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Cleaner Production Strategy As A Supporting Analysis of Environmental Impact on Drinking Water Treatment Process Using Life Cycle Assessment Approach

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ABSTRACT

The Drinking Water Treatment Plant has an impact on the environment due to its production process. This emerging impact can be studied strategically by carrying out the concept of cleaner production. Cleaner production is an integrated environmental management effort in a series of product life cycles. The output of this concept is to provide alternative management that is environmentally friendly. The principle of cleaner production is in line with the Life Cycle Assessment. This study examines data on drinking water treatment plants to provide certainty before being analyzed using Life Cycle Assessment (LCA). LCA is an approach method that can be used to identify and analyze environmental impacts resulting from all stages of the product life cycle to know which parts have the greatest impact on the environment.

Keywords: Cleaner Production, environmental impact analysis, drinking water treatment process, life cycle assessment

Introduction

The drinking water treatment plant is one of the public facilities that significantly negatively impact the environment. This is based on the fact that drinking water treatment plants use chemicals in coagulants and disinfectants and use large amounts of electrical energy. The high amount of electricity consumption has the potential to produce more carbon dioxide. Therefore, the drinking water treatment plant under the auspices of the PDAM (Perusahaan Daerah Air Minum) must be responsible for the environmental impacts resulting from its production process activities in various aspects (Hischier et al., 2010). There is a special approach that can be used to identify and analyze the environmental impacts that occur, namely the Life Cycle Assessment (LCA) method. LCA can estimate the cumulative environmental impact resulting from all stages of the product life cycle, so it will be known which parts have the greatest impact on the environment (Yola, 2013; Roesnbaum, 2018). With this LCA method, it is hoped that it can provide recommendations for alternative management that are environmentally friendly (Acero et al., 2014).

Research Method

Early stages of research

The first phase is the determination of the scope. The scope analyzed is the gate to gate, namely all units in the drinking water treatment process. The drinking water treatment process at Siwalanpanji consists of two treatments: conventional treatment consisting of intake unit, pre-

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chlorination, pre-sedimentation, aeration, coagulation, flocculation, sedimentation, filtration, reservoir. At the same time, non-conventional treatment starts from intake, pre-sedimentation, ultrafiltration, and reservoir.

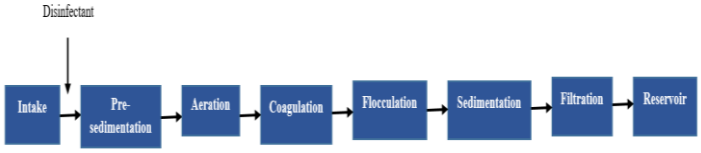

Figure 1. Scope of conventional process

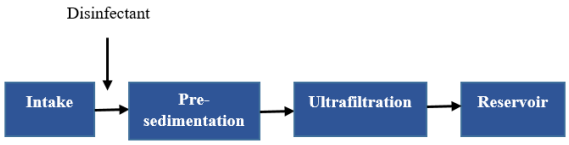

Figure 2. Scope of non-conventional process

Data analysis stages

The drinking water treatment process flow at the Siwalanpanji Water Treatment Plant can be observed in Figures 3 and 4 below.

