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Study on Water Quality Parameters of UTHM Campus Pagoh Drainage Water : COD, pH and Turbidity

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Abstract : Polluted water indicates harmful condition for the environment which causes adverse changes. Towards a sustainable campus environment, university authorities should provide a conducive surrounding from all aspects including water quality in drainage systems. Currently, the level of the water in Universiti Tun Hussein Onn Malaysia (UTHM) Campus Pagoh is still in questionable. This study was conducted to determine the water quality level in drainage system at UTHM Campus Pagoh based on the physicochemical parameters such as COD, pH and turbidity which the results were further supported by Parameter Limits Standard for Sewage & Industrial Effluents based on Environmental Quality (Industrial Effluent) Regulations, 1979 (Malaysia). This study also identified the correlation of these three parameters between UTHM Campus Pagoh (L1) and MPH, Shared Facilities (L2). The water sample was collected in 4 weeks from April to May 2021. The results show the mean score of physicochemical parameters at location 1 and location 2 were 202.42 mg/L (COD High Range, HR), 103.67 mg/L (COD Low Range, LR), 136.65 mg/L (COD HR) and 33.83 mg/L (COD LR), respectively. The mean of pH and turbidity for both locations were 7.24, 7.01, 17.89 NTU and 9.62 NTU. These results revealed that the level of COD at L1 and L2 exceed the limits except for COD LR at location 2 due to high oxidized organic matter in water sample. Furthermore, the COD HR was highly correlated between L1 and L2 except for pH and turbidity. Higher of COD value indicates higher content of organic matter in both locations. Thus, it affects the water quality in drainage system resulting unwanted smell and unpleasant campus landscape. Therefore, UTHM authorities should take further action in order to prevent possible water pollution points in UTHM Campus.

Keywords : Water quality parameter, drainage water, mean score, correlation, EQA-Parameter limits of effluent standard B.

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1. Introduction

UTHM Campus Pagoh and MPH is considered as a concentrated area thus the drains might be polluted as it is still unclear. Polluted drain which cause from high level of turbidity due to high content of suspended solid will produce bad odor and unpleasant view. Therefore, it also will effect of COD level in the drain. Chemical Oxygen Demand (COD) is most commonly used to determine the amount of oxidizable contaminants in surface water or wastewater [1]. Next, pH is used to measure the acidity or basicity of an aqueous solution. Acidity is indicated by a pH less than 7, while a pH greater than 7 indicates a base [1]. Besides, the high COD and unusual pH also affected aquatic living things and other animals around the area. The higher the COD value, the more serious the pollution of organic matter by water [2]. In addition, the majority of aquatic creatures suvive in a pH range of 6.5-9.0, though some can live in water with pH levels outside of this range [3]. It also can affect the reproduction of most aquatic living things as they are sensitive towards the acidity and basicity that exceeds the range. Thus, it needs determination to justify the conditions and taking actions.

The objective of this study is to determine the level of COD, pH and Turbidity of two sampling locations in UTHM Campus Pagoh and MPH drainage water. This study also to identify the correlation of COD, pH and Turbidity parameters between two selected sampling locations in UTHM Campus Pagoh (L1) and MPH (L2) drainage water. Water samples were taken from outside of UTHM Campus Pagoh and Shared Facilities drain water flow during 4 weeks which from 12 April until 5 May 2021. The laboratory testing is carried out to obtain the parameters of water quality which are COD, pH and turbidity. This study determine the level of these parameter water quality by analyze the mean score using Microsoft Excel. On the other hand, this two location is adjacent to each other. Thus, the correlation of both location is crucial as to justify the situation of both pollutions by the parameters from Parameter Limits for Sewage & Industrial Effluents based on Environmental Quality (Industrial Effluent) Regulations. Statistical Package for the Social Sciences (SPSS) is software was used to identify the correlation of these parameter water quality.

1.1 Parameter Limits of Effluent Standard

In Malaysia, Parameter Limits for Sewage & Industrial Effluents based on Environmental Quality (Industrial Effluent) Regulations exists since 1979 to help civilians analyze the water quality which being divided into two standards [4]. Parameter Limits for Sewage & Industrial Effluents based on Environmental Quality (Industrial Effluent) Regulations is being divided into two standards. If the point of discharge into the river is upstream from a water intake point for consumption or water catchment regions, Standard-A is used. Standard-B is applied if the point of discharge into the river is downstream from a water intake point for consumption or water catchment areas [4]. Therefore, parameter limits of effluent standard B will be used in this study since the drainage water in UTHM Campus, Pagoh area is stated as downstream level.

