Assessment of surface water quality along Pazundaung Creek, Yangon City

Hein Htet AUNG (2), Theingi YE MYINT, Nway Nway KHAING

Department of Civil Engineering, Yangon Technological University, Yangon City, Myanmar

E-mail: thihaung.dst16@gmail.com

Abstract. This study focuses on the assessment of water quality at seven sampling points along the Pazundaung Creek in Yangon. Moreover, the determination of BOD, COD, DO, TH, EC, Cu, Cl, TDS, pH, turbidity and temperature were carried out. Water samples had been collected in February, March, April and May. According to the findings of this study, the water quality of Pazundaung Creek was deteriorated due to the rapid urbanization and industrialization along this creek. Therefore, the sources of these types of wastewater should be carefully controlled by applying the effective waste management systems and appropriate wastewater treatment technologies to prevent the water pollution of this creek. All of the results from sampling analyse were compared with Malaysia Water Quality Standard of class IIA and class IIB. According to the standard limitations of Malaysia Water Quality Standard, this type of surface water needed a conventional treatment process to use as water supply. In the case of fishery, the sensitive aquatic species can survival in these limitations and can also be used for recreational use with body contact.

Keywords: Assessment of water quality, Urbanization and industrialization, National water quality Standard of Malaysia

1. Introduction

Rapid Urbanization and Industrialization pose a significant threat to the quality of surface water when pollution exceeds the threshold limit. Urban and industrial activities are highlighted as one of the major causes of contamination in surface water bodies in Myanmar. Water is the basis of global ecosystem. The high average annual range in biochemical oxygen demand (BOD), chemical oxygen demand (COD), dissolved oxygen (DO) levels of surface water in Myanmar are mainly due to the huge discharges of municipal wastewater, Industrials and urban drainages into river basins.

In Myanmar, the amount of population density is greater and greater and then more facilities for our lifestyle are needed. If the industrial and domestic wastewaters are disposed without appropriate treatment, the surface water can be contaminated. After reaching over thresholds limit, they will give many hazardous and damages to biodiversity. Therefore, assessment of river water quality is very important which needed to know whether it is good or bad for domestic and agricultural purposes. The objective of this study is to assess the water quality deterioration due to the urbanization and industrialization along Pazundaung Creek. In this study, the water quality assessment of this Pazundaung Creek covering the periods from February to May 2019 was carried out.
2. Background of the study area
The study area is along the Pazondaung Creek in Yangon City as shown in Figure 1. The length of this creek is 75 miles from north to south and there are five industrial zones and suburban or urban settlements along their flow way. Therefore, it has rapid urbanization as well as rapid industrialization. There are seven sampling points in this study area and they are;
(1) Headwater of Pazundaung Creek
(2) Outlet of Shwe Pouk Kan Industrial Zone
(3) Before South Dagon Industrial Zone
(4) After South Dagon Industrial Zone
(5) Before Thaketa Industrial Zone
(6) After Tharketa Industrial Zone and
(7) Around Pazundaung Market

Figure 1. Location map of study area.
3. Material and Methods

Firstly, the samples were collected from Pazundaung Creek. The required water samples were collected from seven sampling points as shown in Figure 1 and they are headwater of Pazundaung Creek, outlet of Shwe Pouk Kan Industrial Zone, before South Dagon Industrial Zone, after South Dagon Industrial Zone, before Thaketa Industrial Zone, after Tharketa Industrial Zone and around Pazundaung Market.

Secondly, some water quality parameters of water samples were determined. For the third step, the laboratory results of water quality determination were analyzed.

Finally, the results were compared with the National Water Quality Standards of Malaysia Class IIA and IIB. Water qualities of samples were analyzed by field measurements and laboratory testing method. The water samples were collected in February, March, April and May of 2019.

Five parameters of water samples were experimented for each simple point in the field measurements of this study. They are pH, temperature, electrical conductivity (EC), total dissolved solid (TDS) and dissolved oxygen (DO). All of these parameters were analyzed by the Multimeter (SensoDirect 150) as shown in Figure 2.

