Study of the Wastewater Treatment Plant at Industrial Estate Rungkut Surabaya (SIER), East Java, Indonesia

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Abstract. An evaluation was done on the domestic and non-domestic wastewater treatment plants (WWTPs) at PT. SIER. The purpose of this study is to analyze three aspects of the WWTPs i.e. technical aspect, institutional aspect and environmental aspect. One of the methods used was a combination of physical methods (primary treatment), biological methods (secondary treatment) without using or adding chemicals. Another was conducting a study of the adequacy of human resources management and installation manager at PT. SIER. In addition, environmental reviews of the management and monitoring plan to anticipate impacts of the company WWTP were also conducted. The results showed that the maximum flowrate was 10,000 m³/day which is equal to 11.57 L/s. The average discharge was 5,672 m³/day, equal to 6.65 L/s, while the existing flowrate was 7,000 m³/day, equal to 8.18 L/s. Results of the study provide recommendations of technical and non technical management and maintenance of the WWTP.

Keywords : Aspects, Evaluation, Discharge, Maintenance, Methods, SIER, WWTP

1. Introduction
Industrial wastewater treatment has become a current issue in the era of industrialization. Therefore, regulations on environmentally friendly industrial development are important [1]. Waste is not only generated at the end of the production process but also since the beginning of it. Thus, waste treatment must start early in the production process. This means that waste management must be carried out thoroughly from upstream to downstream because if this is not done then the threat of pollution will be fatal [2].

This study examines three aspects of domestic and non-domestic wastewater treatment plants (WWTPs) at PT. SIER. The technical aspect discusses about the design capacity of each WWTP building unit according to the existing ideal capacity based on standard method [3]. Environmental aspect examines the amount of pollution load/concentration of various parameters of the influent and effluent at each unit, the results of which will be compared with existing quality standards based on Minister Regulation No. 05/2012. The institutional aspect considers the workload that exists in PT. SIER WWTP as well as from the operational procedure system [4]. Physical processing of WWTP is used to deposit, screen and remove particles of sand or discrete particles, and also larger objects that float or sink which can inhibit and even damage the pump's performance in further processing. [5].

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2. Purpose of this study
Study of the technical aspect evaluated the wastewater in Surabaya Industrial Estate Rungkut, East Java, Indonesia. Moreover, the environmental aspect evaluation studied the wastewater based on standard method of discharge to the environment. Also, the institutional aspect evaluation analyzed the organization structure.

3. Methodology
The preliminary stage was observation in the field, then collection of data of the wastewater. Moreover, sampling of data such as water flowrate and pH was done. After that, collection of data from SIER company such as map, number of industries there, collection flowrate per day, efficiency of day work. The methods of grab sampling was directly used once at the wastewater treatment. Sampling preparation was done by sampling liquid from the wastewater treatment in Surabaya Industrial Estate Rungkut (SIER), East Java, Indonesia. Samples were taken from the primary settling tank, oxidation ditch, secondary sedimentation tank and effluent tank.

4. Results and Discussion
On the technical aspect, the design capacity of the Wastewater Treatment Plant in SIER Company was 10,000 m³/day, and the average use of industrial wastewater was 6,734 m³/day, while the wastewater treated at SIER was 5,672 m³/day. Discharged water was 5,672 m³/day or 65.64 L/s. From the institutional aspect, the company had improved management systems of standard operational procedures (SOP) in accordance with regulations set by the government. The environmental aspect is guided by Ministerial Decree number 68 of 2016, which says parametric analysis should be conducted regularly.

The institutional study aims to explain the institutions involved in the WWTP industrial estate in SIER, the institutional structure of human resources in the management of wastewater management at PT. SIER. An institution is an order and pattern of relations between community members or mutually binding organizations that can determine the form of relations between humans or between organizations that are accommodated in an organization or network and are determined by limiting and binding factors in the form of norms, codes of ethics, formal and informal rules to control social behavior and incentives to cooperate and achieve common goals. An institutional analysis includes regulatory aspects that are guided by government regulation laws that can be applied where regulations are accepted. In addition, concerning environmental reviews, the management had a monitoring plan to anticipate the impact in the WWTP of the company. Table 1 shows all parameters and the design criteria.

| Parameter | Unit | Result |
|-----------|------|--------|
| pH        | -    | 6,7    |
| COD       | mg/L | 805    |
| BOD       | mg/L | 470    |
| TSS       | mg/L | 430    |
| NH3       | mg/L | 43     |

Table 2 shows that, if reviewed technically, the value of overflow rate was smaller than the design criteria. This did not significantly affect the efficiency of eliminating pollutants. However, from the economical point of view, this condition would be uneconomical because the actual dimensions needed are smaller than the existing. The following tables show the analysis results of each wastewater treatment plant unit by criteria design and their compliance when compared with standard values.
### Table 2. Result of Primary Settling Tank Analysis

| Parameter                  | Standard Range | PST Analysis Result | Compliance |
|----------------------------|----------------|---------------------|------------|
| HRT (hour)                 | 1.5 – 2.5      | 1.5                 | ✓          |
| OFR Qave* (m³/m².day)      | 30 – 50        | 14                  | x          |
| OFR Qpeak* (m³/m².day)     | 80 – 120       | 25                  | x          |
| Nre*                      | < 2000         | 10,075              | ✓          |
| NFr*                      | > 10^{-5}      | 1.95 x 10^{-6}      | ✓          |
| Vsc (m/second)*           | > 3 x 10^{-5}  | 0.2141              | ✓          |
| pH                        | 6 – 9          | 6.8                 | ✓          |
| Parameter removal efficiency** | Standard Range | Analyzed Removal | Compliance |
| TSS %                     | 50 – 65        | 54                  | ✓          |
| BOD %                     | 30 – 40        | 43                  | ✓          |
| COD %                     | 30 – 40        | 49                  | ✓          |

### Table 3. Result of Oxidation Ditch Analysis

| Parameter                  | Standard Range | OD Analysis Result | Compliance |
|----------------------------|----------------|--------------------|------------|
| HRT (hour)*                | 18 – 36        | 17*                | ✓          |
| F/M ratio L/day*           | 0.05 – 0.3     | 0.17*              | ✓          |
| I organic (kg BOD/m³ day)* | 0.1 – 0.6      | 0.56               | ✓          |
| Efficiency BOD (%)         | 80 – 93        | 93                 | ✓          |
| Efficiency COD (%)         | 80 – 93        | 93                 | ✓          |
| pH                        | 6 – 9          | 6.8                | ✓          |
| MLSS (mg/L)               | 3000 – 6000    | 3100               | ✓          |

### Table 4. Result of Effluent Analysis

| Parameter                  | Standard Range | Effluent Analysis Result | Compliance |
|----------------------------|----------------|--------------------------|------------|
| HRT (hour)*                | 1.5 – 2.6      | 2                        | ✓          |
| OFR Qave (m³/m².day)*      | 25 – 30        | 30                       | ✓          |
| OFR Qpeak (m³/m².day)*     | 50 – 70        | 60                       | ✓          |
| pH                        | 6 – 9          | 7                        | ✓          |

5. Conclusions
The result of this was determined from each one of the aspects. The technical aspect determined the characteristic of the wastewater, the environmental aspect compared test wastewater quality results with one decree law, and the institutional aspect examined the structure of the organization.

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