5. Acknowledgements
The UNEP CounterMEASURE II project funded this research.

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B005

Soil Bacteria Dynamics in Constructed Wetland for Treating Domestic Wastewater Treatment

Chalisa Tudsanaton[a,b], Thanit Pattamapitoon[a,b], Onanong Phewnil[a,b], Kasem Chunkao[a,b], Parkin Maskulrath[a,b] and Watcharapong Wararam[a,b]

[a]*The King's Royally Initiated Laem Phak Bia Environmental Research and Development Project, Chaipattana Foundation, Thailand*
[b]*Department of Environmental Science, Faculty of Environment, Kasetsart University, Bangkok, Thailand*
Correspondence to Chalisa Tudsanaton
The King's Royally Initiated Laem Phak Bia Environmental Research and Development Project, Bangkok, 10900 Thailand Tel +6684-637-8514 E-mail: chalisa.tu@ku.th

Abstract
Regarded as one of the most natural methods for treating domestic wastewater, the constructed wetland has been referred to by many to have successfully treat such contaminants through the combination of many differences scientific processes which may include the likes of the phytoremediation and thermo-osmosis. While the efficiency of the system can varies depending the wastewater input at both the quantity and quality, the species of plant used also played the roles in the estimation for its usage period and appropriate design.
For Phetchaburi province, the municipality wastewater is gathered and transferred though a combine sewer system into the collection pound within the city, following the transfer process

under an anaerobic close pipe system (18.5km) into the 100-meter constructed wetland treatment facility at The King's Royally Initiated Laem Pak Bia Environmental Research and Development Project (LERD) in Laem Phak Bia Sub-district in Phetchaburi province. This study aims to focus on the usage efficacy of the constructed wetland wastewater treatment system after 6 years of usage towards the new readjusted wetland system. The results shows that there was a different in the two-time period of before and after the reconstruction in the *Typha angustifolia* Linn plot. The data demonstrate a differences number of bacteria while also showing that at 40-50meters, both the contaminates concentration and the bacteria dynamics shows a positive coloration as the bacteria and water quality (treatability). These dynamics suggested for the efficacy of the constructed wetland at the LERD Project to be over design. The findings of this paper suggested for the appropriate design and treatability of the domestic wastewater in the nature by nature constructed wetlands treatment system.

Keywords: *Typha angustifolia*, Nature by Nature, Bacteria Dynamics, Constructed Wetland, Wastewater

1. Introduction

One of the major continuous concerns about the increase in domestic wastewater management in maniciplaity, the focus in many first world countries have been through the introduction of high-end expensive treatment facilities that support the generation of these waste products. However, such technologies can been applied anywhere, one inhibition of this products are in it high price. With many developing countries unable to have a appropriate fundings for importing them. Through this the nature-by-nature initiates has been established in support for using local and inexpensive materials for solving the aforesaid problems.

Once of the most commonly found nature by nature techniques in treat domestic wastewater is through the use of the constructed wetland (CW). Where in understanding the bacteria, soils, plant and contaminants within the wastewater allows for the integration of both; science and engineering knowledge to combine as the CW system is a technology that mimics the nature and its low-cost solution are often to go-to method of many developing areas. Figure 1, shows the connectivity of the CW system.

Through its mention importance, this study focuses on the usage efficacy of the constructed wetland wastewater treatment system after 6 years of usage towards the newly readjusted wetland system bacteria dynamic.

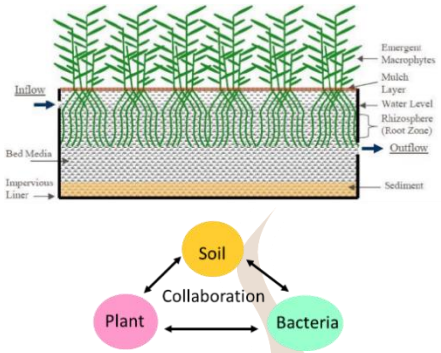


Figure 1: Outline dynamics of the CW system

1.1 Site of Study:

The study site is The King's Royally Initiated Laem Pak Bia Environmental Research and Development Project (LERD) in Laem Phak Bia Sub-district in Phetchaburi province. The LERD Project where the Phetchaburi municipality wastewater is gathered and transferred though a combine sewer system into the collection pound within the city, following the transfer process under an anaerobic close pipe system of 18.5km into the 100-meter constructed wetland treatment facility at.

Figure 2 Study Area

2. Materials and Methods

2.1 Structure and Working process of the CW system:

The normal working process of this CW is base on an alternating wet and dry phase. Where the mentioned wastewater is being transfer into the CW plot for 5 days and after 5 days of the HRT in the CW plot, where plants, bacteria and soils all work together to treat the wastewater, the treated wastewater is then release out into the nature, as another 2 days is use for drying the soil.