2. Materials and Methods

2.1 Methodology Flowchart

The overall research flow chart is shown in **Figure 1**. This research is mainly focus on study of water quality parameters of UTHM Campus Pagoh drainage water by evaluating the COD, pH and Turbidity data in two sampling locations. The process of laboratory testing for each one parameter was conducted in a week with several preparations and considerations to achieve study objectives as for this study research objective which is to determine the level of COD, pH and Turbidity and to identify the correlation of COD, pH and Turbidity parameters between two sampling locations. Water quality test data need to be analyzed to know the level of WQ of each parameter in L1 and L2 drainage water using mean score method and the result will be compared based on Parameter Limits of Effluent Standard B.

After that, this study involves analyzing data using SPSS software in order to find the relationship and correlation for each parameter of two sampling locations selected.

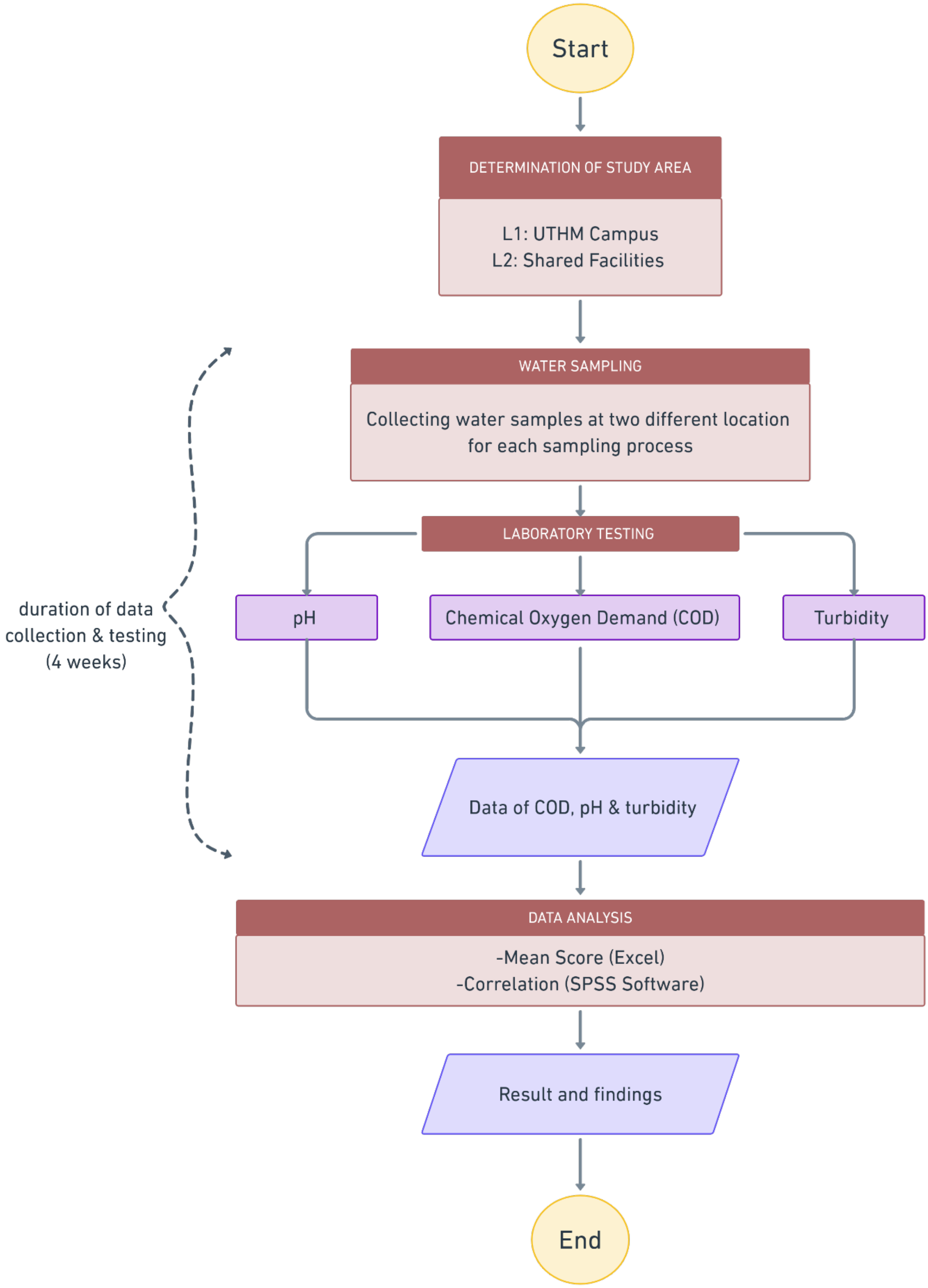

Figure 1: Research Flow Chart

2.1 Study Area

UTHM Campus Pagoh is located near the Exit of the Expressway of Pagoh, nearby with necessities and only 20 km away from Muar town city. It situated on a 170 acres site with a Gross Built-up Area of 19,400 sq. m which surrounded by 3 institutions, stadium and other facilities. In this study, two sampling locations located near the developed area were chosen**.** Figure 2(a) & (b) show the exact location of these two sampling locations. The details of the research area as shown in **Table 1**:

Table 1: Sampling location description and coordinates

Sample	Location	Coordinate	Description
L1	UTHM Campus	2° 8' 57.77" N, 102° 43' 51.92" E	Concentrated area. Nearby with the cafeteria, laboratories, classes, toilets and a pedestrian walk.
L2	Shared Facility	2° 9' 3.26" N, 102° 43' 57.25" E	Public area (some trees nearby). Nearby shared multi-purpose hall.

