value=0.000), E.coli (p-value=0.023), temperature (p-value=0.038), NO3-N (p-value=1), oil and fat (p-value=0.858). There is a difference before and after treatment in temperature, TSS, pH, BOD, TF-P and E.Coli. Whereas there was no difference in NO3-N, oil and fat.

Keywords: WWTP Hasan Basry, wastewater, physic parameters, chemical parameters, biology parameters.

INTRODUCTION

Wastewater is liquid or filth from households, industry and other public places that contain hazardous materials that could endanger human life and other living beings as well as disturb the environment. According to the Minister of Environment Regulation No. 5 of 2014 on Wastewater Quality Standard mentioned that domestic waste water is waste water that comes from effort and/or settlement activities, restaurants, offices, commercial, apartments and dormitories. For that in 2005 established the feasibility study the Company Wastewater Banjarmasin city which was then on the 24th of August 2006 stood PD PAL Banjarmasin (Local Company of WTP Banjarmasin).1, 2

Based on data of average incoming water quality examination in PD PAL Banjarmasin 2015, Total Solid Suspense (TSS) in WWTP Hasan Basry is 28.58 mg/l, for that TSS has suitable with the water quality criteria based on Government Regulation 82 of 2001 that is below 50 mg/l. BOD 18.31 mg/l, based on Government Regulation 82 of 2001 BOD has not suitable with water quality criteria namely 3 mg/l. While E.coli amounted to 311,733 amt/100 ml, based on Government Regulation 82 of 2001, E.coli has not suit with water quality of 1,000 amt/ml.3

The high level of domestic WWTP Hasan Basry give a significant impact on the quality of health of people living along the riverbanks as diarrhea and skin diseases. Based on data from 10 diseases in the working area of the WWTP Hasan Basry, there are 343 cases of diarrhea and gastroenteritis and 331 cases of dermatitis.4, 5

Therefore, wastewater treatment needs to be handled properly and sustainably, so that waste water into the body of water is safe for public health and the environment.4 Based on this background, it is necessary to do research on the evaluation of waste water treatment in WWTP Hasan Basry Banjarmasin which include

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temperature, TSS, pH, BOD, TF-P, oils and fats, and E.coli.

**MATERIALS AND METHOD**

This research is an analytic observational with cross sectional study. The object used is domestic waste water before and after treatment in WWTP Hasan Basy Baniyamin 2016. Data processing and analyzing consisted of univariate analysis to explain the distribution of each independent variable and bivariate analysis using paired T-test and Wilcoxon test.

**RESULTS AND DISCUSSION**

The relationship between the temperature, pH, BOD, NO₃-N, TF-P, Oil and Fat, and E.Coli of the waste water treatment in WWTP Hasan Basy can be seen in Table 1 and 2.

**Table 1. Result of Paired-T Test and Wilcoxon Test of Temperature, pH, BOD, NO₃-N, TF-P, Oil and Fat, and E.Coli Before and After Treatment**

<table>
<thead>
<tr>
<th></th>
<th>Temperature</th>
<th>TSS</th>
<th>pH</th>
<th>BOD</th>
<th>NO₃-N</th>
<th>TF-P</th>
<th>Oil and Fat</th>
<th>E.Coli</th>
</tr>
</thead>
<tbody>
<tr>
<td>p-Value</td>
<td>0.038</td>
<td>0.000</td>
<td>0.014</td>
<td>0.034</td>
<td>1.000</td>
<td>0.000</td>
<td>0.858</td>
<td>0.003</td>
</tr>
</tbody>
</table>