The parameters for analyzing in laboratory testing were dissolved oxygen (DO), biological oxygen demand (BOD), chemical oxygen demand (COD), chloride (Cl), total copper (Cu), total hardness (TH), and Turbidity. Among them, DO, BOD and COD were analyzed with required chemicals and determined with standard method but Cl, Cu, total hardness and turbidity are analyzed with the photometer (MD 600) as shown in Figure 3. Sampling method was adopted from guideline of water sampling procedures from the project of World Bank and Government of the Netherlands funded.

All of the data and information of catchment area were received from surveying site study before starting sampling procedure, using internet website, studying the previous similar thesis references and using software application such as Google Earth and Google Map.

![Figure 2. Multimeter (SensoDirect 150).](image)

![Figure 3. Photometer (MD 600).](image)
4. Results and Discussion
The monthly results of seven sampling points along Pazundaung Creek were as shown in Table 1.

| Parameters | Months | NWQS for Malaysia |
|------------|--------|-------------------|
|            | Feb    | Mar               | April           | IIA | IIB |
| **BOD (mg/l)** |        |                   |                 |     |     |
|            | 2.4a   | 1.8a              | 6a              |     |     |
|            | 30b    | 30b               | 150b            |     |     |
|            | 60c    | 72c               | 30c             |     |     |
|            | 12d    | 36d               | 12d             |     |     |
|            | 72e    | 30e               | 12e             |     |     |
|            | 42f    | 18f               | 18f             |     |     |
|            | 42g    | 6g                | 12g             |     |     |
| **COD (mg/l)** |        |                   |                 | 25  | 25  |
|            | 32a    | 32a               | 128a            |     |     |
|            | 384b   | 480b              | 864b            |     |     |
|            | 320c   | 384c              | 288c            |     |     |
|            | 288d   | 256d              | 480d            |     |     |
|            | 128e   | 288e              | 384e            |     |     |
|            | 320f   | 320f              | 320f            |     |     |
|            | 192g   | 160g              | 288g            |     |     |
| **DO (mg/l)** |        |                   |                 | 5 to 7 | 5 to 7 |
|            | 3.35a  | 3.38a             | 4.3a            |     |     |
|            | 0.4b   | 0.5b              | 0.4b            |     |     |
|            | 1.3c   | 3.38c             | 1.4c            |     |     |
|            | 2.2d   | 2.5d              | 1.7d            |     |     |
|            | 3.3e   | 3.8e              | 2.1e            |     |     |
|            | 1.3f   | 4.2f              | 5.1f            |     |     |
|            | 1.2g   | 4g                | 3.9g            |     |     |
| **pH**     |        |                   |                 | 6 to 9 | 6 to 9 |
|            | 7.12a  | 7.16b             | 7.14c           |     |     |
|            | 7.34b  | 6.36b             | 8.34c           |     |     |
|            | 7.38c  | 5.51c             | 7.36c           |     |     |
|            | 7.39d  | 5.36d             | 7.55d           |     |     |
|            | 7.4e   | 5.52e             | 7.67e           |     |     |
|            | 7.43f  | 5.58f             | 7.35f           |     |     |
|            | 7.34g  | 8.07g             | 7.45g           |     |     |
| **EC (µS)** |        |                   |                 |     |     |
|            | 122.3a | 131.1b            | 187.7c          |     |     |
|            | 0.62b  | 0.86b             | 0.97b           |     |     |
