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THE EFFECT OF BOTH, BED FILTER THICKNESS AND KINDS TRICKLING FILTER MEDIA ON VARIOUS OF FLOWRATES TO DECREASE OF TAPIOCA WASTEWATER

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Abstract

Tapioca industry growth rapidly, so wastewater from its increase too. The quantity of wastewater from tapioca industry is large and they have high BOD (Biological Oxygen Demand) and high COD too (Chemical Oxygen Demand), so if they are untreated before release to streams, include to high pollutant stage.

Organic matter content on wastewater decreased by biological treatment, one of them is trickling filter. Trickling filter basically is an artificial channel, consist of rough and uncertain shape materials as a filter arranged in the channel. Wastewater spray on it and flow in this channel trickle down through this filter has the form of thin layer above surface of filter media, which have contact with air. Biological slime consist bacteria, protozoa and other microorganism living on surface of filter media, consume organic matter of wastewater, so they are decrease.

The experiment was aimed at studying the effect of flowrates and filter bad thickness of trickling filter process with river rock and plastic ball as filter media to efficiency BOD decrease of tapioca wastewater.

The experiment is conducted using randomized block design, employing two factors i.e. a bed filter thickness (T) and a type of filter media (M). The filters consist of three respective levels; 1m, 1.5m, and 2m and the media employed are river stones and plastic balls, respectively. The respective applied are 35 ml/min, 105 ml/min and 175 ml/min. The treatments are conducted in three replicates.

The results showed that the use of 2 m bed filter of river stone at flowrate of 35 ml/min reduced BOD level by 5263 ppm, which is equivalent to 75.18 % of its initial level. However, the use of 1 m bed filter of river stone at a flowrate of 175 ml/min resulted in the lowest reduction of BOD level i.e. 2672 ppm.

PREFACE

Tapioca starch has functions in various industries besides on baking industry as a raw material (Ciptadi & Nasution, 1978). In the process of tapioca starch there is need much water, so wastewater from this process is large quantity. That is from washing, extraction and settling. In the modern installation of tapioca industry, centrifugation process establish for wash starch to whiten it color, so water consumption increase as high as wastewater. Tapioca wastewater have high organic matter content because the method of starch extraction by break the cell of cassava root and soluble with water. This method due to organic particles soluble in the water and become dissolved in wastewater. The height of organic particles content reflected on Biochemical Oxygen Demand (BOD) value of tapioca wastewater is high.

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Decreasing BOD need wastewater treatment, one of them is trickling filter. Trickling filter is an artificial percolation channel where organism culture lives on it (Barnes et al, 1981). The media used on it must be comfortable for living microorganism culture that is porous and rough one.

Trickling filter typically used as secondary treatment where effluent flow from primary treatment, spray on filter media. Biological slime will be performed above media surface. The optimum temperature promotes microorganism culture to growth (Clark et al, 1977). An optimum performance of trickling filter plant will occur after two weeks installed, called maturating period (Kamala and Rao, 1979). The most important component on trickling filter is media filter (Peavy et al, 1986). Recently fabricated plastic media developed to get more advantages such as light, chemically resist, high specific of surface and high percentage of free space (Hammer, 1977). Fabricated sheet media designed to divide discharge and to get maximum contact between organic compound on wastewater and microorganism culture. The others shape media are ring and ball.

It is difficult to obtain an adequate measure of the active mass of biological solids in a trickling filter. Although the total surface area of the medium gives some indication of the possible areas on which the biomass could grow, both the actual thickness of the biomass and the percentage of it which is active cannot be practically determined. Therefore, it is customary ti make the volume of the medium as the most practical measure of the microorganism activity in a trickling filter and so to express organic loading rate in terms of the daily mass of BOD applied per unit volume of filter medium (kg BOD/m3.d). The hydraulic loading rate per unit surface area of filter (m^3/m^2.d) is also important since it affects distribution of the flow over the surfaces of the medium, and hence the quality of contact between the applied organic matter and the active biomass.

The hydraulic loading rate is the volume af wastewater treated per unit surface area of filter per hour. The weight of BOD_5 on the temperature of 20^oC apllied per unit volume of filter mediun called organic loading rate (Kamala & Rao, 1988)

EXPERIMENTAL PROCEDURE

Trickling filter instalation made from PVC pipe 0.18 m diameter and 3 kinds of heigh 1m, 1.5m and 2m respectively, used medium both river stone and plastic ball. After the preparation periode the installation must be maturated. Tapioca wastewater flowed on it for two weeks continously on 35 ml/minutes to 176 ml/minutes discharge on respective treatment to mature it. If the installation was ready at the first time installation operate on 35 ml/minutes discharge for two days continously and the effluent of respective treatment take out for sampling. Sample of second and third replicates take out after 2 hours from the first sample in a series. At that moment BOD of sample analized.

Than, instalation operated on 105 ml/minutes flowrate for two days continously. Sampling analogically with previous treatment. Later, the same procedure employed for 175 ml/minutes flowrate.

RESULTS AND DISCUSSION

The result showed that the thickness of bed filter have significan effect to decreasing BOD of tapioca wastewater on 35 ml/minutes and 105 ml/minutes flowrates but no statistical significance was detected ($P<0.01$) on 175 ml/minutes flowrate.

