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ABSTRACT

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Department of Environmental Engineering
Institut Teknologi Bandung

Environmental Technology & Management Seminar
Bandung, Indonesia, January 9 – 10, 2002
ISBN : 979-8456-20-3

Biological Nutrient Removal from Agroindustrial Wastewater Using a Two Reactor System

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Abstract – Agroindustrial wastewater is rich in organic material, especially organic carbon and nutrient. In this work a two reactors system consists of anoxic and erobic reactor was operated with different recycle and C/N ratio. Experimentation using molasses-based artificial wastewater containing 114 mg/L of NH_3-N, 10 mg/L of NO_3-N, 25 mg/L of NO_2-N, and 1300 mg/L COD, which was fed directly into the anoxic reactor showed increaing of DO concentration in the anoxic reactor from 0,13 mg/L to 0,32 mg/L which increasing recycle rations from 100% to 300%. Despite the anoxic reactor was capable to reach a nerly 94% denitrification efficiency, the overall system produced final effuent containing 98.31 mg/L of NO_3-N. yet, this system was capable to reduced COD concentration from 1,284 mg/L to 186 mg/L, reduced NO_2-N concentration from 25.71mg/L to 1.50 mg/L and NH_3-N concentration from 114 mg/L to 0.91 mg/L with a 100% recycle ratio. Reducing the recycle ratio up to 50% still did not significantly improve the anoxic reactor for complete denitrification process. It produced a final nutrient containing 96.99 mg/L NO_3-N, 190mg/L of COD, and 1.47 of NH_3-N further experimentation using higher concentraton of COD (2600mg/L) with 100% recycle ratio resulted increasing denitrification efficiency from 94% to 97%. The overall system produced final effuent containing 94.48 mg/L of NO_3-N. this system was capable to reduced COD concentration from 2,644 mg/L to 232mg/L

Keywords -

INTRODUCTION

Nitrogen compound in wastewater decreases water perimetr quality. It is because of nitrogen compound at certain concentration decrease oxygen concentration and cause eutrophication. That's why nitrogen compound in wastewater should be decreased as much as possible. A way to separate nitrogen compound is by applying waste treatment process biologically. General principal of bilogical tratment which is applied to separate nitrogen compound is nitrification and denitrification process.

Nitrification and denitrification are biological process in wastewater where nitrogen compound is changed into nitrogen gas. In nitrogen, ammonium oxidation becomes nitride then nitride is oxidized to be nitrate. Next step, nitrate is reduced to be nitrogen gas in dentification process. Both processes change chemical compound which is harmful for environment to be the advantageous ones.

To make nitrification and denitrification perfect, we need to know the condition of environment and waste chemical compound. Worth-consideringenvironment factors are dissolved oxigen and hydraulic retention time (HRT), for examples chemical compound s to be examined are organic deposit, ammonium, nitride and nitrate. Dissolved oxygen is needed while it is hardly needed in denitrification. This will also be influential in reduction oxidation process, which can be measured by ORP-meter. Hydraulic remain time will be represented by circulation debit. Circulation from aerobic reactor to anoxic reactor is believed to be very influential in nitrification and denitrification process perfection. Chemical compounds mentioned above are very influential in the process, as well. Organic deposit is needed for microorganism growth, so is ammonium nitride and nitrate.

MATERIAL AND METHOD

Material, which I used for this research, consists of two kinds, processing materials and analytical material. Material for processing is molasses based artificial waste . Materials for analytcal purpose are chemical materials for analysis of COD, NH_3-N, NO_3-N, NO_2-N, DO, pH and ORP analysis.

Tools used for research are two-steps reactors, anoxic and aerobic reactor, with capacity of 5,000 ml respectively. Tool for analysis is analytical tool for COD. NH_3-N, NO_3-N, NO_2-N, DO meter, pH meter and ORP meter. Analytical methods used are COD with oxidarion calcium dichromate methods, BOD with Winkler methods, NH_3-N with Nessler method, NO_3-N with brusin-sulfanilat methods, and NO_2-N with naftilamin method.
This research examines optimum condition in nitrification and denitrification process .
Optimizing is observed by circulating process from aerobic reactor to anoic reactor.
Besides, optimum ratio of COD and nitrogen compound in wastewater in nitrification and denitrification process is measured

