Planning of Eka Hospital Pekanbaru wastewater recycling facility

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Abstract. The Ministry of Public Works No. 06 2011 required the large scale of water to conserve the water resource, Eka Hospital Pekanbaru have to improve the sewage treatment plant through the wastewater recycling. The effluent from the plant can be used to landscape gardening and non-potable activities. The wastewater recycling design was done by analyzing the existing condition of the sewage treatment plant, determine the effluent quality standards for wastewater recycling, selected of alternative technology and processing, design the treatment unit and analyze the economic aspects. The design of recycling facility by using of combination cartridge filters processing, ultrafiltration membranes, and disinfection by chlorination. The wastewater recycling capacity approximately of 75 m$^3$/day or 75% of the STP effluent. The estimated costs for installation of wastewater recycling and operation and maintenance per month are Rp 111,708,000 and Rp 2,498,000 respectively.

1. Introduction

Water is a vital need for human life, so the availability of water becomes the most attention in various activities. Water have to follow the quality aspects, quantity, and continuity is needed for meet human needs that continue to increase, so it takes conservation efforts of water resources. Conservation of water resources is done through the protection and conservation of water resources, water preservation, and quality management and control of water pollution. Every person or business entity utilizing water resources is encouraged to conduct water preservation through water saving movement and controlling groundwater use by stakeholders by recycling liquid waste into raw water [1].

The recycling of liquid waste into clean water needs to be carried out by large groups of water users such as hotels, hospitals, commercial and industrial areas to maintain the sustainability of water use and efforts to minimize waste disposed into the environment [2]. Liquid waste recycling results can be utilized for agricultural irrigation or landscaping, industrial uses, groundwater replenishment, clean water supplies, and for non-potable uses such as flushing and fire water [3].

Eka Hospital as one of the hospitals in Pekanbaru City. The use of groundwater should be regulated and supervised so the existing of the underground water as water resources still support and can anticipate the demands of sustainable development [4]. Planning of a liquid waste recycling system can maintain the availability of groundwater and as a form of responsibility for the utilization of water resources by stakeholders [1].

Eka Hospital Pekabaru has conducted liquid waste treatment through Sewage Treatment Plant (STP) so that the waste discharged into the environment fill in the quality standard specified in PERMEN LH No.5 year 2014 [5] on Quality Standard of Waste Water for Business and/or Activity of Health Service Facility. Waste water treatment at Eka Hospital is conducted in Sewage Treatment
Plant (STP) physically, chemically, and biologically with processing capacity of 235 m$^3$/day. Liquid waste generated from various hospital activities is channeled into the chamber inlet, whereas liquid waste from kitchen, cafes, restaurants and sources that produce oil and fat is flowed to the grease trap. The liquid waste is then channeled into the gravitational equalization basin through the overflow channel.

Wastewater treatment is also equipped with biosystem bios tub or biocontrol tub it basically water quality control boiler using biological indicator. Based on the data of the effluent quality test results on effluent STP Eka Hospital shown that the processed water are filled in the quality standard, so it has the potential to be developed and utilized as a source of recycled water.

2. Methodology

2.1. Research sites
The research has been done on EKA Hospital in Pekanbaru City, Riau Province.

2.2. Types and data sources
Secondary data obtained from the Eka Hospital Pekanbaru was used as the planning location to know the existing condition of the planning area. The data was used to determine the quality of liquid waste. Secondary data are also obtained from manufacturers of processing units used as a reference in conducting economic analysis. The required data can be seen in Table 1.

| Data Description                      | Data Type       | Data source                              |
|---------------------------------------|-----------------|------------------------------------------|
| Location characteristic               | Secondary data  | Company data, survey identification, literature |
| Clean water needs                     | Secondary data  | Company data, survey identification, literature |
| Capacity and dimension of Existing WWTP | Secondary data  | Company data, survey identification, literature |
| Debit and characteristic liquid waste | Secondary data  | Company data, survey identification       |
| Recycle needs                         | Secondary data  | interview, survey identification          |
| Monetary Funds                         | Secondary data  | Treatment unit factory                    |

2.3. Data collection technique
The data was used as source of planning data. Processing and data analysis based on technical aspects to determine the form of processing, it can be applied in Eka Hospital Pekanbaru. Selection of processing form with technical aspect analysis consisted of:
1. Existing Sewage Treatment Plant (STP) condition analysis
2. Determination of water quality targets from recycling plants
3. Selection of Recycling Installation processing unit

The recycling installation has been done by analyzing STP condition. The analysis has been done by knowing the efficiency of pollutant removal by STP, and base on the efforts was used to optimize STP performance. Based on the results of the analysis, technical and non-technical advice is given to
improve the condition and quality of the effluent STP in order to support the planned recycling plant planning.

The STP effluent condition determined the type of advanced processing unit and the type of pre-treatment required. The analysis has been done by examining the results test of each sample parameter. Recycled water have to established the standard quality. Recycled water quality requirements are adjusted with reference to Government Regulation No.82 of 2001 [6] on Water Quality Management and Water Pollution Control and United States Environmental Protection Agency (U.S.EPA).