2.2 Collection Method and Plate Count for Aerobic Bacteria

While altogether this research will compare the differences in the soil dynamics between a newly construed CW system and a 6 years old CW system. With this will be in focus with the Aerobic bacteria, the sample collection is by using an aseptic method as follows: (Figure 3 and 4)

Using the soil core to collect the soil sample from 0-30cm soil depth, control the sample in 4C. Where the collation site is every 20meters in line from 0-100meters of the CW plot.
Once collected each sample from each distance will undergo a quartering method shown in the picture.

After the random quartering, the sample then undergo a “serial dilution” technique for finding the Total aerobic bacteria that will count the colonies and report the result.
The method was then repeated two times as these were the 1) The soil bacteria dynamics after

Distance (m)	Number of Aerobic bacteria (CFU/g)		p-value
	Before reconstruction	After reconstruction	
0	1.02×10^{7}	1.15×10^{6}	*
20	6.66×10^{6}	6.73×10^{5}	*
40	5.57×10^{5}	7.28×10^{5}	*
60	7.28×10^{6}	6.38×10^{5}	*
80	9.75×10^{6}	6.46×10^{5}	*
100	1.01×10^{7}	1.15×10^{6}	*

the 6 years use and 2) the newly constructed CW system.

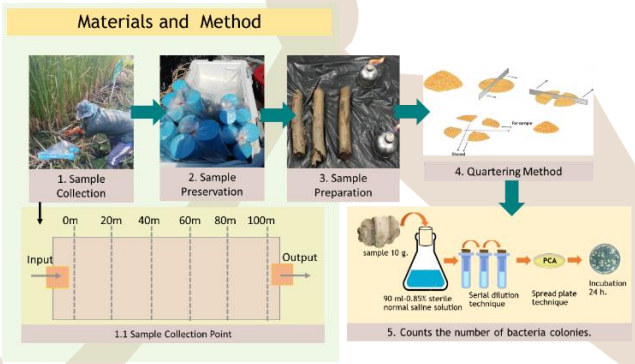
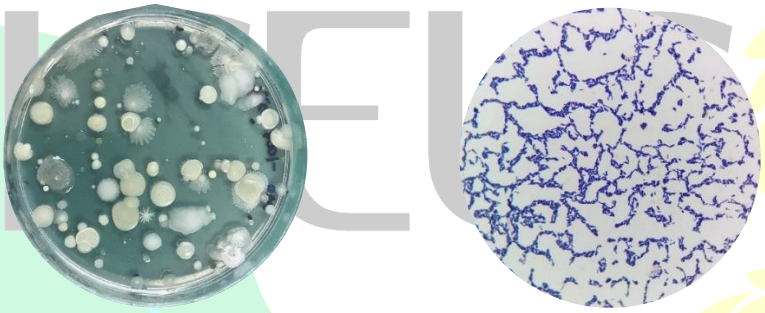


Figure 3 Sampling Collection; Quartering method. Collection Points and Serial dilution Method for Aerobic Bacteria Plate count



(a) **(b)**

Figure 4 (a) Aerobic bacteria on PCA and (b) gram-positive bacteria (Spore forming bacteria) were found in constructed wetland soil

3. Results and Discussion

Table 1: The Statical Test of the Number of Aerobic bacteria in the Before and After CW Plot
Remarks: * = Statistical variances at a 95% confidence level

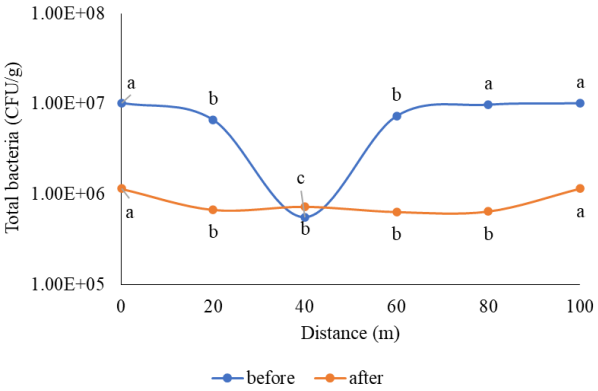


Figure 5: The number of aerobic bacteria colonies is different in both before (6 years) and the newly constructed CW system.

From the result in figure 5 and table 1, the number of aerobic bacteria colonies in the 6 years old CW plot, when compared to the aerobic bacteria colony in the newly constructed CW. In all in distance of the two plots at the distance of 0, 20, 40 ,60, 80 and 100m; within in its own plot. The results have suggested that as well significantly different in the age of the plot, newly constructed and the 6 years old plot has shown that have been containing the higher number of aerobic bacteria.