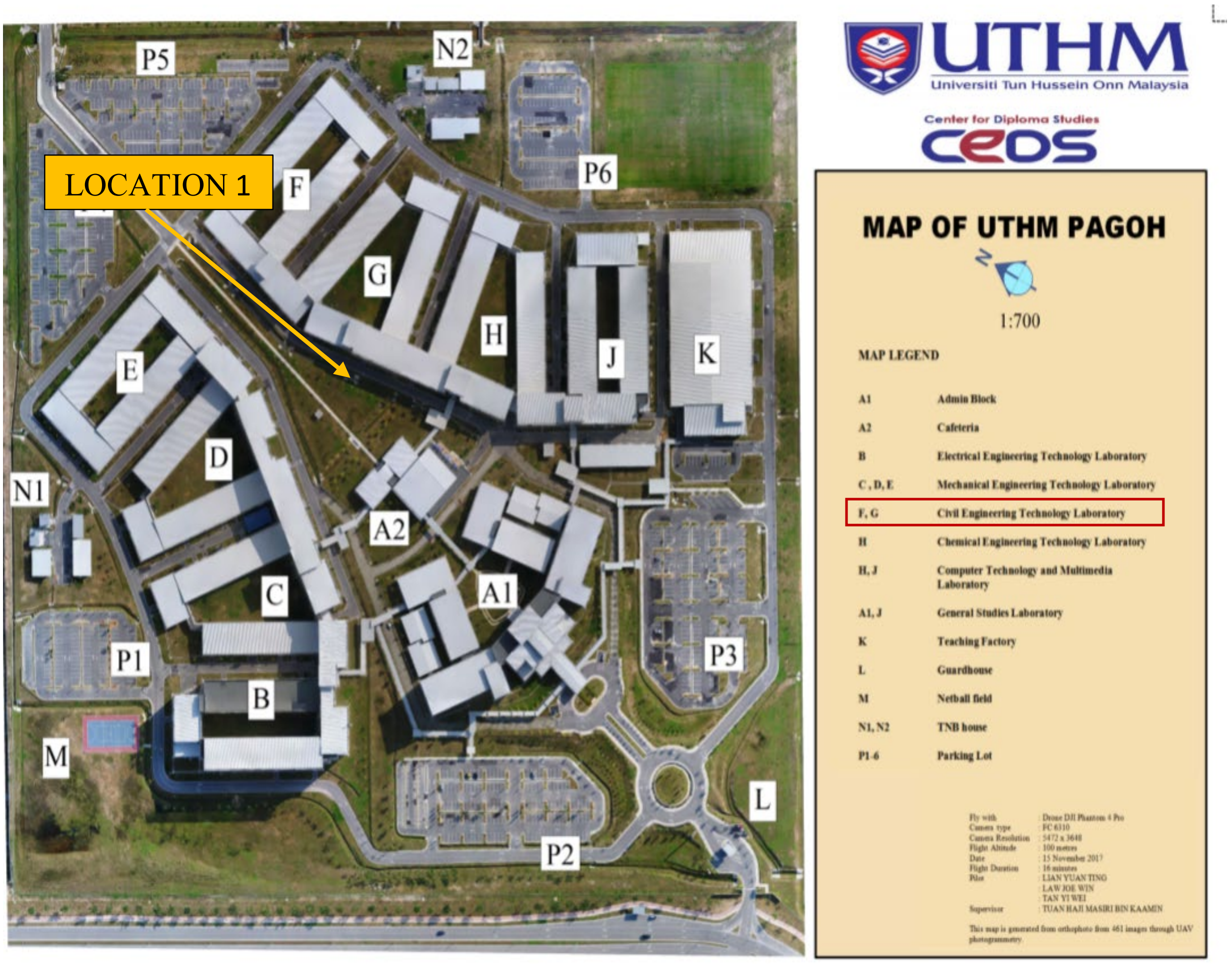

Figure 2: Sampling location, (a) Location 1 at UTHM Campus Pagoh, (b) Sampling location 2 at MPH

2.2 Sample Collection and Methods

Water sample from for both study location were collected at two sampling locations weekly (April to May 2021). Sample were analyzed for quality parameter. The parameters involved in this study were Oxygen Demand (COD), pH and turbidity. Furthermore, these samples were tested for contamination using a physicochemical approach in accordance with the American Public Health Association's standard procedure (APHA) for water examination [5]. The physicochemical parameter were measured in laboratory such as pH by using pH meter and the turbidity (TUR, NTU) was measured by using the tubidimetry. The chemical oxygen demand (COD) was analysed using the DRB200 Reactor and UV VIS Spectrophotometer (HACH DR6000). All laboratory analyses were conducted at the Environmental Laboratory of Civil Engineering UTHM.

2.3 Data Analysis and Statistical Method

Results of analysis were further compared with the parameter limits of effluent standard B stated by Environmental Quality Act (EQA) 1974, regulations of Environmental Quality (Sewage and Industrial Effluents) 1979, Malaysia as shown in **Table 2**. In the addition to the assessment of water quality, this study investigated the level of water quality in UTHM Campus, Pagoh. This appropriate/allowable will determine the circumstance of drainage water in UTHM Campus either exceed the limits standard or not in order to be a satisfactory drainage system.