Tabel. 1
Data Decreasing BOD (ppm), average from three replicates

Treatments	Flowrates (ml/minutes)		
	35	105	175
T1M1	3986	3779	3469
T1M2	3986	3572	2671
T2M1	4509	4279	3936
T2M2	4771	4065	3088
T3M1	4902	4788	4429
T3M2	5163	4422	3375

Be the contrary, the kind of media show significan effect to decreasing BOD on 175 ml/minutes flowrate and no statistical significance was detected ($P<0.01$) on 35 ml/minutes and 105 ml/minutes flowrate. There is no statistical significance interact between the thickness of bed filter and the kind of media to decreasing BOD. The highest decreasing BOD occurs on T3M2 on 35 ml/minutes flowrates i.e. 5163 ppm and the lowest reduction occurs on treatment T1M3 on 175 ml/minutes flowrates i.e. 2671 ppm. The respective level of bed filter thickness have significant effect to BOD reduction on 35 ml/minutes and on 105 ml/minutes flowrates. The greater bad filter thickness, BOD reduction greater too. It is caused by the larger of medium volume and the wider of medium surface for growing microorganism, so the quantity of microorganism increase. The heigh quantity of microorganism need organic matter as an nutrition more. This organic matter took from wastewater so it is reduce in more quantity.

On 175 ml/minutes flowrates, the kind of medium filter have statistical significant effect to decreasing BOD of tapioca wastewater both, river rock and plastic ball. The result show that reducing BOD on plastic ball medium is greater than on river rock medium. Trickling filter consist of plastic ball medium have better performance to decrease BOD than river rock medium, on high flow rate. But on low flowrates, both trickling filter consist of plastic ball medium and trickling filter consist of river rock medium show no difference to reducing BOD performance. It is caused by the same intensity of contact between microorganism culture and wastewater liquid on low flowrates, on both plastic ball medium and river rock medium. This process not occurs on high flowrates (175 ml/minutes). Plastic ball medium have higher ability to spread wastewater liquid than river rock medium. The uniform shape of plastic ball medium give effect to higher intensity of contact between microorganism culture and organic matter on it. The other way, on river rock medium wastewater flow only on special pattern according to certain surface of river rock, unevenly distribute on whole surface.

Measurement width of surface per volume of plastic ball higher than river rock. Hence the quantity of microorganism culture on trickling filter consist of plastic ball medium higher than trickling filter consist of river rock medium. It is support plastic ball one have better performance.

Reducing BOD lower on high flowrates caused by higher velocity of wastewater flow according to higher flowrates. Hence detention time of wastewater on trickling filter shorten and organic matter on it have less possibility to consumed by microorganism. On the contrary, the wastewater have higher detention time give more possibility to consumed by microorganism.

CONCLUSIONS

The higher of bed filter thickness of trickling filter give not only higher reducing BOD performance, but also higher efficiency to do it too. On the opposite occurs on flowrates treatment, the higher flowrates give lower reducing BOD performance and lower efficiency too. On high flowrates palstic ball medium give reducing BOD performance better than river rock one, but on low flowrates, both trickling filter consist of plastic ball medium and trickling filter consist of river rock medium show no difference to reducing BOD performance statistically.

RECOMMENDATIONS

To get higher efficiency of reducing BOD of trickling filter, it can do by substitute medium with both higher spesific surface width and higher degree of comfort for microorganism living.

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Table. 2.
Analysis of variance for reducing BOD on 35 ml/minutes flowrates

Source	Degrees of freedom	Sum of squares	Mean square	Variance ratio	F 5%	F 1%
Group	2	622037	27045	1.27	3.59	6.11
Treatment	5	3558842	154732	7.27 **	2.81	4.34
T= Bed thickness	2	3354218	145835	6.85 **	3.59	6.11
M= Medium	1	136416	5931	0.28	4.45	8.40
TM	2	68208	2965	0.13	3.59	6.11
Experimental error	17	489631	21288	1		
Total	29	4670510				

** Significantly different (P<0.01)

Table. 3.
Analysis of variance for reducing BOD on 105 ml/minutes flowrates

Source	Degrees of freedom	Sum of squares	Mean square	Variance ratio	F 5%	F 1%
Group	2	73958	3216	0.17	3.59	6.11
Treatment	5	2926256	127229	6.56 **	2.81	4.34
T= Bed thickness	2	2593134	112745	5.82 *	3.59	6.11
M= Medium	1	308898	13430	0.69	4.45	8.40
TM	2	24224	1053	0.05	3.59	6.11
Experimental error	17	445833	19384	1		
Total	29	3446047				

* Significantly different (P<0.05)
** Significantly different (P<0.01)

Table. 4.
Analysis of variance for reducing BOD on 175 ml/minutes flowrates

Source	Degrees of freedom	Sum of squares	Mean square	Variance ratio	F 5%	F 1%
Group	2	87469	3803	0.13	3.59	6.11
Treatment	5	5778135	251223	8.83 **	2.81	4.34
T= Bed thickness	2	2077643	90332	3.17	3.59	6.11
M= Medium	1	3645000	158478	5.57 *	4.45	8.40
TM	2	55492	2413	0.08	3.59	6.11
Experimental error	17	654614	28461	1		
Total	29	6520219				

* Significantly different (P<0.05)
** Significantly different (P<0.01)