Where from the suggested study by (Chunkao et al., 2014) and (Wongsrikaew, 2019) In the CW plots, it has been show that in the age of usage of the plot for treating domestic wastewater, the input of organic matter has been deposited into the CW while this is not the only source of organic input into the CW plot, it was also base on the plant species that were used to Phyto remediate and treat the wastewater such that, the death or remaining part of the plant will also contribute to the organic content inside the plot thus as the result, the relation to the number of aerobic bacteria would increase base on the higher organic matter content.

In further analysis, the application of the water quality analysis in term of BOD concentration for the CW efficacy at the LERD project was also depicted as the biological oxygen demand (BOD) would be the clear indicator for the treatment efficacy of domestic wastewater. From Figure 6 it can see that the efficacy in the treatment of the BOD concentration have decreased over the 6 years period from 84.7% to 27.5%. where from the study of (Wongsrikaew, 2019) it was summarized that within the plant that was used within the plots, from the age of the plants the efficacy is then reduced.

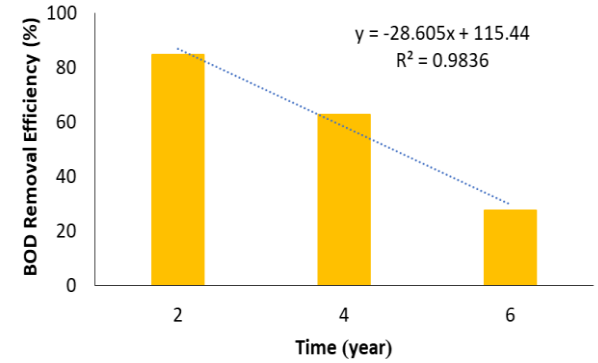


Figure 6 BOD removal efficiency in constructed wetland

While to combine this the knowledge of the increasing number of bacteria colonies, it can be state that the increasing number of bacteria does not go in a positive relationship with the

treatment efficacy in terms of BOD. Where to explain for this phenomenon, we have to look at the plant species used in the CW system. As a good phytoremediation plant, the LERD project have used different types of Fast-growing species of plant in treat the incoming domestic wastewater. As for this the fast-growing species such as Canna and Typha (for example) have their growing phase per life cycle of 90 and 45 days, respectively. Once these plants have reached their mature phase, we have to cut them in order to increase their efficiency in the treatment process.

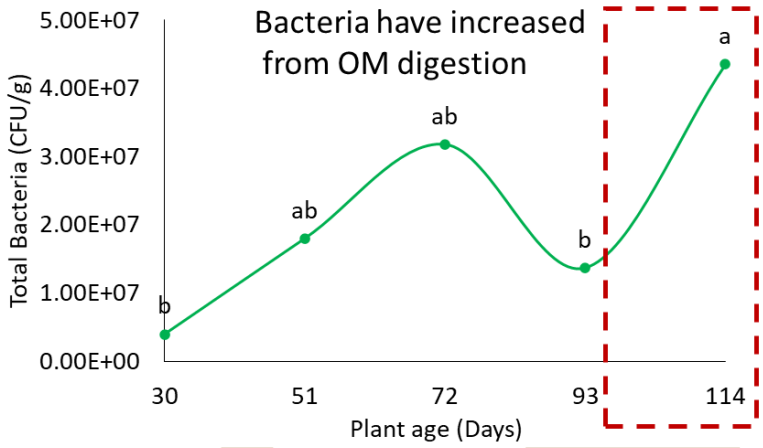


Figure 7 The Rhizosphere bacteria dynamic constructed wetland for treating domestic wastewater treatment

After many and many cycle of cutting, the plant begins to age. As many of their parts beings to fall off. This would then increase the amount of organic matter within the CW plot. Thus, besides digesting the organic matter OM in the incoming wastewater, the bacteria would also have to digest the plant dead parts as well. While it may seem that a higher colony of total aerobic bacteria is good in the treatment method, it can also be seen that these bacteria does not only digest to OM in the water but the dead plant parts as well, therefore, we get the lower treatment efficacy as the outcome of the growing age of the CW system.

5. Conclusion:

Thus from this study, it can be said that the results shows that there was a different in the two-time period of before and after the reconstruction of the Typha angustifolia Linn plot. As the data demonstrate a differences number of bacteria in both the contaminates concentration and the bacteria dynamics shows a negative coloration as the bacteria and water quality (treatability). These dynamics suggested for the efficacy of the constructed wetland at the LERD Project to be over design. The findings of this paper suggested for the appropriate design and treatability of the domestic wastewater in the nature by nature constructed wetlands treatment system as we also can prove about the apporite age where maintenance in required.

4. Acknowledgements

This study was funded by the King's Royally Initiated Laem Pak Bia Environmental Research and Development Project (LERD), Phetchaburi, Thailand

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