# Performance of Floating wetland to reduce the organic matter in river water

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**Submission date:** 28-Mar-2023 12:59PM (UTC-0400)
**Submission ID:** 2049177278
**File name:** 4_Performance_of_Floating_wetland_to_reduce_the.pdf (1.83M)
**Word count:** 1716
**Character count:** 8917

MATEC Web of Conferences **280**, 05013 (2019) https://doi.org/10.1051/matecconf/201928005013
*ICSBE 2018*

# Performance of Floating wetland to reduce the organic matter in river water

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**Abstract.** Floating wetlands are innovative systems that rarely used in South Kalimantan Indonesia so their performance using local species of plant are still scarcely known. To gain initial information on their performance and potential in removing pollutants, especially organic content, an experiment have been conducted in laboratory scale. This study used local plants (*Echinodorus palaefolius* and *Limnocharis flava*) with a plant height of approximately ±30 cm and ±15 cm, grown with a distance of 15 cm x 15 cm, which was floated into a plastic-coated plywood reactor with a size of 80 cm x 40 cm x 40 cm. Water samples are taken from Kerukan River (Banjarmasin, South Kalimantan Indonesia) which is flowed continuously to the reactor with a flow rate of 0.002 L/s. After 30 days, floating wetland planted with *E. palaefolius* can reduce organic material (BOD, COD) by 82.19%; 77.22% and floating wetland planted with *L. flava* can reduce BOD and COD respectively by 78.83% and 72.75%. This show that floating wetland very potential to use as an organic pollutant removal from river water.

## 1 Introduction

The Kerukan River is one of the existing river in Banjarmasin City with the classification of a small river with a length of 1113.03 m, and has a maximum width of 23 m, with an empty river to Barito. Kerukan River is located in Teluk Dalam village, Banjarmasin Tengah sub-district, with a population of about 28,321 people. Based on the findings of the field found several domestic sewerage dumps residents around directly discharged into the river Kerukan [1]. One way to find out how far pollution loads on wastewater is to measure BOD (Biochemical oxygen demand), and COD (Chemical Oxygen Demand). BOD is the amount of oxygen demand needed by microorganisms to oxidize the organic compounds present in the waste. COD is the amount of oxygen needed to oxidize the organic compounds chemically [2]. The initial test results of BOD and COD in Kerukan Banjarmasin river water were 27.52 mg / l and 54.47 mg / l, respectively. The value of BOD and COD exceeds the water quality standard of the river according to South Kalimantan Governor Regulation No.5: 2007.

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Floating wetland is one of the cheap, easy and effective technology to improve the quality of river water. The water purification process in a floating wetland involves biological processes with the help of microorganisms, physical processes, and chemistry. However, the use of a floating wetland system in South Kalimantan is fairly new because it has not been widely applied. Therefore, to gain initial information on floating wetland performance and potential in removing pollutants, especially organic matter, experiments have been conducted in laboratory scale.

## 2 Materials and methods

This research was carried out with the floating wetland system, the operating system in kontinu with flow rate 0.02 m/s. The research was conducted for 30 days with of 5-day sampling interval. The model constructed wetland is made of wood with dimensions of 0.8 m x 0.4 m x 0.4 m. River water derived from Sungai Kerukan di Kelurahan Teluk Dalam Kecamatan Banjamasin Barat, South Kalimantan, Indonesia. Wetland vegetation used are *Limnocharis flava* and *Echinodorus palaefolius* with an average height of 15 cm with a spacing of 15 cm. Plants are acclimatized for 7 days. At the acclimation stage fertilizer and river water are dredged, which is marked by the condition of the plant not dry, the addition of plant height and the appearance of plant roots in the lower layer of paranet. Effluent water samples will be tested by testing the parameters of BOD (Biochemical oxygen demand) (Winkler method), and COD (Chemical Oxygen Demand) (SNI 6989.2: 2009) in the laboratory. The efficiency of a floating wetland was calculated using the equation:

$$E = \frac{Co - Ce}{Co} x\ 100\% \quad (1)$$

with
E= Efficiency (%)
Co= influent BOD and COD concentration (mg/L)
Ce= effluent BOD and COD concentration (mg/L)

