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The Effect Of Aerobic Biofilter Method WWTP System On Phosphate In Kediri District Hospital Year 2020

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ABSTRACT

Laundry activities at the Kediri District Hospital are the largest producer of pollutants in the form of phosphate in the waters in addition to other pollutants if they are not processed first. From some of the data from the analysis of the effluent wastewater quality test in April to October 2020, namely 1,853, 1.8448, 1,490, 2,836, 1,202, 1,340, 1,966 which have a standard value of 2 mg/L (East Java Governor Regulation No. .72 of 2013). This shows that the phosphate parameter in the wastewater effluent has a tendency to increase. Other data show the presence of all indicator fish that died gradually in July 2020 suspected of high phosphate levels. Specific objectives of the research: a. To determine the phosphate content of wastewater before going through the WWTP system with aerobic biofilter method, b. To determine the phosphate content of wastewater after going through the WWTP system with aerobic biofilter method, c. To determine the effect and effectiveness of the WWTP system, the aerobic biofilter method in reducing phosphate levels. The design of this research is quantitative using analytic observational research with cross sectional approach. The sample in this study is part of the hospital wastewater taken from the WWTP. The research data were tested using the Paired Sample T test, pre-test and post-test data. The results showed that from point 1(T1) to point 2 (T2) phosphate levels increased by 8.46%. At point 2 (T2) to point 3 (T3) phosphate levels decreased by 17.43%, at point 3 (T3) to point 4 (T4) phosphate levels decreased by 40%. The results of statistical tests showed that there was no significant reduction effect after going through the WWTP system with the aerobic biofilter method or in any process of the WWTP system at T2, T3, T4. The level of effectiveness of the WWTP system with the aerobic biofilter method of 46.27% is considered to have not been able to give a significant effect. Applicative suggestions include: a. It is necessary to calculate the discharge adjusted to the volume of the bioreactor. b. It is necessary to clean the mud at the bottom of the reservoir regularly and periodically. c. It is necessary to add a tool for aeration in the holding pond. d. It is necessary to measure daily DO, to get the optimal oxygen value, which is 2-4 mg/l. e. It is necessary to review the probiotics that have been used for a long time. f. It is necessary to add an aerator in the final treatment. g. Another way that is more effective and economical is precipitation with the addition of a commonly used coagulant, namely lime. This deposition method can reduce up to 80% of phosphate levels in water, as has been done in previous studies.

Keywords : Effectiveness of WWTP, Hospital Liquid Waste, Phosphate Levels, WWTP System

INTRODUCTION

Laundry activities in hospitals are the largest producer of pollutants in the form of phosphate in the waters in addition to other pollutants if they are not processed first. Laundry waste contains the active compound methylene blue (surfactant) which is difficult to degrade and is harmful to health and the environment (A.K. Prodjosantoso, 2011).

Detergents are generally composed of three main components consisting of

surfactants (as the basic ingredient of detergents) between 20-30%, builders (phosphate compounds) between 70-80% and additives (bleach, fragrance) between 2-8%. The content of phosphate compounds in detergents is large enough so that the waste from the washing process has a fairly high phosphate content. The presence of excessive phosphate in water bodies causes a phenomenon of eutrophication. Eutrophic conditions allow algae and aquatic plants to grow rapidly. This situation causes water quality to decline, due to the low concentration of dissolved oxygen even to zero, resulting in the death of aquatic creatures such as fish and other species that live in water (Siti Mashita et al., 2017).

As an effort to control environmental pollution, the parameters of phosphate and waste water can meet the quality standards according to East Java Governor Regulation No. 72 of 2013, the Kediri District Hospital (RSKK) treats the liquid waste generated by the WWTP system with the aerobic biofilter method. From initial observations, the physical condition of the WWTP building is very good, and there is no damage to the building. The RSKK WWTP system consists of an equalization tank, a collection tank, an aerobic biofilter reactor tube, a sedimentation tank, a chlorination tank, a stabilization tank and an indicator fish pond. In the aerobic biofilter reactor tub, the pipe from the blower machine is connected, the pipe is connected to the drybed, and the pipe is connected to the sedimentation tank.

