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by

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EFFECT OF ROTATION SPEED *OF RBC* ON SUGAR WASTE WATER TREATMENT

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ABSTRACT

Sugar Industry waste water has a high *Chemical Oxygen Demand (COD) content so that it becomes a serious threat to the environment if it is not treated properly*. For this reason, it is necessary to carry out processing efforts, one of which is with an alternative processing technology using *a Rotating Biological Contactor* (RBC). RBC is a wastewater treatment reactor physically and biologically consisting of a circular disk rotated by a shaft at a certain speed. This study aims to determine the efficiency of removal in treating wastewater from sugar factories and to identify microorganisms that play a role in the process of removing organic matter. In this study using variations of disc rotation speed and *influent COD concentration* . The parameter studied was COD from the sugar factory wastewater from Candi Baru, Sidoarjo. The results of the most effective variations in COD removal were at a disc rotation speed of 4 rpm with an *influent COD concentration of* 260 mg/L and for parameters. The highest reduction efficiency is 87.69 % for COD. The overall results of this study indicate that changes in disc rotational speed affect the removal efficiency for the COD parameter.

Keywords : Sugar factory waste water, COD, Disc Rotation Speed and RBC

ABSTRACT

Waste water Sugar Industry has a content of Chemical Oxygen Demand (COD) is high so that it becomes a serious threat to the environment if not treated properly. It is necessary for the processing effort of one of them with alternative processing technologies using Rotating Biological Contactor (RBC). RBC is a physical and biological waste water treatment reactor consisting of a circular disc which is rotated by a shaft at a certain speed. This study aims to determine the removal efficiency in treating wastewater from the sugar industry and identification of microorganisms that contribute organic content of the preliminary process. In this study, using a variation of rotational speed of discs and influent COD concentration. The parameters studied were the COD of waste water from Candi Baru sugar factory, Sidoarjo. The most effective variation results in the removal of COD is the disc rotational speed of 4 rpm with an influent COD concentration of 260 mg/L and for the parameter. The highest removal efficiency is 87.69 % for COD. The overall results of this study indicate that the disc rotational speed changes affect the removal efficiency for COD parameters .

Keywords: COD, RBC, disc rotational speed and sugar industry wastewater,

INTRODUCTION

The sugar industry is currently growing rapidly. The sugar factory is an industry that processes sugarcane raw materials into a product, namely sugar. In addition to producing products, sugar factories also produce waste. Wastewater parameters such as COD generally have high levels . Sugar factories have the potential to cause environmental pollution. The COD parameter, in treating sugar factory wastewater can be done in three ways , namely physically, chemically and biologically or a combination of the three. Considering that the sugar factory wastewater has a high organic content, this waste can be reduced using aerobic biological treatment by utilizing microorganisms, especially bacteria which can degrade organic matter into stable elements.

This study uses a biological treatment method, namely with an attached growth system, one of which is RBC because it can overcome the various weaknesses of other biological waste treatment systems that have been used so far, especially in terms of the low energy required, easy maintenance and operation and effective in eliminating organic pollutant content (Zulkifli, 2001).

This study aims to remove the organic content of wastewater from the Candi Baru Sidoarjo Sugar Factory, namely the COD parameter which was carried out aerobically and to determine the effect of disc rotation speed and influent COD concentration on processing efficiency and the types of microorganisms *that* play a role in the RBC reactor.

The variation of disc rotation in this study which used 4-12 rpm is close to the conditions of disc rotation variations that have been carried out by *Palma* , 2009. Meanwhile, inlet COD concentrations ranged from 260-640 mg/L. The COD concentration is also close to the value of the inlet COD concentration that has been carried out by Hiras *et al*. , 2004. The residence time in the reactor is set at one hour as has been researched by Yanti, 2008. It is hoped that the research results obtained can be used as material for consideration for industries in wastewater management, especially those with sugarcane-based ingredients.

METHOD

This research was carried out continuously *and* carried out in three stages, namely the preparation stage, RBC operation and identification of microorganisms.

Laboratory scale RBC design with discs submerged in wastewater 40% of disc area (Zulkifli, 2001). The RBC reactor has a volume of 16.2 liters. The size of the disc diameter is 20 cm, the diameter of each stage is 24 cm. Each stage has 10 discs with each disc spacing of 3 cm.

