EFFECT HYDRAULIC AGITATION USING ANAEROBIC BIOFILTER FOR TREATED DOMESTIC WASTEWATER

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ABSTRACT

The objective of this study was to investigate the efficiency the TSS reduction of domestic wastewater by using hydraulic agitation in anaerobic biofilter. The reactor consists of four columns. Each column has a sampling point. Upflow direction was operated in reactor in order to maximize the hydraulic agitation. Gravel was used as filter media to support the growth of biofilm. The reactor treated wastewater of FST Airlangga University canteen which contains 8237.463 mg/l of TSS. Flow used during processing was 0.3 ml/min. Sampling TSS were performed on days 7, 14, 21, and 28. The results showed that the efficiency of TSS were 64.57%, 76.16%, 94.23% and 98.46% respectively. The average TSS removal was 83.36%.

Key words: *TSS, domestic wastewater, hydraulic agitation, hybrid anaerobic reactor*

INTRODUCTION

One of domestic waste water effluent quality standard is The Total Suspended Solid (TSS). According to Sugiharto (1987) total suspended solids are suspended materials (diameter > 1 μm) which is retained on the millipore filter with 0.45 μm pore diameter. TSS is a major cause of inorganic materials such as ions which are common in the waters. For example, wastewater often contains molecules of soap, detergents and water-soluble surfactants, such as the domestic waste water.

Anaerobic biofilter using gravel filter media is used as a tool for domestic liquid waste treatment which base on the principle processes without oxygen. This is an alternative treatment for biological waste treatment residual activity of human activity, whether in industrial activities, commercial activities or domestic activities using the activity of microorganisms.

Some advantages of anaerobic treatment are the production of biogas, produce a little sludge produced, does not require a large area and does not require energy for aeration. While the shortage of anaerobic, microorganisms are growing slower than in the aerobic process (Indriyati, 2007).

One of the modifications in the process of anaerobic digestion is done by combining the attached growth biomass and suspended material in a bioreactor called hybrid reactors. This design has advantages in the maintaining of concentration of biomass with a high amount in the reactor that is expected to improve the efficiency of waste water treatment with high concentrations.

Anaerobic biofilter in this study has the same working principle with Hybrid Anaerobic Baffled Reactor (HABR). HABR is a unit of Anaerobic Baffled Reactor combination (ABR) with anaerobic filter. According to Metcalf and Eddy (2003) Anaerobic Baffled Reactor (ABR) is a kind of suspended growth treatment which utilizes bulkhead (baffle) in agitation aimed to allowing contact between wastewater and biomass. A baffle is used to direct the flow of wastewater in upflow mode through a series of sludge blanket reactors. Sludge in the reactor up and down with gas production and flow, but moves through the reactor at a low rate.

Type of biofilter used in this study is an anaerobic filter. Anaerobic filter (AF) is a type of biofilm reactor packed-bed. Biomass form a continuous film on the surface of the media. The processing of organic substances occurs by way of wastewater flow between the biofilm-coated media.

Several studies using hybrid anaerobic bioreactor sectional has been done. Ahmad, et al. (2000) using this reactor for treating wastewater palm. A similar study was also conducted by Syafila, et al. (2003) using the reactor for treating wastewater containing molasses. This study is aimed to determine the effect of hydraulic agitation against TSS reduction efficiency of domestic wastewater.

MATERIAL AND METHOD

Material and Instrumens

The reactor is made from PVC pipe and acrylic. Diameter of the pipe is 15 cm and the height is 120 cm. Every column has a valve for effluent. The sample material is waste water from canteen. The material and instruments are filter paper Whatman no. 42, compressor, oven, desicator included silica gel, Ohauss analytic balance which has

precision up to 0.1 mg of carefulness, glass 100 ml, cup, plastic, container.

Flowrate setting

Flowrate setting is done by adjusting the valve. Flowrate variation is used around 0.3 ml/minute.

Seeding and Acclimatization

Seeding is done by submerging the gravel with rumen's cow. It is diluted 1:1 in water. Seeding is conducted over two days. Acclimatization process was conducted over seven days. The process of acclimatization successful if the results exceed 50% removal.

Running Reactor

The reactor was run for a month. From the equalization basin, sewage flowed by pump to be processed in the reactor. Anaerobic biofilter reactor used. The reactor consists of four columns with upflow stream. Each column is given the gravel as high as 50 cm for biofilm attachment media (Figure 1). Sampling was done on days 7, after completed acclimatization.. Samples were taken at the point of influent, effluent, and effluent point of each column. Each sample were measure TSS, VSS, temperature, and pH.