From some of the data from the analysis of wastewater quality tests in April to October 2020, the phosphate parameter has almost reached and even exceeded the permitted quality standards, namely 1,853, 1.8448, 1,490, 2,836, 1,202, 1,340, 1,966 which have standard the value of the quality standard is 2 mg/L (East Java Governor Regulation No. 72 of 2013). This shows that the phosphate parameter in the wastewater effluent has a tendency to increase. Other data indicate that all indicator fish that died gradually in July 2020 suspected of high phosphate levels.

In terms of effectiveness, the data analysis of the results of the outlet wastewater quality test on the inlet from April to October was 16.76%, 31.72%, 30.89%, 20.19%, 20.83%, 16%, 60, 01% and 19.56%, this shows that the WWTP system is only able to provide an average effectiveness of 26.99% for reducing phosphate levels. The effectiveness of the WWTP system should be optimized up to 60% more, this is based on the highest WWTP system effectiveness value in 2020, namely in September of 60.01%, while in other months it was only 20-30%.

Regarding the appointment of quality indicators as a form of RSKK Environmental Sanitation Installation (IPL) service, namely the wastewater quality standard that meets the requirements, and is committed to seeking a maximum phosphate parameter of 1.5 mg/l and in general the effectiveness of the WWTP system is 80%.

This research was conducted as an alternative solution to determine the effect of the WWTP system with the aerobic biofilter method on phosphate. Thus, this study is an evaluation of the ability of the process unit in the WWTP system with the existing aerobic biofilter method, in influencing the decrease in phosphate levels through laboratory analysis.

The problem formulation is there any effect of the WWTP system with aerobic biofilter method on phosphate parameters?

METHODS

The design of this research is quantitative using analytic observational research with cross sectional approach. The research data were tested with SPSS Paired Sample T test, pre-test and post-test data.

RESULTS

A. Phosphate levels of wastewater before going through the WWTP system were 2.243, 1.439, 2.706, 1.641 with an average value of 2.01. Based on the sampling time, the

phosphate level tends to be higher at the lowest time with an average value of 2.18 compared to peak time with an average value of 1.84.

Laboratory Analysis Results

Time	Sampling Parameter Phosphate	Initial Phosphate Level WWTP (mg/L)	Phosphate Level after WWTP process (mg/L)			Average (X)	Min	Max
		T1	T2	T3	T4			
Peak Time	I	2,243	1,995	1,761	0,596	1,649	0,596	2,243
	II	1,439	1,644	1,143	0.858	1,271	0.858	1,644
Average		1,84	1,82	1,45	0,73			
Lowest Time	I	2,706	2,640	2,046	0,898	2,072	0,898	2,706
	II	**1.641**	**2,444**	**2,118**	1,966	2,042	1.641	2,444
Average		2,18	2,54	2,08	1,43			

B. Phosphate levels after going through the WWTP system with the aerobic biofilter method changed varied. The highest average value of phosphate levels occurred at the Lowest time, which was 2.54 mg/L. Meanwhile, the lowest average phosphate level occurred at Peak time of 0.73 mg/L.

Rate of Change in Phosphate Level

Time	Sampling Parameter Phosphate	T1	Changes in Phosphate Level					
			T2	Yield %	T3	Yield %	T4	Yield %
a	b	c	d	e	f	g	h	i
Peak Time	I	2,243	1,995	11,15	2,209	**-10,5**	0,596	72,88
	II	1,439	1,644	**-14,25**	0,631	61,62	0,858	**-35,97**
Lowest Time	I	2,706	2,640	2,59	1,939	26,52	0,898	53,64
	II	1,641	2,444	**-48,7**	2,421	0,82	1,966	19,0
Average		2,01	2,18	**-8,46**	1,80	17,43	1,08	40
Phosphate Reduction Rate			**-8,46** %		17,43 %		40 %	
Phosphate Reduction Rate (Inlet-Outlet or T1-T4							46,27 %	

Hypothesis Test Results

The research data were tested with SPSS Paired Sample T test, pre-test and post-test data.

Interpoint Test Results Process

WWTP System Procces	n	Average ± to	Significance
T1 - T2	4	2,640 ± 1,644	0,505
T2 - T3	4	2,421 ± 0,631	0,421
T3 - T4	4	1,966 ± 0,596	0,137

Based on Figure, indicates that the significance value (2 tailed) is 0.065 > 0.05 indicating that there is no significant difference between the initial variable and the final variable. This shows that there is no significant effect on the treatment given to each variable. Thus the hypothesis (H1) is rejected.