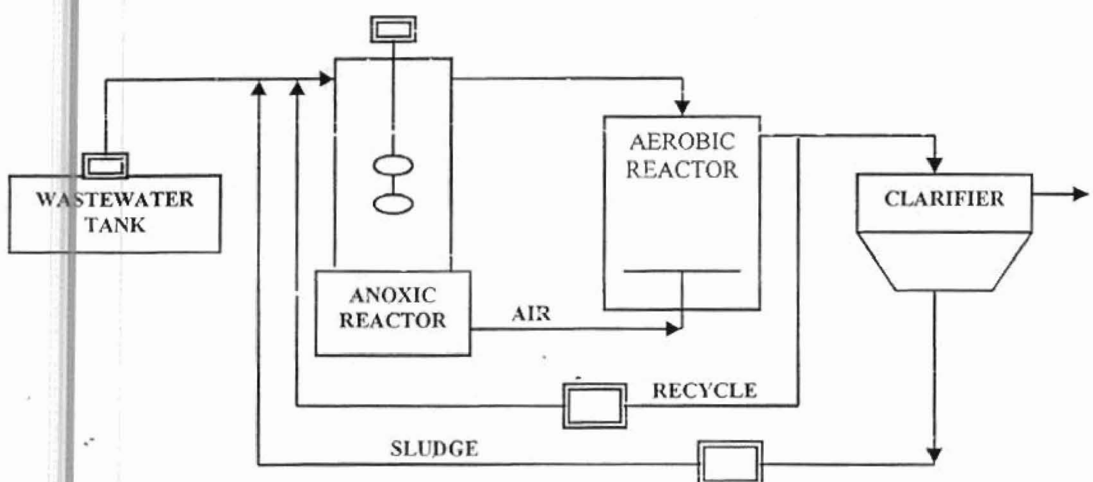

Figure 1. Reactor Configuration

Figure 1 shows reactor configuration used in this research. Various circulations from aerobic reactor to anoxic reactor are done in the research. Various circulation's are 0%, 50%, 100%, 200% and 3005 to influent.
On a research, which is done to examine the influence of burdened waste against nitrification and denitrification process, it is made various waste with various ratio of COD and nitrogen compound. The ratio will be made to 10/1 and 20/1

RESULT AND DISCUSSION

1. Circulation Speed Influence to NH_3-N decrease (Nitrification)

NH_3-N change obviously takes place either at anoxic reactor or at aerobic reactor at anoxic reactor the more circulation speed the more NH_3-N decrease. This can happen because more oxygen concentration dissolve when circulation speed is higher. When dissolved oxygen concentration at anoxic reactor reaches higher, nitrification process will work at anoxic reactor

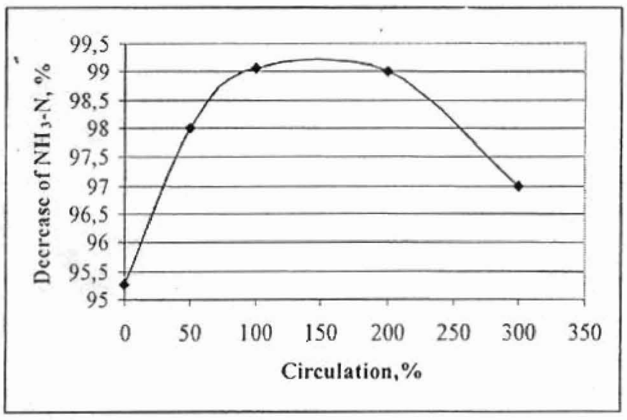

Figure 2. Circulation Speed Influence to Total Percentage of NH_3-N Decrease

As a whole NH_3-N can be decreased particularly at aerobic reactor where nitrification process occur. Total percentage of NH_3-N decrease at every circulation speed level isseen at figure 2. Figure 2 shows that most optimum decrease of 99.07% takes place at 100% circulation speed level.

Nitrification process occurs at aerobic reactor where ammoniac is changed to be nitride and then nitride is oxidazed to be nitritate. Thus decreasing ammoniac at aerobic reactor shows nitrification amount. Figure 3 show that circulation significant for decreasing NH_3-N. At ratioof COD/N 20/1 with 100% circulation, total decrease of NH_3-N is smaller compared with COD/N 10/1 ratio i.e. from 99.7% to be 93.68%.

Figure 2 shows that optimum percentage to decrease ammoniac is 100% circulation toward influent i.e. 99.07%. In this case, it is said that optimum nitrification at COD/N 10/1 occur at 100% circulation. By increasing COD/N ratio to 20/1 so that nitrification decrease to 93.68%. It shows that COD/N ratio increase has enough influence to decrease nitrification.

