NST 2020_Performance of Spirulina Platensis in Oxidation Ditch Reactor for treating Tofu Wastewater

by Euis Nurul Hidayah

Submission date: 03-Dec-2020 07:46AM (UTC+0700)
Submission ID: 1462987942
File name: NST_2020_Performance_of_Spirulina.pdf (787.45K)
Word count: 1760
Character count: 9530

1st International Conference Eco-Innovation in Science, Engineering, and Technology
Volume 2020
http://dx.doi.org/10.11594/nstp.2020.0512

NST PROCEEDINGS

OPEN ACCESS

Conference Paper

Performance of Spirulina Platensis in Oxidation Ditch Reactor for treating Tofu Wastewater

Lolita Kurniasari [1]*, Savira Safrilia [1], Ni Made Maya Febriana Ramadhany [2], Iqbal Ramadhan [1], Euis Nurul Hidayah [1]

[1] Undergraduate Program of Environmental Engineering, Universitas Pembangunan Nasional "Veteran" Surabaya, East Java, Indonesia
[2] Master Program of Environmental Science, Universitas Pembangunan Nasional "Veteran" Surabaya, East Java, Indonesia

*Corresponding author:
E-mail: lolitakurniasari@gmail.com

ABSTRACT

Spirulina platensis is a type of blue - green algae that has a micro-sized spiral shape and lives in marine waters. There are so many benefits of this microalgae, one of which is it can degrade organic pollutants in wastewater. Excessive nitrate and phosphate in the water can cause eutrophication which is indicated by the death of many sea biotas because of phytoplankton bloom. In this research, tofu which high in organic pollutants are used as experimental test media. The microalgae which will be tested is cultivated first to obtain a sufficient amount for research, then the microalgae are acclimatized before being put into an Oxidation Ditch Reactor mixed with tofu waste with a capacity of 250 liters, ran with 60 rpm brush aerator for 7 x 24 hours and also uses natural lighting from sunlight. samples were taken once a day at 12 noon each day. This research has a variety of wastewater: algae that are 1:1. From the results, it can be observed that Spirulina platensis microalgae could reduce maximum phosphate by 33,15 %, from 18,1 mg/L to 12,1 mg/L. Furthermore, microalgae also capable of decreasing nitrates by 46,07 from 0,89 mg/L to 0,48 mg/L.

Keywords: nitrate, oxidation ditch algae reactor, phosphate, tufo wastewater

Introduction

Nitrates and phosphates are a source of nutrients needed by living organisms in the waters. But if these nutrients are in excess and cross the threshold, eutrophication will occur which disturbs the ecological balance of organisms in the water (Boeykens *et al.,* 2017). In addition, if you consume drinking water that is high in nitrate content, it will cause methemoglobinemia in infants, liver damage, and even carcinogenic diseases (Fewtrell, 2004).Therefore, removal of nitrates and phosphates in water is very important to improve water quality.

At present, various types of treatment are applied to degrade nitrates and phosphates (Yamashita *et al.,* 2014). But microalgae-based biological treatment is the most interesting because it has a high efficiency and low cost. In addition, if processing with microalgae, no more waste is released by the microalgae. *Spirulina platensis* is used because it can reduce the nitrate content in water only at relatively low concentrations (Nemcic-Jurec & Jazbec, 2016). Spirulina platensis is a green-blue microalgae that has a spiral length of 43 - 57 µm and a width of 26 - 36 µm (Jung & Kruger-Genge, 2019). Spirulina has several advantages over other types of microalgae, namely it is faster in production and its biomass is easy to harvest (Soni & Sudhakar, 2017).

The oxidation ditch is a modification of the activated sludge process which has been known for many years to remove nitrogen content (Hadisoebroto *et al.,* 2014). This building is usually made of concrete or soil that is excavated to a certain depth. OD consists of an aeration basin in

How to cite:
Kurniasari, L., Safrilia, S., Ramadhany, N. M. M. F., Ramadhan, I., & Hidayah, E. N. (2020). Performance of spirulina platensis in oxidation ditch reactor for treating tufo wastewater. *1st International Conference Eco-Innovation in Science, Engineering, and Technology*. NST Proceedings. pages 86-90. doi: 10.11594/ nstp.2020.0512

the form of a trench with one or more rotational rotors. Meanwhile, the *Oxidation Ditch Reactor* (ODR) has a flow circuit and has a brush aerator which has the function of providing air in water. So that in this study a combination of oxidation ditch will be carried out by adding algae *Spirulina platensis* to it to remove nitrate and phosphate content in water (Lodi *et al.,* 2003).

Material and Methods

Cultivation

The microalgae *Spirulina platensis* will be cultivated until they are sufficient for the main research. Cultivation is carried out by mixing microalgae seeds with mineral water mixed with sea salt provided that every 500ml of mineral water requires 2 teaspoons of sea salt which will then be put into a container. During the cultivation process, fertilizers, adequate lighting, and aerators are also needed so that microalgae can grow well. Microalgae growth can be seen by changing its color. If the microalgae has turned dark green color, then it can be moved to another place to be cultivated again.