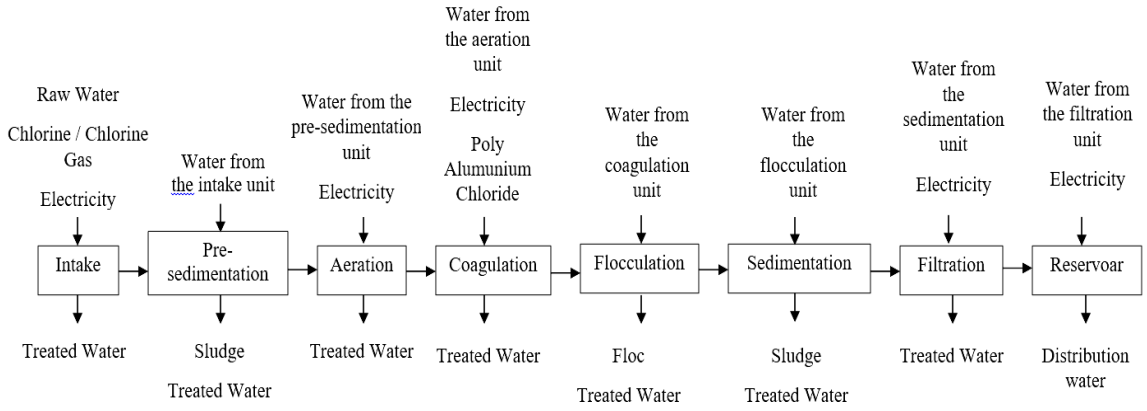

Figure 3. Conventional processing flow

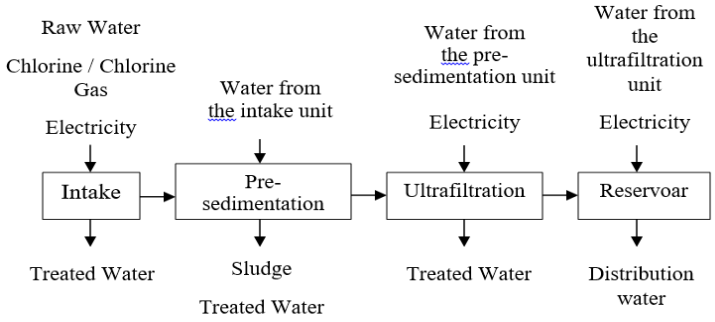

Figure 4. Non-conventional processing flow

Some of these units include:

1. Intake
   Intake is a building that taps raw water channeled to a drinking water treatment plant for further processing into drinking water according to quality standards. The raw water tapped at the Siwalanpanji WTP comes from the Buduran Afvoer.
2. Pre-sedimentation
   Pre-sedimentation is a building that deposits large amounts of coarse particles (discrete particles) or mud.
3. Aeration
   Aeration is adding air or oxygen to water by bringing water and air into close contact by providing fine bubbles of air and allowing it to rise through the water.
4. Coagulation
   Coagulation is a rapid stirring process by adding several chemicals (coagulants) to the water. This causes the union with other particles and forms larger particles called floc nuclei. In this process, there is the destabilization of particles and colloids as a result of rapid stirring and the addition of coagulant.
5. Flocculation
   Flocculation is a slow stirring step that follows a fast stirring unit to accelerate the rate of collision of particles or floc cores.
6. Sedimentation
   Sedimentation separates suspended solids in water by using precipitation by gravity to separate suspended particles contained in the liquid.
7. Filtration
   Filtration is the process of filtering water deposited and removing suspended particles using filter media to produce drinking water of good quality and according to quality standards.
8. Ultrafiltration
   Ultrafiltration is a membrane with a pore size of less than 0.1 micron operated at a pressure of 30-90 psi which has the ability to separate viruses, proteins, particulates, colloids, and silica.
9. Reservoir
   A reservoir is a building to accommodate processed water in drinking water treatment plants which will then be distributed through distribution pipes

In general, the input data used in the drinking water treatment process are data on raw materials, data on electrical energy needs, and data on the use of chemicals. The chemicals used are Poly Aluminium Chloride (coagulant), Chlorine Gas, and Chlorine (disinfectant). Energy consumption comes from pumps and blowers. Every day, the electricity demand used can reach 3142.64 kWh. The use of chemicals used PAC 1518.88 kg, chlorine gas 228.93 kg, Chlorine 29.51 kg.

Result and Discussion

The cleaner production concept strategy applied in drinking water treatment plants using the life cycle assessment approach serves to determine the environmental impacts arising from the drinking water treatment process and can provide management alternatives that are more environmentally friendly than before. In the scope of the gate to gate, all input and output data of the production process is needed because it will affect the results of the analysis. The wider the scope selected, as the cradle to grave, the better the results will be. Therefore, it is hoped that future research to choose a wider scope to achieve a cleaner production strategy from drinking water treatment plants in Indonesia.

Conclusion

All data on the gate to gate scope method of drinking water treatment at Siwalanpanji Water Treatment Plant can be used to analyze environmental impacts that occur with a wider scope using the life cycle assessment approach.

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