TSS Analysis

TSS gravimetric measurement method includes weighing filter paper blank, sample filtering and weighing the residue suspended. TSS can be calculated by (Alaerts and Santika, 1987):

$$TSS(mg/l) = \frac{A - B}{C} \times 1000$$

Description:

A: The dry weight of the filter paper containing the residue suspended (mg)

B: blank filter paper dry weight (mg)

C: volume of sample (ml)

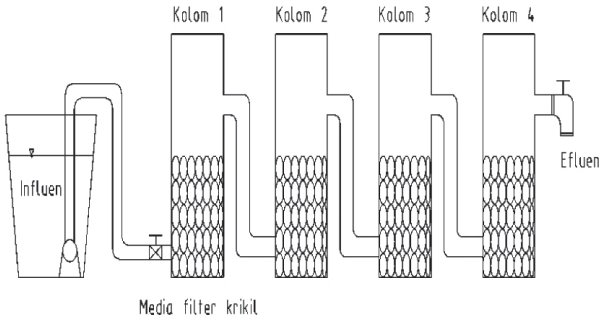

Figure 1. The scheme of reactor

RESULT

The results TSS reduction efficiency of influent, 1st, 2nd, 3rd, 4th column, effluent are showed a dynamic pattern . The results are shown in figure 2. Figure 3 showed dynamic pattern of TSS removal percentage in reactor

DISCUSSION

The first phase of the study are the process of seeding and acclimatization. Seeding process is the stage of growth and proliferation of anaerobic microorganisms. The process of acclimatization is an adaptation of microorganisms to the wastewater which to be treated. Domestic effluent wastewater study is FSaintek Unair canteen. From the analysis of TSS, TSS reduction obtained 83.16% after 7 days.

Anaerobic biofilter reactor has four columns. From the equalization basin, domestic wastewater is flowed by the pump. From the first column of domestic wastewater flows after passing media upflow gravel. In Figure 2, the concentration of TSS reduction taken on the 7th day. Influent

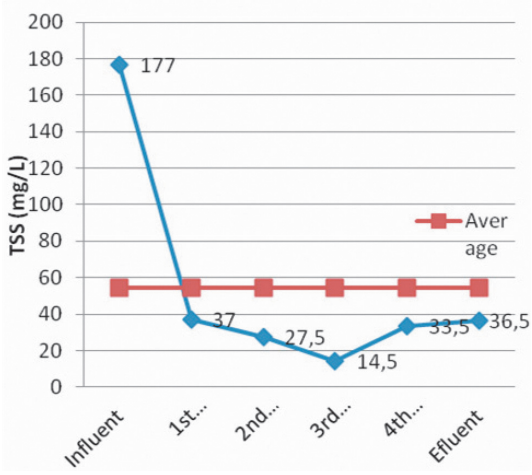

Figure 2. TSS concentration in each point sampling

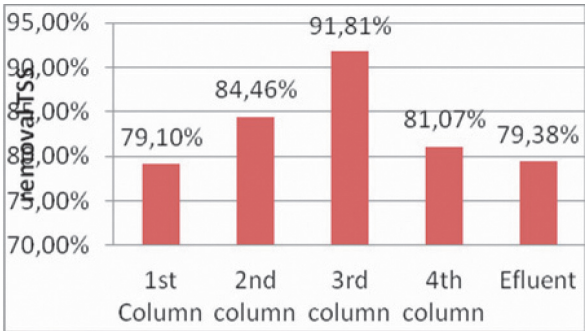

Figure 3. TSS reduction efficiency in each point sampling

showed 177 mg/l of TSS then 1st column can decreased the concentration until 37 mg/l. Then, in 2nd column, TSS concentration more lower than 1st. The concentration is 27.5 mg/l (Figure 2). The 3rd column was 14,5 mg/l. It become lower than 1st and 2nd column. It was showed thatprocess in hybrid reactor can do well. Particle has filtrated by media and degraded by microorganism. The other side, in 4th and effluent, the concentration became higher again. There was 33.5 mg/l in 4th column and 36,5 in effluent. It was probably caused inconvenient situation for microorganism degraded organic matter in particle size. pH situation in reactor was 4-5, the other side suitable pH for anaerobic process are 7–8.

The percentage removal also showed dynamic pattern (Figure 3) from 1st column until effluent. There were 79.10% in 1st column; 84.46% in 2nd column; 91.81% in 3rd column; 81.70% in 4th column; and 79.38% in effluent. The highest removal was in 3rd column. It was showed that microbes could degradation TSS and survive in inconvenient situation until 3rd column. Then in 4th and effluent, the microbiology process could not optimal anymore.

From Figure 2 and Figure 3 showed that there were many phenomenas in reactor. There were two phenomenas occurring in the reactor. The first was an filtration processing. Waste water was treated by anaerobic filter when passed through a gravel filter media. The second was waste water degraded by microorganisms attached growth. After treatment, the wastewater flows upflow. In hydraulic mixing process occurs that causes TSS reduction efficiency increases in which it was support with convenient situation of microbes too. Barber and Stuckey (1999) as cited by Indriani and Herumurti (2010) states that the hydrodynamics and mixing in the reactor affect the level close to the contact between the substrate and bacteria, resulting in mass flow control and reactor performance.

Other causes of low feed flow rate, so that microorganisms have a longer time to degrade organic compounds contained in wastewater. High flow rate makes the microorganisms do not get enough time to degrade organic compounds. Ahmad, et al. (2000) states that an increase in the feed flow causes the flow pattern in the system becomes turbulent and can be washed biomass solids that carried by the flow out of the system.

The combination of hydraulic agitation and low feed flow rates produce large TSS reduction efficiency. This statement is further supported by the number of column four. The number of columns is made of liquid waste to stay longer in the reactor.

Sarathai, et al. (2010) also conducted research on research ABR TSS efficiencies of 90%. This is because HRT higher than that combination. From the research that has been done, it can be concluded that: The average TSS reduction efficiency of 83.16%. The other conclusion, Environmental condition in reactor should be concerned to get optimal removal and hydrodynamic and agitation affect the rate of degradation of organic compounds.

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