Acclimatization

Before doing the main research, the algae were acclimatized to find out how resistant the algae were to pollutants in wastewater. At this acclimatization stage, variations in the concentration of waste 10%, 20%, 30%, and 40% were used and the best results were obtained, namely at a concentration of 30%, where the macroalgae conditions showed a color change on the seventh day. Whereas in mg / L, the condition of the macoalgae had changed color on the second day and began to die on the third day. So from the result of the amatization, the concentration of waste used for the main research was 30%.

Main Research

The reactor used is cleaned and sterilized using alcohol first. After that, the reactor was filled first with algae and then finally filled with tofu waste. Then the aerator brush is rotated at 60 rpm for 24 hours. Samples were taken on days 1, 2, 3, 5, and 7 once a day.

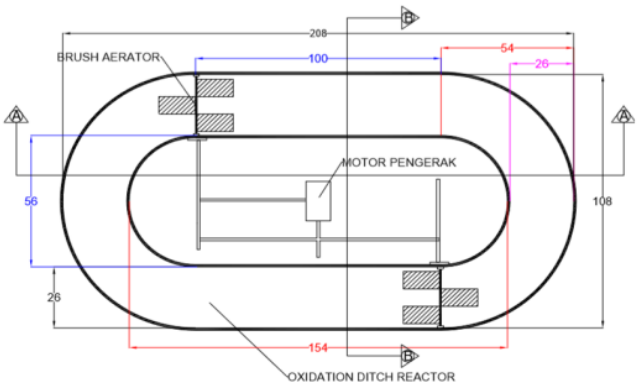

Figure 1. Oxidation ditch reactor design

Results and Discussion

Phosphate removal (%)

Phosphate is a source of P for microalgae. The reduced levels of phosphate in the microalgae media were caused by the utilization of phosphate as a nutrient for the growth of microlagas.

phosphate functions as energy metabolism, protein synthesis, regulation of starch and starch production, formation of protein, carbohydrates, cell structure and cell membrane stabilizers (Kim *et al.,* 2011). The phosphate ion in this study is utilized by microalgae as nutrients so that the longer the macroalgae lives in the waste media, the smaller the phosphate concentration in the waste (Dickinson *et al.,* 2016).

After the experiment was carried out within 7 days, it was obtained that the percentage reduction in phosphate was relatively stable. This result was assumed to be the optimum time for microlaga to remover phosphate. Sampling was carried out on days 1, 2, 3, 5, and 7 at 12 noon. Following are the results of the phosphate analysis after analysis.

Table 1. Phosphate reduction percentage

Day	Phosphate (mg/L)	Removal (%)	Biomass (mg/L)
1	18,1	-	1.510
2	17,23	4,81	2.050
3	15,9	12,15	2.350
5	14,54	19,67	3.020
7	12,1	33,15	3.320

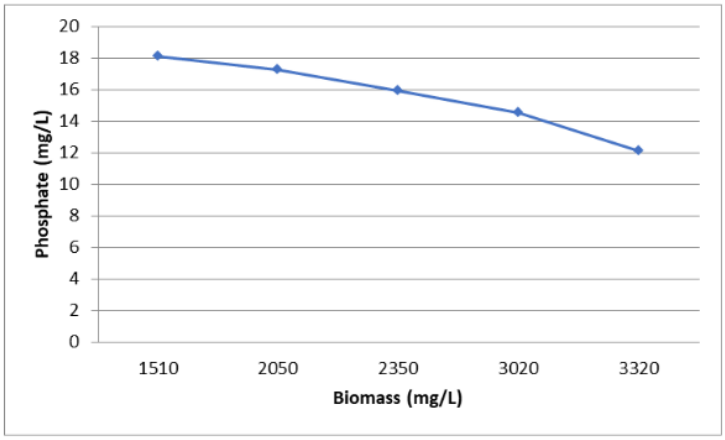

Figure 2. Phosphate reduction chart

It can be seen in the graph and table that the phosphate reduction data in the reactor with tofu waste is obtained. The results of the initial analysis of phosphate taken from the first day were 18.1 mg / L. Then on the second day, the maximum phosphate reduction was 4.81%. Then on the third day of observation, the maximum phosphate reduction was 12.15%. Furthermore, on the fifth day of observation, the maximum phosphate reduction was 19.67%. Finally, on the seventh day of observation, the maximum phosphate reduction was 33.15%.

Removal nitrat (%)

Utilization of N as a nutrient by macroalgae can assist growth and synthesis in protein. According to Harrison & Hurd (2001) nitrogen that can be utilized directly by macroalgae are free ammonia (NH3) and nitrate (NO3), which can function for the formation of amino acids, fats, and vegetative cells. After the experiment for 7 days, the following graph was obtained.