It was concluded that there was no effect of decreasing phosphate levels in the WWTP System of the Aerobic Biofilter Method. Phosphate levels of wastewater did not decrease significantly after the process of the WWTP system using the aerobic biofilter method.

The average phosphate level at T1 to T4 decreased by 46.27% which is the value of the effectiveness of WWTP.

The average phosphate level at T1 to T4 decreased by 46.27%, which is the value of the effectiveness of WWTP. The effectiveness value of 46.27% is concluded that it has not been able to give a significant effect.

DISCUSSION

A. Phosphate levels before going through the WWTP system with aerobic biofilter method were 2.243, 1.439, 2.706, 1.641 with an average value of 2.01. The average value indicates that the phosphate level exceeds the quality standard stipulated in the East Java Governor Regulation No. 72 of 2013 which is 2 mg/l and the IPLRS Quality Indicator is 1.5 mg/l. The alert is on the uncontrolled fluctuation of the phosphate pollutant material. Changes in the value of phosphate levels are influenced by the characteristics of wastewater which change over time depending on the number and type of hospital activities that produce liquid waste.
B. Phosphate levels after going through the WWTP system with aerobic biofilter method, From Table 4.2. the average result in general from point 1(T1) to point 2 (T2) phosphate levels increased by 8.46%. At point 2 (T2) to point 3 (T3) phosphate levels decreased by 17.43%, at point 3 (T3) to point 4 (T4) phosphate levels decreased by 40%. And at point 1 (T1) to point 4 (T4) phosphate levels decreased by 46.27% which is the value of the effectiveness of WWTP.
    1. The increase in phosphate levels by 8.46%, which is at T2, namely the collection tank is caused by:

        The volume of occupied waste water in the collection tank is 51.58 m^3. In the collection tank wastewater is accommodated and experiences residence time. Wastewater at the bottom of the grit layer that will be pumped into the reactor input has the potential to cause deposition of wastewater particles which still binds phosphate cumulatively to the bottom of the pond.

        The concentration of phosphate near the surface and near the bottom is different, where the average level of phosphate near the bottom is higher than in the surface layer. The high levels of phosphate in the bottom waters are because the

bottom of the waters is generally rich in nutrients, both from sediment decomposition and organic compounds from dead flora and fauna (Edward and Tarigan, 2003 in Simon 2015).

The process of biological wastewater treatment in a reservoir is to accommodate wastewater in a pond with sufficient residence time so that with the activity of micro-organisms that grow naturally, pollutant compounds present in the water will decompose. To accelerate the process of decomposition of pollutant compounds or shorten residence time, an aeration process can also be carried out (Kemenkess RI, 2011). Under aerobic conditions Linear Alkyl Sulfonate (LAS) can be degraded well, but under anaerobic conditions, the removal of LAS is still not good. (Zairinayati, 2019).

An aeration process is needed in the collection tank with the aim of decomposing the pollutant compounds earlier so that it will ease the next process. The aeration process is carried out especially at the lowest time, or continuously.

Replacement of the biofilter is not required as long as there is no deadlock. Replacement of bacteria is not required as long as the results of BOD and COD meet the requirements. In the Biofilter, the mechanism for the degradation of organic matter, namely BOD, nitrogen and phosphate, is the first to diffuse into the biological layer or film attached to the surface of the media. At the same time by using the dissolved oxygen in the In wastewater, these pollutant compounds will be broken down by microorganisms in the biofilm layer and the energy produced will be converted into biomass (Kemenkes RI, 2011).

2. At T3 lowers phosphate levels by 17.43%, this can be caused by several factors, among others,
   a. The flow of wastewater that enters the reactor is too heavy resulting in the flow of waste water passing through the biofilter too fast so that the phosphate degradation process is less than optimal. This can be seen in the measured reactor output discharge of ± 1.5 liters/second and the wastewater in the reactor overflows.
   b. In conditions where the reactor is full of waste water, it causes the oxygen supply from the incoming blower to be less than optimal because the oxygen supply is not proportional to the volume of waste water, and the air flow is blocked by the pressure of the waste water and can even enter the blower machine.

      At the climax the available oxygen is not sufficient to decompose the chemical components so that the condition in the biofilter which was originally aerobic will become facultative due to lack of oxygen so that microorganisms will die and settle in the cavities of the media. This can cause the organic load to increase at the biofilter outlet and cause the removal efficiency to decrease.