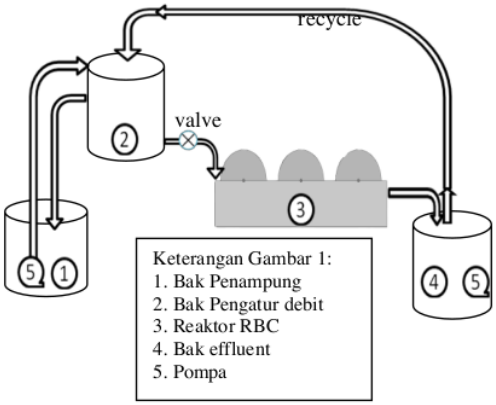

Figure 1. RBC processing flow chart schematic

Preparation phase

This preparation stage includes the process of *seeding* and acclimatization. In the *seeding stage* , filling the RBC reactor with sugar factory waste water, then moving the disc which is submerged 40% of the cross-sectional area in the waste water at a speed of 12 rpm. The bacteria

began to grow in about five weeks, which was marked by the growth of the slime layer on the biofilm and covered all surface areas of the media, so the RBC reactor was ready to be used for gradual elimination of organic load (acclimatization) of 25% to 100% of wastewater.

BC Operation Stage

The wastewater from Sugar Factory PG Candi Baru Sidoarjo was collected in a holding tank with various *influent COD concentrations* of 640, 510, 410 , 330 and 260 mg/L . Waste water from the waste storage tank is channeled into the discharge control tub by means of a pump. Then from the waste water debit control tub it flows towards the RBC by gravity. Then the discs that had grown biofilm were rotated with variations of 4, 6, 8, 10 and 12 rpm . Then, when rotating, the part of the microorganism that is submerged in water will decompose the organic matter dissolved in the water. When in contact with air, the biomass will oxidize, thereby achieving aerobic conditions. The treated waste is flowed by gravity to the *effluent tub* . From the treated waste *effluent tub, it is recycled* again with a ratio of 0.75 (Yanti, 2008) and flowed into the debit control tub in order to get maximum results. Sampling from the channel leaving the RBC reactor was carried out with a detention time of 1 hour.

Sample Analysis

Analysis of COD samples refers to SNI 06-6989.15-2004, while identification of micoorganisms by morphological tests uses biochemical tests.

RESULTS AND DISCUSSION

Prior to the research, wastewater was analyzed first to determine its physical and chemical characteristics . The initial analysis data of this wastewater is shown in Table 1 as follows:

Table 1 . Preliminary analysis of Sidoarjo Sugar Factory wastewater.

No.	Parameter	Test results	Unit
1.	COD	640	mg/L
2.	BOD	368	mg/L
3.	TSS	83	mg/L
4.	pH	7,9	mg/L

Preparation

Seeding is carried out to grow and breed microorganisms originating from the waste water of the Candi Baru Sidoarjo sugar factory which takes five weeks. The *seeding* process was carried out continuously at a disc rotation speed of 12 rpm and adding $(NH_2)_2CO$ and KH_2PO_4 as nutrients. Wastewater that has a BOD concentration of 368 mg/L, so that the nutritional needs with a ratio of BOD : N : P is 100 : 5 : 1 (Indriasari, 2007), N is obtained is 18.4 mg/L and for P 3.68 mg/L. Biofilm layer formed can be seen physically the presence of a layer of mucus attached to the disc media and a change in color from dark brown to lighter brown. After *the biofilm* has grown to look like brown mucus, acclimatization is carried out.

Acclimatization is the stage where microbes adapt to wastewater. At this acclimatization stage, the concentration of indirect waste is 100%. This is because the microbes do not die. The concentration of wastewater given is 25%, 50%, 75% and then 100%. Incoming wastewater replaces the nutrients provided during the *seeding process* (Indriasari, 2007). After acclimatization with 100% wastewater concentration, *a trial* was carried out first on each part of the reactor. The analysis at 100% acclimatization that has been carried out can be seen in Table 2.

In Table 2, it can be seen that in the 100% acclimatization of wastewater for period 1 and period 2, the percentage of

removal increased slightly. However, in period 3 it decreased, this was due to *sloughing* or peeling of the biofilm layer. The percentage of COD removal in 100% acclimatization of wastewater was constant (75.06 % , 76.25% and 69.37%) then the RBC operation was carried out.

Table 2. Analysis during acclimatization of 100% of the wastewater from the Candi Baru Sidoarjo Sugar Factory.