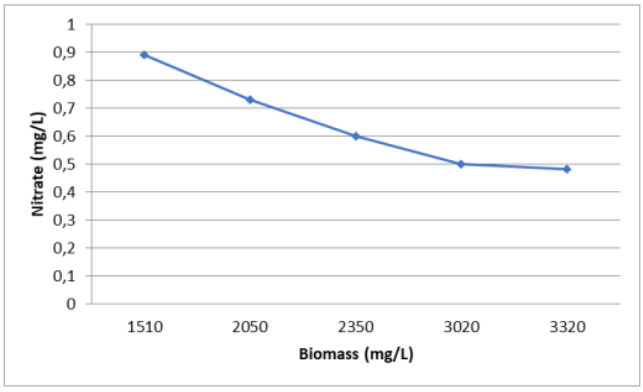

Figure 3. Nitrate reduction chart

It can be seen in the table and graph above that the nitrate reduction data in the reactor is obtained. The results of the initial analysis of nitrate taken from the first day were 0.89 mg / L. Then on the second day the maximum nitrate reduction was 17.98%. Then on the third day of observation, the maximum nitrate decrease was 32.58%. Furthermore, on the fifth day of observation, the maximum nitrate reduction was 43.82%. Finally, on the seventh day of observation, the maximum nitrate reduction was 46.07%.

Conclusion

Microalgae Spirulina platensis was able to reduce the maximum phosphate content in tofu wastewater by 33.15%. Furthermore, microalgae were able to reduce the Nitrate content in tofu wastewater by 46.07%.

Acknowledgment

Praise be to Allah SWT for giving His grace and guidance so that we can finish this journal well. And we also thank Mrs. Euis Nurul Hidayah ST., MT., Ph.D because she was the one who always helped and gave us direction. As well as to colleagues who have been good at working together and giving encouragement.

References

Berykens, S., Piol, M. N., Legal, L. S., & Saralegui, A. B. (2017). Eutrophication decrease: Phosphate adsorption processes in presence of nitrates. *Journal of Environmental Management, 203*(3), 30-35, doi: 10.1016/j.jenvman.2017.05.026

Dickinson, S., Mientus, M., Frey, D., Amini-Hajibashi, A., Ozturk, S., Shaikh, F., Sengupta, D., & El-Halwagi, M. M. (2016). A review of biodiesel production from microalgae. *Clean technologies and Environmental policy, 19*(3), 135-141.

Fewtrell, L. (2004). Dringking-water nitrate, methemoglobinemia, and global burden of disease: A discussion, *112*(14),1371-4. doi: 10.1289/ehp.7216

Hadisoebroto, R., Kamil, I. M., Notodarmojo, S., & Bindar, Y. (2014). Improving performance of water treatment on oxidation ditch using modification of reactor hydrodynamic. *Jurnal Teknologi, 69*(6), 55-60.

Harrison, P, J., & Hurd, C. L. (2001). Nutrient physiology of seaweeds: Application of concepts to aquaculture. *Cah. Biol. Mar.,42*, 71-82.

Jung, F., & Kruger-Genge, A. (2019). Spirulina platensis, a super food?. *Journal of Cellular Biotechnology, 5*(1), 43-54. doi: 10.3233/JCB-189012

Kim, H-C., Kim, T-W., & Kim, D-M. (2011). Prolonged production of proteins in a cell-free protein synthesis using polymeric carbohydrates as an energy source. *Process Biochemistry, 46*(6), 1366-1369. doi: 10.1016/j.procbio.2011.03.008

Lodi, A., Binaghi, L., Solisio, C., & Converti, A. (2003). Nitrate and phosphate removal by *Spirulina platensis*. *Journal of Industrial Microbiology and Biotechnology, 30*(11), 656-60. doi: 10.1007/s10295-003-0094-5

Nemcic-Jurec, J., & Jazbec, A. (2016). Point source pollution and variability of nitrate concentrations in water from shallow aquifers. *Applied Water Science, 7,* 1337-1338.

Soni, R. A., & Sudhakar, K. (2017). Spirulina-from growth to nutritional product: A review. *Trends in Food Science & Technology*, *69*, 34-42.

Yamashita, T., & Yamamoto-Ikemoto, R. (2014). Nitrogen and phosphorus removal from wastewater treatment plant effluent via bacteria sulfate reduction in an anoxic bioreactor packed with wood and iron. *Int.J. Environ. Res. Public Health, 11*, 9835-9853. doi:10.3390/ijerph110909835

NST 2020_Performance of Spirulina Platensis in Oxidation Ditch Reactor for treating Tofu Wastewater

ORIGINALITY REPORT

2%	2%	2%	0%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	repository.unair.ac.id Internet Source	1%
2	jcs.biologists.org Internet Source	1%
3	www.tierzucht.uni-kiel.de Internet Source	1%
4	www.nstproceeding.com Internet Source	<1%

Exclude quotes	Off	Exclude matches	Off
Exclude bibliography	On		