      In the biofilter, the mechanism for the degradation of organic matter, namely BOD, nitrogen and phosphate, is the first to diffuse into the biological layer or film attached to the surface of the media. At the same time, using dissolved oxygen in wastewater, these pollutant compounds will be broken down by microorganisms in the biofilm layer and the energy produced will be converted into biomass (Ministry of Health, 2011).

      A daily DO measurement is needed to monitor the oxygen level in the appropriate wastewater, which is 2 mg/l so that the treatment results are more optimal. (Flathman, 1994 in Eko, 2015) states that the dissolved oxygen in the submerged attached reactor must be kept between 2 – 4 mg/l. Oxygen plays a role in the process of oxidation, synthesis and respiration of cells.
3. At T4 able to reduce phosphate levels by 40%.

The wastewater in T4 has undergone a deposition process, a filtration process, a chlorination process and a sedation process by passing through 5 slow-flow system stabilization tanks. Most of the phosphate content in wastewater, is separated in the final treatment (Final Treatment).

According to a previous study, the resulting phosphate content began to decrease after precipitation by 15% and further decreased after going through the filtering process to 72.5%. (Herlina Sattuang, 2020).

In the final treatment aims to remove suspended particles and disinfection. Stabilization ponds with slow flow provide the opportunity for wastewater to stay in the pond for a long time and experience sedimentation, namely depositing solid particles in wastewater by gravity settling to the bottom of the pond, which provides an opportunity for floc to occur and removes nutrients including phosphates and stabilizes organic substances in wastewater.

Consideration of additional processes with conventional biological treatment is not carried out. As an alternative if the phosphate content is very high, it requires the addition of a chemical process, and then a precipitation process can be carried out.

C. Effect and effectiveness of the WWTP system with aerobic biofilter method on phosphate

From the whole process, the WWTP system was able to reduce phosphate levels by 46.27%. One of the factors that affect the effectiveness of the wastewater treatment system is the residence time of the wastewater in the treatment pond. According to previous research, it is known that the optimum residence time of wastewater in aeration ponds is 5 days (Wahyuni, 2010). During the aerobic process there is a decrease in the phosphate content. This occurs due to the utilization of orthophosphate for cell synthesis and stored for future needs.

Wastewater runoff that is too heavy causes the residence time of this wastewater to not be achieved by the waste entering the WWTP system due to the disproportionate amount of waste entering the pond size. processing, so that the water that comes out of the treatment system does not meet the expected quality standards.

CONCLUSION

1. Phosphate levels before going through the WWTP system with aerobic biofilter method

   The design of the WWTP system with the aerobic biofilter method is capable of treating wastewater with large fluctuations. In RSKK the WWTP system, the aerobic biofilter method is able to treat an average of 60 m per day that is discharged into water bodies. With the low time, the phosphate level is higher than the peak time

2. Phosphate levels after going through the WWTP system with aerobic biofilter method

   The average phosphate level after being processed in the WWTP system increases and decreases at each sampling point. The average phosphate level after being processed in the WWTP system increased and decreased at each sampling point.

   a. The increase in the average level of phosphate is at T2, which is at the bottom of the reservoir of 8.46% mg/l. Reservoir ponds are facultative and very likely to occur sedimentation, including phosphate which settles with wastewater particles to the bottom of the pond. The bottom of the pond with anaerobic conditions cannot decompose phosphate so that there is a cumulative increase in levels.
   b. At T3 the mean phosphate level decreased by 17.43% mg/l. Because the runoff of wastewater at the reactor input is too heavy, it causes pressure so that the wastewater flows quickly into the biofilter. This causes the process of phosphate erosion in the biofilter to decrease. With the condition of the reactor full of waste

water, the aeration process does not run optimally, because the reactor does not have empty space to optimize the aeration process.

c. At T4 phosphate levels decreased by 40% mg/l. The filtration and deposition processes have a major influence on the reduction of phosphate levels in the WWTP system.

3. Effect and effectiveness of the WWTP system with aerobic biofilter method on phosphate

In the T1 to T4 process, the value of the effectiveness of the WWTP system using the aerobic biofilter method at the time of the study was 46.27%. which should be able to achieve 80%. And it can be concluded that the WWTP system with the aerobic biofilter method has no significant effect on reducing phosphate levels in wastewater when conducting research.

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