The standard on PP 82/2001 is used as a consideration of the effluent quality standards of the Recycle Installation in accordance with the water quality standards in Indonesia, while the USEPA standard is chosen because Indonesia does not have specific quality standards for recycled water use, and some countries that have not has a quality standard on water recycling has been pushed to this standard [3].

| Parameter      | Landscape and Parks | Non-Potable Needs |
|----------------|---------------------|-------------------|
| pH             | 6-9                 | 6-9               |
| BOD            | ≤ 30 mg/l           | ≤ 10 mg/l         |
| TSS            | ≤ 30 mg/l           | -                 |
| Turbidity      | -                   | ≤2 NTU            |
| Coliform/100 ml| 0                   | 0                 |
| Residu Cl2     | ≤ 1 mg/l            | ≤ 1 mg/l          |

3. Discussion

3.1. Recycle unit design
The targeting of recycled water quality targets is based on the results of effluent quality measurements and used as parameters for planning the recycling of wastewater, as recycling plants are planned by utilizing the output from STP. The test results are compared with Government Regulation No.82 of 2001 [6] on the standard of clean water quality class II. The STP effluent test results are also compared with the recycled water quality standard by U.S.EPA for landscape irrigation and non-potable activities because Indonesia does not have a quality standard for recycled water. The U.S.EPA standard is selected because Indonesia does not have a specific quality standard for recycled water use, and some countries that do not have a quality standard on water recycling have proceeded to this standard [7].

The comparison of recycled water quality standards based on PP No.82 of 2001 [6] and U.S. EPA Guidelines for landscape and non-potable needs as a consideration of the effluent standard of recycled water can be seen in Table 3.
Table 3. Recycle water standard

| Parameter      | Value | Efluent STP quality | PP 82/2001 Class 2 | USEPA Landscape and parks [6] | USEPA Non Potable needs [8] |
|----------------|-------|---------------------|--------------------|-------------------------------|----------------------------|
| pH             | -     | 7.44                | 6-9                | 6-9                           | 6-9                        |
| BOD mg/l       | 70.2  | 3                   | 30                 | 10                            |
| COD mg/l       | 118   | 25                  | td                 | td                            |
| TSS mg/l       | 42    | 50                  | 30                 | td                            |
| Residu Cl2 mg/l| -     | td                  | 1                  | 1                             |
| Oil and Fat mg/l| 1    | 1 x 10-3            | td                 | td                            |
| MBAS mg/l      | 0.474 | 0.2 x 10-3          | td                 | td                            |

The installation planning is equipped with pre-treatment using a filter cartridge to extend the membrane of life, and the disinfection process in an attempt to optimize STP conditions for reducing the total number of coliforms. Re-planning of disinfection process has been done by placing disinfection process after treatment with ultrafiltration membrane, and disinfecting was done by adding chlorine and injection is shown in reservoir. Liquid waste processing and recycling plants is shown in Figure 1.

3.2. Ultrafiltration membrane design
The liquid waste to be recycled is pumped from the effluent tub to the ultrafiltration unit. The ultrafiltration membrane is a micron scale filter that can filter solids and turbidities up to a size of 0.005 - 0.2 μm [8]. Pretreatment (pre-treatment) is necessary to protect the membrane from damage and blockage. Micro screening or pre-filtration will exclude larger size particles of 0.1-0.5 mm [9].

3.3. Disinfection process design
The main purpose of the disinfection process is to kill pathogenic bacteria that pass from wastewater treatment units. In this planning chlorination is used with the use of chlorine as a disinfectant. Chlorination process is done post-chlorination, that is after the water undergoes the processing.

3.4 Container tub design (reservoir)
Reservoirs are planned to accommodate recycled water before being used for garden irrigation or non-potable activities. Recycled water was used for the use of irrigation parks with an area of 1890 m², and non-potable needs include vehicle wash water, washbasin carts, backwash tube filtration at STP, and fountains with a discharge of ± 75 m³.
3.5. Budget plan
The Budget plan is undertaken for predicting the cost for initial investment and operating costs as well as maintenance of waste water recycling installations. Economic analysis is also done by calculating the costs required for the operational and maintenance costs of the planned recycling plant. The required operating costs are calculated on the basis of electricity consumption and the required chemicals. The initial investment cost required for the construction of this recycling plant is Rp 111,708,000. Initial investment costs can be cheaper or higher than the budget design offered, as this depends on the conditions in the field. Operational and maintenance costs incurred are Rp 2,498,000,- per month. Operational and maintenance costs can be reduced, if the unit replacement period is longer than expected.

Figure 1. Sewage treatment plant (STP) and recycle unit plan.
4. Conclusion
Based on the results, it can be concluded that the process of recycling liquid waste was planned by utilizing membrane technology. The planned recycling installation scheme is processing with filter cartridge, ultrafiltration membrane, disinfection process with chlorination method, and reservoir with production capacity of 75 m³/day. Liquid waste recycling process required 3 units of filter cartridge, 6 units of ultrafiltration membrane, disinfecting process with CaO(Cl)₂ injecting using dosing pump, and 1 reservoir unit to hold recycled water before used for garden irrigation and non-potable requirement.

Estimated cost of initial investment for the construction of waste water recycling installation amounted to Rp 111,708,000,- covering the cost of procurement of materials, equipment, and labor wages. The estimated operational and maintenance costs required per month amounted to Rp 2,498,000,- which includes electricity costs, chemical purchase costs, and membrane replacement and other maintenance costs.

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