**Table 2. Difference of Temperature, pH, BOD, NO₃-N, TF-P, Oil and Fat, and E.Coli Before and After Treatment**

<table>
<thead>
<tr>
<th>Month</th>
<th>Temperature</th>
<th>TSS</th>
<th>pH</th>
<th>BOD</th>
<th>NO₃-N</th>
<th>TF-P</th>
<th>Oil and Fat</th>
<th>E.Coli</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan</td>
<td>26.8</td>
<td>26.9</td>
<td>38</td>
<td>26</td>
<td>6.79</td>
<td>7.01</td>
<td>13.9</td>
<td>10.1</td>
</tr>
<tr>
<td>Feb</td>
<td>27.3</td>
<td>27.5</td>
<td>27</td>
<td>20</td>
<td>6.86</td>
<td>7.60</td>
<td>11.3</td>
<td>10.8</td>
</tr>
<tr>
<td>Mar</td>
<td>28.1</td>
<td>28.3</td>
<td>38</td>
<td>23</td>
<td>6.85</td>
<td>6.93</td>
<td>13.3</td>
<td>10.4</td>
</tr>
<tr>
<td>Apr</td>
<td>27.6</td>
<td>27.8</td>
<td>35</td>
<td>22</td>
<td>6.81</td>
<td>7.05</td>
<td>12.7</td>
<td>9.08</td>
</tr>
<tr>
<td>May</td>
<td>27.8</td>
<td>27.9</td>
<td>26</td>
<td>16</td>
<td>6.81</td>
<td>7.18</td>
<td>10.2</td>
<td>7.83</td>
</tr>
<tr>
<td>Jun</td>
<td>27.0</td>
<td>27.0</td>
<td>35</td>
<td>13</td>
<td>6.70</td>
<td>6.90</td>
<td>14</td>
<td>12.5</td>
</tr>
<tr>
<td>Jul</td>
<td>27.0</td>
<td>27.0</td>
<td>28</td>
<td>7</td>
<td>7.08</td>
<td>7.48</td>
<td>18</td>
<td>14.7</td>
</tr>
<tr>
<td>Aug</td>
<td>27.0</td>
<td>27.0</td>
<td>23</td>
<td>3</td>
<td>7.12</td>
<td>7.42</td>
<td>41.83</td>
<td>63.36</td>
</tr>
<tr>
<td>Sep</td>
<td>28.0</td>
<td>28.0</td>
<td>18</td>
<td>2</td>
<td>7.06</td>
<td>6.78</td>
<td>23.1</td>
<td>21.34</td>
</tr>
<tr>
<td>Oct</td>
<td>28.0</td>
<td>28.0</td>
<td>32</td>
<td>5</td>
<td>7.05</td>
<td>6.94</td>
<td>29.7</td>
<td>24.06</td>
</tr>
<tr>
<td>Dec</td>
<td>27.0</td>
<td>27.0</td>
<td>20</td>
<td>16</td>
<td>7.14</td>
<td>7.28</td>
<td>10.66</td>
<td>10.43</td>
</tr>
<tr>
<td>Avg</td>
<td>27.47</td>
<td>27.53</td>
<td>29.58</td>
<td>14</td>
<td>6.93</td>
<td>7.14</td>
<td>18.32</td>
<td>17.85</td>
</tr>
</tbody>
</table>

Notes:

B: Value Before Treatment
A: Value After Treatment

3.1 Temperature of the waste water treatment in WWTP Hasan Basy
Based on the table 1, the result of Paired-T Test show that p-value=0.038 (p< 0.05). There are a difference between average of temperature value before and after treatment in WWTP Hasan Basry. The temperature increase before and after the treatment are 0.22%. Wastewater generally have a higher temperature than the local air temperature. The effect of temperature can be annoying and leave a chemical reaction aquatic life. Waste that has hot temperatures will disrupt certain biota. The level of oxidation agents is greater at higher temperatures and decay jaring occur at low temperatures.4,6

The concentration of the wastewater temperature are 26.9 to 28.3 °C and it has qualified with criteria of Government Regulation ranged from 24.53 to 30.53 °C. The decomposition occurs due to the concentration of high temperatures. Decomposition resulting odor that bothered. More and smell of the water cause the higher the concentration of microbes and inorganic substances in the water. If the concentration of microbes on the high water and disinfection is not done. Then it is possible for the occurrence of waterborne disease.4,7,8