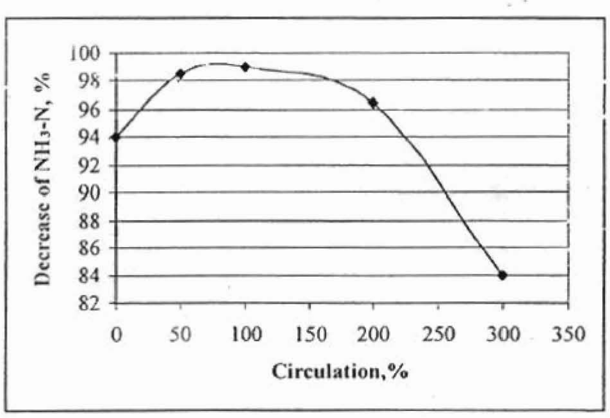

Figure 3. Circulation Speed Influence to Percentage NH_3-N Decrease at Aerobic Reactor

2. Circulation Speed Influence to NO_3-N decrease (Denitrification)

Beside of waste contains NO_3-N. NO_3-N itself is made at aerobic reactor. Further change of ammoniac to be nitride is becoming nitrate.Nitrate resulted at aerobic reactor is circulated to anoxic reactor to be changed to be nitrogen gas. This denitrification process is done by bacteria Pseudomonas, Alkaligenes, Acinetobacter, Hyphomicribium, and Thiobacillus (Fochit and Verstrate, 1977). These bacteria live in limited oxygen content. In this research, optimum oxygen content denitrification decrease again.

Denitrification is stated as decrease of NO_3-N at anoxic reactor.There are two sources of nitrate which go into anoxic reactor namely influent and circulation of aerobic reactor. Circulation of aerobic reactor bears dissolved oxygen so that the faster circulation speed the bigger dissolved oxygen at anoxic reactor. Level of circulation influences decrease percentage of nitrate atanoxic reactor as shown by Figure 4.

Figure 4 shows that increase of circulation speed influence decrease percentage of nitrate. It means the faster circulation speed the higer concentration of nitrate goes into anoxic reactor.

It is clear if it's compared to contral (0% circulation speed). From exposed circulation, 200% circulation speed reaches the highest decrease percentage of nitrate i.e. 94.97%. At higher exposed circulation i.e. 300%, decrease speed of nitrate goes down again. It means the most optimum of circulation speed os 200%.

When ratio increase of COD/N becomes 20/1 denitrification is almost unchanged i.e. 94.78%.

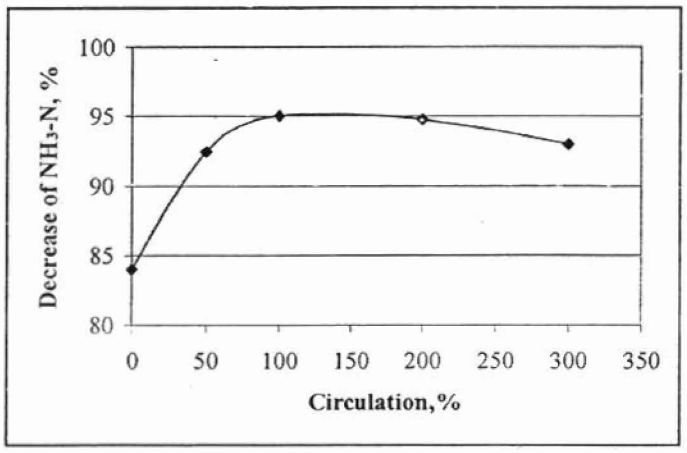

Figure 4. Circulation Speed Influence to Total Percentage of NO_3-N Decrease

3. COD Decrease in Nitrification and Denitrification

Decrease percentahe of COD is almost not influenced by circulation speed level.. At 0% circulation COD decrease 85.24%, at 50% circulation COD decrease 85.23%, at 100% circulation COD decrease 85.94%, at 200% circulation COD decreases 85.0% and 300% circulation cause COD to decrease 85.38%. While COD/N 20/1j ratio which done at 100% circulation, COD decrease from 85.94% to 91.70%.

4. Total Nitrogen Compound Decrease

Total nitrogen is sum of NH_3-N, NO_3-N, and NO_2-N concentration. At COD/N 10/1 ratio average efficient decrease of nitrogen compound at 100% circulation is 60.13%, while COD/N 20/1 ratio is 59.46%. The highest compound if effluent is NO_3-N. This compound becomes high because of there is a change of nitride to be nitride to be nitrate as a result of ammoniac change.

CONCLUSION

Optimum nitrification of COD/N 10/1 ratio can be reached at 100% circulation and 99.07% efficiency while COD/N 20/1 is at the same circulation and 93.68% efficiency. Optimum denitrification of COD/N 10/1 can be reached at 200% circulation and 94.97% efficiency while COD/N 20/1 is at 100% circulation and 94.78% efficency.Total efficient decrease of nitrogen compound at COD/N 10/1 ratio is60.13% while COD/N 20/1 is 59.46%.

RECOMENDATION

In order to raise efficient decrease of nitrogen compound, it should be added an anoxic reactor after aerobic to make nitrate concentration down.