Part	Unit	COD concentration (mg/L)		
		1*	2*	3*
Influent tub	mg/L	640	640	640
Tank	mg/L	190	205	224
Stage 1	mg/L	182	198	216
Stage 2	mg/L	175	182	212
Stage 3	mg/L	167	167	204
Effluent bath	mg/L	160	152	196
Allowance Percent	%	75.00	76,25	69,37

* Period

Influence of Speed Play Disc Dan COD concentration _ *Influent* T o Reduction of COD Concentration _ _

The disc rotating speed can affect the COD *effluent concentration* . The ability to reduce COD concentrations can be shown in Table 3 as follows:

Table 3 Effect of variable disc rotational speed and COD concentration *influent* to decreasing concentration of CO D

rpm	COD concentration (mg/L)				
	640	**510**	**410**	**330**	**260**
12	144	104	80	64	48
10	140	100	76	60	44
8	128	96	72	56	40
6	112	88	68	48	33
4	104	84	72	44	32

Table 3 shows that the largest percentage of COD removal was 87.69% (32 mg/L) using a disc rotation speed of 4 rpm and an influent COD concentration of 260 mg/L. According to Indriasari's research (2007), if the residence time of microbes in wastewater to degrade organic matter is long, the removal results are also maximum. Table 3 also shows that the slower the rotational speed of the discs given to the process, the greater the ability to reduce COD *effluent* because more air enters the biofilm which is used as air circulation for the microbes. An increase in removal ability was shown for each decrease in disc rotational speed with *influent* COD concentrations varying from COD 640 mg/L to 260 mg/L. In Figure 2 below, you can see the ability to reduce COD in sugar waste water by varying the rotational speed of the disc and the *influent COD concentration* .

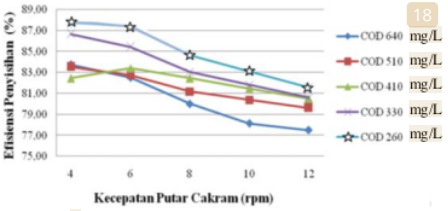

Figure 2. Relationship between COD reduction efficiency and rotational speed discs at various *influent COD concentrations* .

In Figure 2 above, it can be seen that the results of the greatest removal efficiency for COD content were at a COD concentration of 260 mg/L and a disc rotational speed of 87.69% at 4 rpm. There are two variations of disc rotation speed which are almost the same at 4 rpm disc rotation speed. This is due to the microbes experiencing a saturation phase . The saturation phase is marked by the number of *sloughing or sloughing* biofilms . Meanwhile, the lowest COD removal efficiency results at an *influent COD concentration* of 640 mg/L and a disc rotating speed of 12 rpm is 77.50%.

The Effect of Bacterial Growth in Disc Media on COD Removal

Elimination of the organic load of wastewater is carried out when the biofilm grows and sticks to the entire surface of the disc.

According to Yanti, 2008, when the biofilm reaches its maximum thickness, diffused oxygen cannot be consumed, oxygen cannot fully penetrate, so that the surface of the media will be in anaerobic conditions. So that the microorganisms will die and the biofilm will be detached from the disc. Then a new layer of biofilm will start growing again. In order for the waste water to remain in aerobic conditions, an appropriate disc rotation speed is required. This is because if the rotational speed of the disc is too slow, the condition of the waste water becomes anaerobic, because oxygen transfer is not running optimally.

The influence of PH

pH is one of the factors that influence microbial growth, including its ability to treat wastewater flowing in the reactor. Figure 4 can be seen during the operation of the RBC, the pH value ranged from 7.2 to 7.9. According to the research by Coetzee *et . al* (2004), with the parameters pH and COD, the pH value is towards a pH value of 7 or a neutral pH, the ability of microbes to reduce the organic content of COD increases. From the research conducted, it was found that the most effective variable in removing COD was pH 7.2 with a percent COD removal capacity of 87.69%.

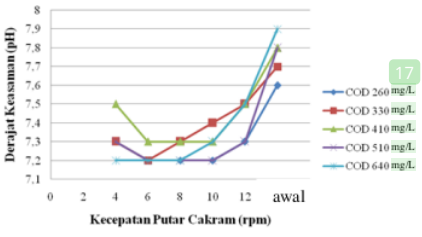

Figure 4. The relationship between pH and various disc rotation speeds in RBC operation

In Figure 4 it is explained that the pH fluctuates in the sugar wastewater treatment. In the fifth week the bacteria undergo a stationary phase, where these bacteria can already be used as a reference in the COD biodegradation process.

In Figure 4 it is also explained that the pH fluctuates in the sugar wastewater treatment. In the fifth week the bacteria undergo a stationary phase, where these bacteria can already be used as a reference in the COD biodegradation process. This is caused by the effect of adaptation of waste to bacteria in COD removal.

CONCLUSION

Based on the research that has been done, some of the conclusions obtained are:

1. The greatest reduction efficiency of COD was 87.69 % at disc rotation speed of 4 rpm with the lowest *influent organic concentration, namely 260 mg/L.*
2. The period of rotational speed of the disc shows that the longer the residence time of microorganisms in wastewater can increase the removal efficiency that occurs. The greater the *influent COD concentration* , the lower the removal efficiency will be .

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