3.2 Total suspended solid (TSS) of the waste water treatment in WWTP Hasan Basry

Based on the table 1, the result of Wilcoxon Test show that p-value=0.000 (p< 0.05). There are a difference between average of TSS value before and after treatment in WWTP Hasan Basry. The TSS percentage decrease before and after the treatment are 52.68%. TSS is the amount of weight in mg/l and dried mud in the waste water after a filtration with membrane measuring 0.45 microns. Suspended solids consist of particles whose size and weighs less than the sediment, such as clay, certain organic materials, cells of certain microorganisms and so forth.7,9

The concentration of TSS in wastewater undergoes treatment has been qualified, ranged from 2 to 26 mg/l. Where this value suitable with criteria of Government Regulation No.82 Year 2001 under 50 mg/l. The high concentration of TSS will cause turbidity so as to disturb the disinfection process for the absorption of some colloidal bacteria may protect the organism from the disinfectant.5,8,10

3.3 pH of the waste water treatment in WWTP Hasan Basry

Based on the table 1, the result of Paired-T Test show that p-value=0.014 (p< 0.05). There are a difference between average of pH value before and after treatment in WWTP Hasan Basry. The pH percentage increase before and after the treatment are 3%. pH is a measure of the acidity that is determined based on the high and low concentration of hydrogen ions in the water. The pH value of the water is used to determine the condition of acid (hydrogen ion concentration) of waste water. The pH scale ranges from 1-14, pH value range 1-7 including acid conditions, pH 7-14 including alkaline conditions and pH 7 including neutral conditions. pH values either allow organisms to live and grow, as well as biological life is going well. Most microorganisms are sensitive to changes in pH and the like between 7 to 8.5.4,6,11

The concentration of pH in wastewater has been qualified, ranged from 6.78-7.60. The pH value lower than 1-7 mean to be more acidic, so it will be corrosive to the organs of the body when consumed by humans. With the metal content in the water, it will indirectly affect the aesthetics of the water, which cause a sour taste in the water. Besides the waste water has a low pH water becoming corrosive often resulting metal becomes more rusted pipe.9,12,13

3.4 Biochemical oxygen demand (BOD) of the waste water treatment in WWTP Hasan Basry

Based on the table 1, the result of Paired-T Test show that p-value=0.034 (p< 0.05). There are a difference between average of BOD value before and after treatment in WWTP Hasan Basry. The BOD percentage decrease before and after the treatment are 2.56%. BOD is the oxygen requirement for the number of bacteria to decompose (oxidize) all organic substances dissolved or as suspended in water into organic matter is much simpler.6,9

The concentration of BOD in wastewater has been not qualified, ranged from 7.83-63.36 mg/l. Where this value not suitable with criteria of Government Regulation No.82 Year 2001 are under 3 mg/l. If wastes with high BOD values discharged into the waters of the microorganisms contained in the water will begin to degrade organic matter in the waste. This process will spend the oxygen in the water. When oxygen levels decrease would interfere with the survival of fish and other aquatic fauna.8,9,11

3.5 The NO3-N of the waste water treatment in
WWTP Hasan Basry

Based on the table 1, the result of Paired-T Test show that p-value=1.000 (p> 0.05). There are a difference between average of NO$_3$-N value before and after treatment in WWTP Hasan Basry. The NO$_3$-N percentage increase before and after the treatment are 81.8%. Nitrate nitrogen is very soluble in water and are stable.\textsuperscript{11}

Based on the table 2, that the concentration of NO$_3$-N in wastewater has been qualified, ranged from 0.1415-3.6498 mg/l, suitable with criteria of Government Regulation No.82 Year 2001 are 10 mg/l. Nitrate is a form stable compounds and derives its existence from the waste, fertilizers, animal and human feces and so on. High nitrate concentrations can be toxic and can affect people’s health, especially for infants can cause “blue baby”, i.e. the occurrence of a bluish color because of lack of oxygen.\textsuperscript{8,15}