|            | 2.6c   | 6.43c             | 5.15c           |     |     |
|            | 4.09d  | 9.48d             | 7.48d           |     |     |
|            | 4.01e  | 10.34e            | 7.82e           |     |     |
|            | 5.67f  | 12.09f            | 8.6f            |     |     |
|            | 8.85g  | 15.49g            | 12.31g          |     |     |
| Parameters     | Months          | NWQS for Malaysia |
|----------------|-----------------|-------------------|
|                | Feb             | Mar               | April            | IIA  | IIB  |
|                | 83\(^a\)        | 88.2\(^a\)        | 125\(^a\)        |      |      |
| TDS (ppm)      | 174\(^b\)       | 423\(^b\)         | 648\(^b\)        | 1000 |      |
|                | 174\(^c\)       | 423\(^c\)         | 342\(^c\)        |      |      |
|                | 267\(^d\)       | 639\(^d\)         | 499\(^d\)        |      |      |
|                | 265\(^e\)       | 693\(^e\)         | 508\(^e\)        |      |      |
|                | 381\(^f\)       | 808\(^f\)         | 572\(^f\)        |      |      |
|                | 593\(^g\)       | 1032\(^g\)        | 819\(^g\)        |      |      |
|                | 26\(^a\)        | 27\(^a\)          | 28\(^a\)         |      |      |
|                | 26\(^b\)        | 28.2\(^b\)        | 30.1\(^b\)       |      |      |
|                | 25\(^c\)        | 27.8\(^c\)        | 29.9\(^c\)       |      |      |
|                | 25\(^d\)        | 27.7\(^d\)        | 29.3\(^d\)       |      |      |
|                | 27.8\(^e\)      | 28.8\(^e\)        | 29.8\(^e\)       |      |      |
|                | 27.7\(^f\)      | 28.7\(^f\)        | 29.7\(^f\)       |      |      |
|                | 27.8\(^g\)      | 28.8\(^g\)        | 29.8\(^g\)       |      |      |
|                | 7\(^a\)         | 8\(^a\)           | 9\(^a\)          |      |      |
| Turbidity (FAU)| 408\(^b\)       | 573\(^b\)         | 10260\(^b\)      |      |      |
|                | 16180\(^c\)     | 12840\(^c\)       | 8200\(^d\)       |      |      |
|                | 2650\(^d\)      | 2830\(^d\)        | 3735\(^d\)       |      |      |
|                | 2836\(^e\)      | 2837\(^e\)        | 2838\(^g\)       |      |      |
|                | 3110\(^f\)      | 3111\(^f\)        | 3112\(^f\)       |      |      |
|                | 404\(^g\)       | 405\(^g\)         | 406\(^g\)        |      |      |
|                | 0.06\(^a\)      | 0.28\(^a\)        | 0.27\(^a\)       |      |      |
| Cu (mg/l)      | Underrange\(^b\) | Underrange\(^b\)  | Underrange\(^b\) | 0.02 | 0.02 |
|                | Underrange\(^c\) | Underrange\(^c\)  | Underrange\(^c\) |      |      |
|                | Underrange\(^d\) | Underrange\(^d\)  | Underrange\(^d\) |      |      |
|                | Underrange\(^e\) | Underrange\(^e\)  | Underrange\(^e\) |      |      |
|                | Underrange\(^f\) | Underrange\(^f\)  | Underrange\(^f\) | 1.2  |      |
|                | 0.57\(^g\)      | 1.57\(^g\)        | 2.57\(^g\)       |      |      |
|                | 4.8\(^a\)       | 6.1\(^a\)         | 6.5\(^a\)        |      |      |
| Cl(mg/l)       | Underrange\(^b\) | Underrange\(^b\)  | Underrange\(^b\) | 200  | 200  |
|                | Underrange\(^c\) | Underrange\(^c\)  | Underrange\(^c\) |      |      |
|                | Underrange\(^d\) | Underrange\(^d\)  | Underrange\(^d\) |      |      |
|                | Underrange\(^e\) | Underrange\(^e\)  | Underrange\(^e\) |      |      |
|                | Underrange\(^f\) | Underrange\(^f\)  | 85\(^f\)         |      |      |
|                | 9\(^g\)         | Underrange\(^g\)  | 89.5\(^g\)       |      |      |
### Parameters

