The Effect of Idle Capacity on The Treatment Efficiency of IPAL PT. X

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Abstract - PT.X has a Wastewater Treatment Plant (WWTP) with a capacity of 10000 m$^3$/day, but the average daily discharge from 2018 until the beginning of 2019 was 4100 m$^3$/day. Based on this, idle capacity occurred at the WWTP of PT.X. This study aims to determine the effect of idle capacity on the quality of wastewater treatment at the WWTP of PT.X. Data collected included the discharge and waste water quality of each unit. Unit sampling was done at four points using the grab sampling method. Sample testing was carried out in a laboratory. The results of sample testing of PT.X WWTP effluent showed that the efficiency for each unit was very small, for the first settling tank unit the parameters of BOD and COD had efficiencies of -123% and -139%, respectively. Based on that, it was concluded that idle capacity affected the removal efficiency for each unit so that processing was not optimal.

1. Introduction

According to the Environmental Service Office of East Java Province in 2016, the river water in East Java was classified as a class II in the index of river water quality, meaning that it was in a polluted condition. The deterioration in quality was due to an increase in the amount of untreated wastewater. Therefore, we need a waste water treatment plant that is owned by each industry both independently and centrally or communally.

PT. X is a company engaged in the management of industrial estates, and one type of business owned by PT.X is wastewater management. Wastewater that enters PT.X WWTP is wastewater from companies in the region and some from outside the region. PT.X uses physical-biological wastewater processes in its wastewater treatment. The WWTP of PT.X uses 5 different types of wastewater treatment unit i.e. first sedimentation basin, grit chamber, secondary settling tanks, oxidation ditch, and the final settling tank.

Wastewater treatment capacity that can be accommodated by the WWTP PT.X is 10,000 m$^3$/day, but up to 2018, the daily average flow of wastewater accommodated by the treatment plant of PT.X was as much as 4100 m$^3$/day. Peak discharge from the WWTP of PT.X itself was 6000 m$^3$/day. Under these conditions, the design capacity was vastly different from the field condition.

The difference between the planned capacity and field condition was then referred to as the idle capacity. Based on this condition, we attempted to find the impact of the idle capacity on wastewater treatment effluent quality in each unit. So the purpose of this study is to find out the impact of idle capacity based on the technical aspects of wastewater treatment.
2. Materials and Methods
Wastewater samples used in this study were wastewater samples from the influent and effluent of each WWTP unit. Sampling was done with grab sampling method and the time of sample taking was adjusted to the residence time of each unit. Sample analysis was performed in a laboratory using four parameters namely BOD, COD, and TSS. Other supporting data collected included daily wastewater discharge during the period of 2018, and water flow data were used to find the minimum, average, and maximum discharge into the WWTP in the year 2018.

3. Results and Discussion
The wastewater management system of PT. X uses physical-biology processes for treatment, so the units do not involve the addition of chemicals. The WWTP area of PT. X has a regulation stating that wastewater that can enter the PT. X WWTP is only wastewater with specifications that have been adjusted to the ability of biological physical treatment. Therefore, the influent of PT. X WWTP already has a low concentration of metals that is safe to be discharged into the river, in other words, the concentration of metals that enter the treatment of PT.X wastewater has met the East Java Governor's Regulation No. 72 of 2013. The following Figure 1 shows the units used by PT.X as well as the sampling points of each unit.

![Figure 1. Sampling point of WWTP's](image)

Based on the conditions that occur at WWTP, there are units that are not operated to reduce the impact of idle capacity. These said units are 2 oxidation ditches, while the other units are operated according to the amount. The PT. X WWTP has one first settling tank, two grit chambers, one secondary settling tank, four oxidation ditches, and one final settling tank.

The sampling points used were as many as four sampling points, namely the influent, first settling tank unit, grit chamber, primary settling tank, and final settling tank. Laboratory test results in the form of efficiency results for each unit are listed in Table 1. Removal efficiency calculation used the following formula.

\[
\text{Removal Efficiency} = \frac{\text{influent concentration} - \text{effluent concentration}}{\text{influent concentration}} \times 100\%
\]

| Unit                  | TSS  | BOD  | COD  |
|-----------------------|------|------|------|
| First Settling Tank   | -60% | -139%| -123%|
| Grit Chamber          | -11% | -19% | -20% |
| Secondary Settling Tank | 10%  | -19% | -19% |
| Oxidation Ditch-Final Settling Tank | 92%  | 96%  | 94%  |

Table 1. Removal efficiency of WWTP
Based on laboratory test results, it was found that the efficiency of each unit was almost entirely negative. The decrease in efficiency was influenced by the residence time that was too long so that the process that occurred experienced disruption (Tillman G. M., 1996). Idle capacity caused the flow of each unit to take longer than the actual time required so that the efficiency of the process was not optimal. Process efficiency was not optimal because the microorganisms involved experienced developmental problems with inappropriate residence times. The efficiency of the process was of poor quality.

In the wastewater treatment process, the residence time for each unit and the maintenance of the unit is very influential (Metcalf & Eddy, 2014). Too long residence time can cause unwanted microbes’ growth to increase. Increasing number of microbes would also disrupt the process because too many microbes with insufficient food will cause the microbes to die, hence the BOD and COD values in the wastewater would increase (Said & Utomo, 2007).

In contrast, the removal efficiency for all parameters in the final settling tank was very high because the wastewater had been through the process in oxidation ditch, and on the whole the unit was capable of removing impurities well using the aeration process. However, in the field operation, the time required by the unit to obtain high efficiency was very long because effluent wastewater formed sludge that was difficult to be deposited. This process occurred because non-filamentous bacteria were formed in the oxidation ditch because the aeration time was too long.

4. Conclusion
Based on the description above it can be seen that the idle capacity in technical aspects affects the quality of wastewater effluent of each unit. Removal efficiency values for all parameters of the wastewater were of a low value, indicating the processes that occurred were not optimal. Idle capacity that occurs at PT. X WWTP must be immediately handled to achieve maximum process efficiency. One step that can be done is to do an overall evaluation of the WWTP.

References
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