## 3 Results and Discussion

### 3.1 Biochemical Oxygen Demand (BOD)

To show the organic content in river water, this study determines BOD as a parameter. The BOD is an empirical test to determine the molecular oxygen used during a specified incubation period (usually five days), for the biochemical degradation of organic matter (carbonaceous demand) and the oxygen used to oxidize inorganic matter (e.g., sulfides and ferrous iron). Results of this study showed that on the first five days the system failed to reduced organic matter in river water, this showed by BOD effluent is higher than BOD influent in both floating wetland planted with *E. palaefolius* and *L. flava* (Fig. 1). This may be due to the dissolution of the plant attachment media in the paranet layer which is also characterized by an increase in water turbidity. Increased turbidity can reduce the intensity of sunlight which can interfere with photosynthesis so that the dissolved oxygen levels in the water decreases. But in 10 days, the BOD was reduced by 13.08% (floating wetland planted with *L. Flava*) to 53.05 % (floating wetland planted with *E. palaefolius*) (Fig.2). BOD reducing by the floating wetland system continue until day 30. Organic substances contained in wastewater will be decomposed by microorganisms into simpler compounds and will be used by plants as a nutrient. Plant root tissues will decompose organic matter

into carbon, nitrogen, and energy for microbial life (Handayanto and Hairiah, 2007). The decline in BOD values is caused by microorganisms that begin to decompose organic waste due to the increase of dissolved oxygen (DO) values caused by oxygen-releasing plants on the surface of the roots to form a rhizosphere zone [3]. In addition, one of the media used is cow dung, it can reduce BOD levels 65 - 95 percent, allegedly in cow dung there are some populations of microorganisms, one of which is a type of heterotrophic microorganisms. Heterotrophic microorganisms are the most efficient microorganisms in the metabolism of organic matter.

Plants supply oxygen to the water and soil so that the environment has a higher dissolved oxygen than water and soil are not overgrown with aquatic plants, thus allowing the aerobic microorganisms can live in an environment of artificial wetlands. Aerobic microorganism's role in lowering the BOD through the process of oxidation. Aerobic microorganisms decompose the organic matter faster than anaerobic microorganisms [4]. Floating wetland that planted with *E. palaefolius* has greater efficiency (82.19%) in reducing BOD compared with Floating wetland that planted with *L. Flava* (78.83%) (Fig.2). This suggests that different plant species have differences in the amount of oxygen supplied by the roots.