| Parameters          | Months | NWQS for Malaysia |
|---------------------|--------|--------------------|
|                     | Feb    | Mar    | April | IIA | IIB |
| **Total Hardness (mg/l)** |        |        |       |     |     |
|                     | 38\textsuperscript{a} | 57\textsuperscript{a} | 74\textsuperscript{a} |     |     |
|                     | 183\textsuperscript{b} | 249\textsuperscript{b} | 235\textsuperscript{b} |     |     |
|                     | 377\textsuperscript{c} | 1460\textsuperscript{c} | 550\textsuperscript{c} |     |     |
|                     | 585\textsuperscript{d} | 1305\textsuperscript{d} | 1100\textsuperscript{d} |     |     |
|                     | 496\textsuperscript{e} | 1470\textsuperscript{e} | 1135\textsuperscript{e} |     |     |
|                     | 725\textsuperscript{f} | 1465\textsuperscript{f} | 1155\textsuperscript{f} |     |     |
|                     | 1175\textsuperscript{g} | 1850\textsuperscript{g} | 1590\textsuperscript{g} |     |     |

\textsuperscript{a} Sampling Point (1), Head Water of Pazundaung Creek  
\textsuperscript{b} Sampling Point (2), Outlet of Shwe Pauk Kan Industrial Zone  
\textsuperscript{c} Sampling Point (3), Before Southdagon Industrial Zones  
\textsuperscript{d} Sampling Point (4), After Southdagon Industrial Zones  
\textsuperscript{e} Sampling Point (5), Before Tharkaeta Industrial Zone  
\textsuperscript{f} Sampling Point (6), After Tharkaeta Industrial Zone  
\textsuperscript{g} Sampling Point (7), Around Pazundaung Market  
\textsuperscript{h} National Water Quality Standard (NWQS)

For sampling point (1), the concentration of BOD in April, COD and DO for all sampling months cannot meet with standard limits because of the pollutants entered to the headwater of the creek which has the low flow rate and shallow water depth. EC had the higher value than the other points for all sampling months due to the presence of dissolved solids such as chlorides and other compounds from the fertilizers, pesticides and animal manures used in agricultural farms near this point. The contents of total copper were also greater than the standard limit at this point due to the pesticides and animal manures used in agricultural farms near this point.

For sampling point (2), the concentration of BOD, COD and DO for all sampling months cannot meet with standard limits because of wastewater discharged from industrial zone and domestic wastewater from slung quarter near this point. Turbidity values did not meet with standard limits due to the wastewater from surrounding industrial zones, residential areas and grit works.

For sampling point (3), the concentration of BOD, COD and DO for all sampling months cannot meet with standard limits because of wastewater discharged from industrial zone and domestic wastewater from urban drainage channel near this point. Turbidity values did not meet with standard limits due to the wastewater from surrounding industrial zones, residential areas and grit works. The total hardness values which did not meet with the standard limit because of the fluctuation of mineral contents such as calcium and magnesium along the flow way of Pazundaung Creek. The water sample also had the acidic property in March and these values did not reach within standard range.

For sampling point (4), (5) and (6), the concentration of BOD, COD and DO for all sampling months cannot meet with standard limits because of wastewater discharged from industrial zone and domestic wastewater from urban drainage channel near this point. Turbidity values did not meet with standard limits due to the wastewater from surrounding industrial zones, residential areas and grit works. The total hardness values which did not meet with the standard limit because of the fluctuation of mineral contents such as calcium and magnesium along the flow of Pazundaung Creek. The water sample also had the acidic property in March and these values did not reach within standard range. The total copper contents were found at sampling point (5) in April and sampling point (6) in April and May due to the wastewater from industries zone near these points.

