Analysis of effectiveness aeration time with biofilter and ras combination systems on bulking parameters

I A Mursalim¹, M S Pallu², M Selintung³ and I R Rahim⁴
¹Doctoral Civil Engineering Student, Civil Engineering Department, Universitas Hasanuddin, Indonesia
²Civil Engineering Department, Universitas Hasanuddin, Indonesia
³Environmental Engineering Department, Universitas Hasanuddin, Indonesia
E-mail: isye.aryani@gmail.com

Abstract. One of the environmental pollution of the waters is caused by the disposal of industrial liquid waste that has not been treated properly. The solution to overcome this problem is controlling the processing of industrial wastewater to produce a good effluent, secondary treatment is the heart of wastewater treatment. The problem that often occurs is bulking. Various research books have been done. One of the previous studies by Aryani M.I (2004) [1]. The optimal aeration time is 3 hours to eliminate bulking of mixed liquor caused by S.Natans bacteria. This research is a continuation of research and aims to analyze the effectiveness of aeration time with a combination of biofilter systems and variations of Return Activated Sludge (RAS) against the bulking parameters. The method used is an experimental method in the laboratory. The research design uses a completely randomized design. The test that will be carried out is a time test for giving aeration to find out the optimal time in handling bulking with a combination of biofilter systems and variations in the Return Activated Sludge (RAS) against the bulking parameters namely SVI (Sludge Volume Index), DO, MLSS (Mixed Liquor Suspended Solid), BOD, pH & Temperature. The expected result is optimal time effectiveness with a combination of biofilter systems and Return Activated Sludge variations on bulking parameters to handle bulking.

1. Introduction
Control at the stage of waste management is very important. The important stage in waste treatment is secondary treatment. The problem that often occurs is the formation of bulking on mixed liquor. Bulking can cause unsettleable sludge and prevent activated sludge from becoming larger floc so that it inhibits the sludge deposition process and will reduce the overall effluent quality (Davis & Cornwell (1991)[2].

Based on the theory and previous research has been done, including analyzing and classifying the types of bacteria that cause bulking, 28 species were obtained from 63 isolates collected from six culture media by Decai Jin et al (2011)[3]. Another study is to find an intelligent method with an algorithm program to detect the presence of bulking on activated sludge by Hong-Gui Han et al (2018)[4]. Research on bulking control strategies using Bench-scale tests and full-scale applications by Niansi Fan et al (2018)[5]. Research on Review of Technical Aspects of Choosing Biofilter Media for Wastewater Treatment by Nusa Idaman Said and Ruliasih (2005) [11]. Research on the effect of mixed liquor aeration time on SVI, DO and MLSS to handle bulking in secondary processing, resulted in an optimal time of 3 hours by Aryani M.I. (2004)[1].

In this study, we will test the time of aeration to determine the optimal time in handling bulking with a combination of biofilter systems and variations in the Return Activated Sludge (RAS) against the
bulking parameters namely SVI (Sludge Volume Index), DO, MLSS (Mixed Liquor Suspended Solid), BOD, pH & Temperature. The method used is an experimental method in the laboratory, research design using a complete random design.

Figure 1. Secondary Processing.

Figure 2. Bulking filament.

Figure 3. Biofilter film.

2. Methodology

2.1. Location
The materials used in this study are samples of Industrial wastewater and activated sludge samples, originating from PT. Makassar Industrial Estate (KIMA) in South Sulawesi, a 1 cm diameter biofilter film was obtained from Jakarta - Indonesia.

2.2. Experimental program
Mixed liquor sample test was carried out before and after the experiment to determine the value of the SVI (Sludge Volume Index), DO, MLSS (Mixed Liquor Suspended Solid), BOD, pH & Temperature parameters for bulking. The number of test specimens is shown in Figure 1.
### Table 1. The number of specimens.

| Mixed Liquor (ml) | Biofilter (pc) | Number of specimens | Aeration Time (hour) | Number of specimens |
|-------------------|----------------|---------------------|----------------------|---------------------|
| 1000              | 300            | 3                   | 1                    | 3                   |
|                   |                |                     | 2                    | 3                   |
|                   |                |                     | 3                    | 3                   |
|                   |                |                     | 4                    | 3                   |
| Total             |                | 3                   |                      | 12                  |
|                   |                |                     |                      | 15                  |

The parameters are SVI (Sludge Volume Index), DO, MLSS (Mixed Liquor Suspended Solid), BOD (Biological Oxygen Demand), pH & Temperature. In addition, a graph is made that connects mixed liquor content with each of these parameters. From the chart made, the optimal level can be determined by the addition of biofilter to the bulking parameters, namely the number of biofilter in a certain range in a mixture with Mixed liquor (a mixture of waste and activated sludge). In this study, the optimal level of Aeration obtained will then be called the Optimal Aeration Rate with a combination of biofilter and return activated sludge systems.

Immersion of biofilter in mixed liquor for 2 weeks, before the experiment was carried out, was to produce biofilter film as a medium for the process of eliminating bulking in mixed liquor. The duration of the aeration process is 1, 2, 3 and 4 hours in the current liquid waste temperature and room temperature. Bulking parameter test before and after the experiment will be performed for each specimen that has a different aeration duration to get the optimal value of the time of aeration.

### 3. Result and discussion

#### 3.1. Bulking Parameters

It is expected that the results of this study will find one way to handle bulking based on bulking parameters by means of aeration using a combination of biofilter and Return Activated Sludge systems that can be effective in bulking handling process time, so that it can become a theoretical basis and reference in analyzing and determining the next design in handling bulking.

Bulking parameters can be calculated using the formula:

- **Sludge Volume Index (SVI)**

  SVI can be calculated with the following equation:
  
  \[
  SVI = \frac{\text{the volume of sludge settles (ml/l)} \times 100}{\text{MLSS (mg/l)}}
  \]  

- **Dissolved Oxygen (Dissolved Oxygen / DO)**

  \[
  DO = \frac{a \times f \times 1000 \times 0.2}{v - 2}
  \]

  wherein: DO = Amount of dissolved oxygen (mg/l) 
  
  \[
  a = \text{Na}_2\text{S}_2\text{O}_3.5\text{H}_2\text{O} \text{ titration volume}
  \]
  
  \[
  f = \text{number of standardization of solution Na}_2\text{S}_2\text{O}_3.5\text{H}_2\text{O}
  \]
  
  \[
  v = \text{volume of the incubation bottle (ml)}
  \]

- **MLSS (mixed liquor suspended solid)**

  \[
  \text{MLSS} = (A + B) \times \frac{1000}{v}
  \]
wherein: 
\[ A = \text{filter paper weight + suspended residue (mg)} \]
\[ B = \text{filter paper weight (mg)} \]
\[ C = \text{Volume of wastewater sample} \]

- **BOD (Biological Oxygen Demand)**

\[ \text{BOD} = (\text{DO}_1 - \text{DO}_5) \times P \]  \hspace{1cm} (4)

wherein: 
\[ \text{DO}_1 = \text{Number of DO on the first day (mg / lt)} \]
\[ \text{DO}_5 = \text{Number of DO on the fifth day (mg / lt)} \]
\[ P = \text{Dilution} \]

4. Conclusions

Expectation of research results. The conclusions expected from this research are Optimal aeration time with a combination system of biofilter and Return Activated Sludge (RAS) significantly affects the bulking parameters in handling bulking.

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