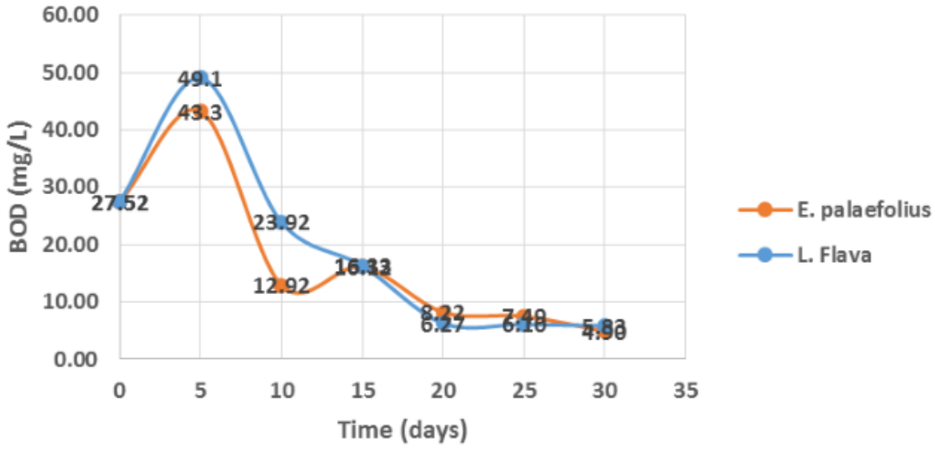


**Fig 1.** BOD effluent of Floating wetland

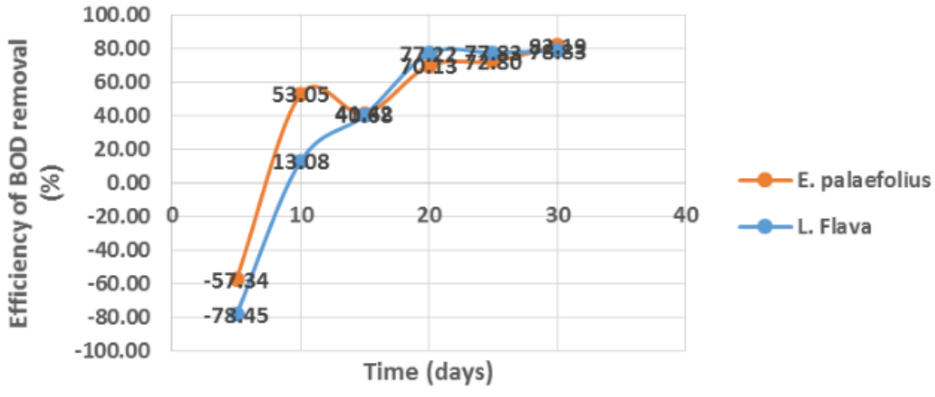


**Fig 2.** Floating wetland's efficiency of BOD removal

### 3.2 Chemical Oxygen Demand (COD)

In this study, the COD content from river water was also determined. COD is the amount of oxygen needed by an oxidizing agent to decompose (oxidize) all organic and inorganic materials contained in water. In the wastewater, there are several components that cannot be biologically oxidized by microorganisms. This is why the COD value is always greater than the value of BOD. The test results of COD which had been conducted used contact period every 5 days, for an average sample value of COD test results can be seen in Fig 3 and Fig 4.

The average of COD concentration increased concentration increased in the first five days, then decreased thereafter and continued to decline until day 30 (Fig 3). Floating wetland that planted with *E. palaefolius* has greater efficiency in reducing COD compared with Floating wetland that planted with *L. Flava*. The similar study by Prihatini, *et al.*, (2017) [5] show that ability to remove COD in constructed wetland reactor for 12 days of the plant *H. Verticillata* was 98.41%; *E. dulcis* was 98.73%; *N. nucifera* was 98.61%; and a combination of *H. verticillata, E. dulcis*, and *N. nucifera* was 98.83%. The declining COD value is due to the availability of oxygen in the water for the oxidation process. Oxygen in water is supplied by plant roots in a floating wetland and also the activity of microorganisms that add dissolved oxygen.

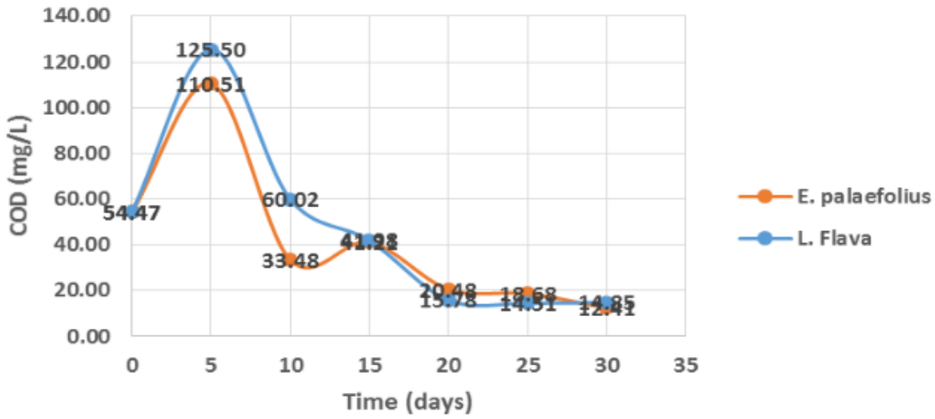


**Fig 3.** COD effluent of Floating wetland

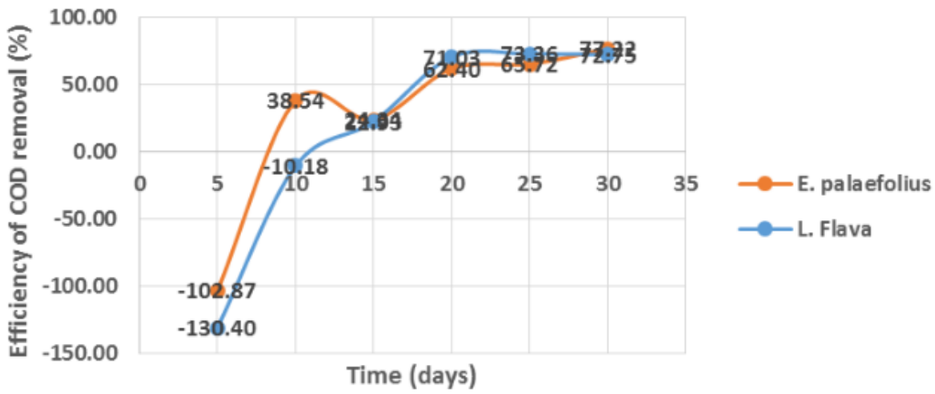


**Fig 4.** COD effluent of Floating wetland

## 4 Conclusion

The performance of Floating Wetland in removing organic pollutants in river water from an experiment in laboratory scale is, after 30 days, floating wetland planted with *E. palaefolius* can reduce organic matter (BOD, COD) by 82.19%;77.22% and floating wetland planted with *L. flava* can reduce BOD and COD respectively by 78.83% and 72.75%. This show that floating wetland very potential to use as an organic pollutant removal from river water.

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