3.6 The TF-P of the waste water treatment in WWTP Hasan Basry

Based on the table 1, the result of Paired-T Test show that p-value=0.000 (p< 0.05). There are a difference between average of TF-P value before and after treatment in WWTP Hasan Basry. The TF-P percentage decrease before and after the treatment are 36.74%. Total phosphate in the waste water, a portion of the phosphate in wastewater society is in the form of inorganic orthophosphate (PO, HPO, H$_2$PO) increase as much as 25% of the total phosphate.\textsuperscript{16}

The concentration of TF-P in wastewater has been not qualified, ranged from 0.726-4.5413 mg/l, not suitable with criteria of Government Regulation No.82 Year 2001 are under 0.2 mg/l. The impact of the high concentration of TF-P is the emergence of sitting due to eutrophication, which it is bad for the raw source for taps and surrounding communities.\textsuperscript{8,17}

3.7 Oil and fat of the waste water treatment in WWTP Hasan Basry

Based on the table 1, the result of Wilcoxon Test show that p-value=0.858 (p> 0.05). There are no difference between average of oil and fat value before and after treatment in WWTP Hasan Basry. The oil and fat percentage decrease before and after the treatment are 20.23%. Basically the oils and fats can create a layer on the surface of the water to form a membrane which inhibits the oxidation process under aerobic conditions.\textsuperscript{3}

The concentration of oil and fat in wastewater has been qualified, ranged from 0-8.5 mg/l and suitable with criteria of Government Regulation No.82 Year 2001 are under 1000 mg/l. The concentration of oil and fats can reduce the concentration of dissolved oxygen in the water due to the fixation of free oxygen to be blocked. As a result, there is an imbalance in the food chain of the water. Oils and fats also affect microbial activity and form a layer on the surface of the waste liquid that inhibit the oxidation process under aerobic conditions.\textsuperscript{8,9}

3.8 Escherichia coli (E.Coli) of the waste water treatment in WWTP Hasan Basry

Based on the table 1, the result of Wilcoxon Test show that p-value=0.023 (p< 0.05). There are difference between average of E.Coli value before and after treatment in WWTP Hasan Basry. The E.Coli percentage decrease before and after the treatment are 79.59%. Escherichia coli practically always present in the digestive tract of animals and humans due to natural Escherichia coli is one of the occupant’s body.\textsuperscript{13}

The concentration of E.Coli in wastewater has been not qualified, ranged from 0-290,000 amt/100 ml and not suitable with criteria of Government Regulation No.82 Year 2001 are under 1,000 amt/100 ml. If the E.Coli found in other parts of the body organ, it will cause serious illness, such as urinary tract infections, bacteremia, and meningitis. It was also reported when E.Coli in the intestine into the bladder, it can cause sinistitis is an inflammation of the mucous membranes of the organ.\textsuperscript{8,10,18}

CONCLUSION

Based on the results of research in WWTP Hasan Basry in Banjarmasin in 2016, there is a difference before and after treatment at temperature (p-value = 0.038), TSS (p-value=0.000), pH (p-value=0.014), BOD (p-value = 0.034), TF-P (p-value=0.000), and E.coli (p-value=0.023). Whereas there is no difference in NO$_3$-N (p-value=1), oil and fat (p-value=0.858). WWTP Hasan Basry should always maintenance and repair, still due to the excess of the standard quality parameters such as BOD, TF-P, and E. coli.
Ethical Clearance: This study approved and received ethical clearance from the Committee of Public Health Research Ethics of Medical Faculty, Lambung Mangkurat University, Indonesia. In this study we followed the guidelines from the Committee of Public Health Research Ethics of Medical Faculty, Lambung Mangkurat University, Indonesia for ethical clearance and informed consent. The informed consent included the research title, purpose, participants’ right, confidentiality and signature.

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REFERENCES