For sampling point (7), the concentration of BOD, COD and DO for all sampling months cannot meet with standard limits because of wastewater discharged from industrial zone and domestic.
wastewater from urban drainage channel near this point. Turbidity values did not meet with standard limits due to the wastewater from surrounding industrial zones, residential areas and grit works. The total hardness values which did not meet with the standard limit because of the fluctuation of mineral contents such as calcium and magnesium along the flow way of Pazundaung creek. The total copper contents were greater than standard limit for all sampling months due to the domestic wastewater from urban drainage channel near this point. In this research, the degree of temperature for all sampling points for all months met with standard degree.

**Figure 4.** Monthly Variation of BOD Concentrations from February to May 2019.

**Figure 5.** Monthly Variation of COD Concentrations from February to May 2019.
Figure 6. Monthly Variation of DO Concentrations from February to May 2019.

Figure 7. Monthly Variation of pH Concentrations from February to May 2019.
**Figure 8.** Monthly Variation of TDS Concentrations from February to May 2019.

**Figure 9.** Monthly Variation of Turbidity Concentrations from February to May 2019.
Figure 10. Monthly Variation of TH Concentrations from February to May 2019.

Figure 11. Monthly Variation of EC Concentrations from February to May 2019.
Figure 12. Monthly Variation of Total Copper Concentrations from February to May 2019.

Figure 13. Monthly Variation of Chloride Concentrations from February to May 2019.
5. Conclusion
According to the monthly results of water quality parameter, some water quality parameters were higher than standard limit due to the wastewater discharged from industrial zones and domestic waste water from urban drainage channel. Therefore, all industries and residential area around this creek should dispose the wastewater from their industries and outlet of urban drainages after treating by using the appropriate treatment processes and they should follow waste management system to achieve the sustainability of this creek.

Moreover, the using of fertilizers and pesticides for agricultural functions should be in the acceptable limit. The awareness of local people about the water pollution caused by the agrochemical products should be promoted by means of knowledge sharing programs. Moreover, the grit works along Pazundaung Creek are the considerable things because the concentrations of turbidity were higher than standard limit at sampling points (2) to (7).

Therefore, the over doing of grit works along Pazundaung Creek should be obstructed by the respective organizations. If the industries do not dispose the wastewater without doing treatment and all of the people follow the rules and regulations about the control of water pollution, the water quality of this creek can be acceptable for both water supply and recreational purposes.

6. Acknowledgment
First of all, the author is very thankful to Dr. Nyan Myint Kyaw, Professor and Head of the Civil Engineering Department, Yangon Technological University. Secondly, the author would like to express special thanks to DEEM project because of their supporting reagents, field measurement apparatus (Multimeter (Sensodirect 150)) and laboratory measurement apparatus (Photometer (MD 600)). The author would like to express his special thanks to Dr. Theingi Ye Myint, External Examiner and thanks to Dr. Nway Nway Khaing, Supervisor, for their support, advices, guidance and suggestions. Moreover, special thanks to laboratory technician Daw Naw Thay Gay Paw for her kind support to complete this research. Finally, the author would like to thank to all my friends who helped towards the successful completion of this study.
References

[1] Bartram J, Ballance R, 1996 Water quality monitoring: a practical guide to the design and implementation of freshwater quality studies and monitoring programmes CRC Press

[2] Chapman DV 1996 Water quality assessments: a guide to the use of biota, sediments, and water in environmental monitoring Second Edition Published by E&FN Spon.

[3] UNESCO-IHE, February 2015. “Pan Hlaing River in the Yangon delta, Myanmar”.

[4] Hydrology Project Training Module file 1999 How to sample surface water for water quality analysis Wold Bank and Government of The Netherlands funded [online] [Accessed 1.6 2019] [https://pdfslide.net/download/link/how-to-sample-surface-waters-for-water-quality-how-to-sample-surface-waterspdf]

[5] ECCM Department, Ethiopian Civil Service University 2018 Causes and impacts of river water pollution in Ethiopian

[6] Water Economic Partnership in Asia National Water Quality Standards for Malaysia [online] [Accessed 1.2.2019] [http://www.wepa-db.net/policies/law/malaysia/eq_surface.htm]