References

APHA, 1992, *Standard Method for the Examination of Water and Wastewater*, 18th ed. American Public Health Association, New York.

Bitton, G, 1994, *Wastewater Microbiology*, John Wiley and Son, Singapore.
Boongstrang, A, Maeda, Y., Suga, K., 1982, *Nitrogen Removal throughout Nitrification, Followed by Denitrification of a Synthetic Wastewater with a Rotating Disc Contractor*. Journal of Fermentation Technology, Vol 60. No.4

Christensen, MH and P. Harremoes, 1978. *Nitrification and denitrification in Wastewater Treatment*, pp-319-414. In Water Pollution Microbiology. Vol.2. R Mitchell, ed Wiley, New York.

Hammer M.J. 1986. *Water and Wastewater Technology*. John Wiley & Sons. New York.

Hao. O.J and Kim . H.M 1990 *Continuous Pre-Anoxic and Aerobic Digestion of Waste Activated Sludge*. Journal of Environemental Engineering. Vol. 116 No.5

Metcalf and Eddy 1991.*Wastewater Engeneering Treatment Disposal Reuse.* 3th ed. McGraw-Hill Book Co, Singapore

Nathanson, J.A. 1997 *Basic Environmental Technology Water Supply, Waste Management and Pollution Control*. Prentice-Hall. New Jersey.

Weisman, U. 1994 *Biological Nitrogen Removal from Wastewater*. Advance in Biochemical Engineering/Biotechnology. Vol.51. A. Fiecher (ed) Springerverlag, Berlin Heidenberg.

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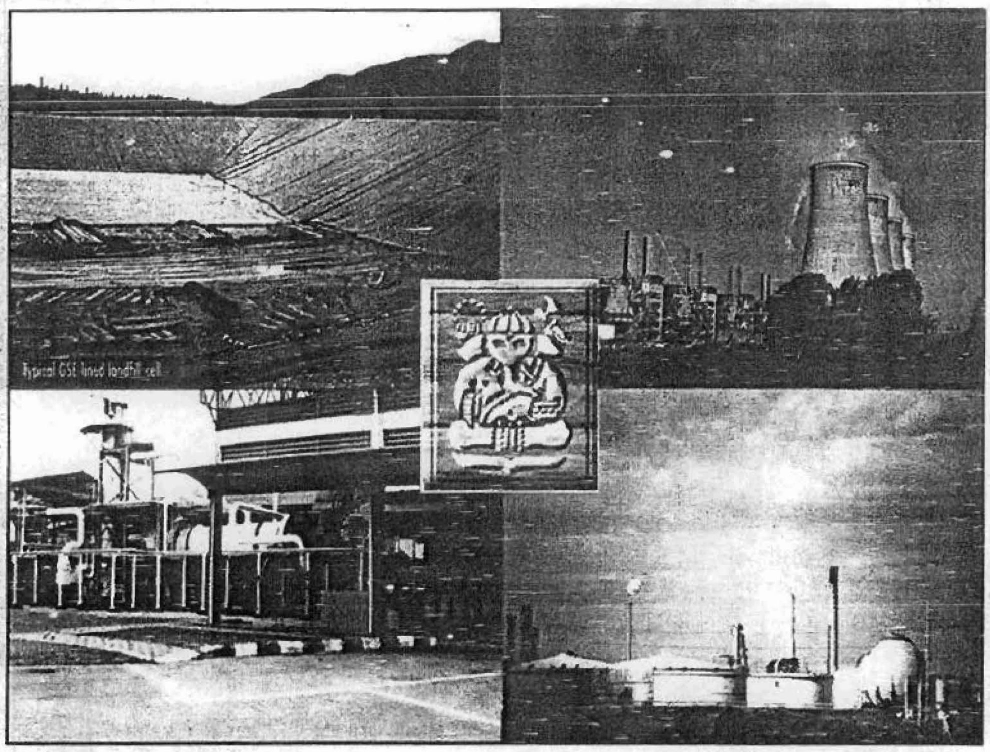
ISBN 979-8456-20-3

ETMS 02

ENVIRONMENTAL TECHNOLOGY & MANAGEMENT SEMINAR 2002

January 9 -10, 2002, Bandung - Indonesia



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Surat Pendokumentasian Karya Ilmiah
Nomor : 3912/I3.6.3 /PP/2009

Karya ilmiah/hasil penelitian atau hasil pemikiran yang tidak dipublikasikan, dengan judul :

Biological Nutrient Removal from Agroindustrial Wastewater Using a Two Reactor System. 2002

Penulis : M. Sukiman, Anas Miftah Fauzi, M. Romli, Suprihatin, Andes Ismayana.

Didokumentasikan di Departemen Teknologi Industi Pertanian Fakultas Teknologi Pertanian Institut Pertanian Bogor.

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