Table 2: Parameter limits of Effluent Standard A and B [4]

Parameter		Unit	Standard	
			A	B
(i)	Temperature	°C	40	40
(ii)	pH value	-	6.0 - 9.0	5.5 - 9.0
(iii)	BOD at 20°C	mg/ l	20	50
(iv)	COD	mg/ l	50	100
(v)	Suspended Solids	mg/ l	50	100
(vi)	Mercury	mg/ l	0.005	0.05
(vii)	Cadmium	mg/ l	0.01	0.02
(viii)	Chromium, Hexavalent	mg/ l	0.05	0.05
(ix)	Arsenic	mg/ l	0.05	0.10

The obtained data were also analysed by using Pearson's correlation coefficient to assess the relationship of physicochemical parameters between two sampling locations, with the level of significance set as alpha value at $p<0.05$ [6][7], using the SPSS software [8]. All data were expressed as the average mean score and correlation coefficient (r) with significance 2-tailed. **Table 3** below demonstrates how correlation coefficient can be interpreted.

Table 3: Interpretation of correlation coefficient [9]

Size of Correlation	Interpretation
.90 to 1.00 (-.90 to -1.00)	Very high positive (negative) correlation
.70 to.90 (-.70 to -.90)	High positive (negative) correlation
.50 to .70 (-.50 to -.70	Moderate positive (negative) correlation
.30 to .50 (-.30 to -.50)	Low positive (negative) correlation
.00 to .30 (-.00 to -.30)	Negligible correlation

Next, correlation will be analyzed diagrammatically using a scatter diagram, as shown in **Figure 3** below. This scatter diagram will be developed with a dot drawn for each pair of data for X and Y, with the value in the X axis as L1 and the value of Y as L2 on the respective axis. The trend shown in Figure 3 is used to assess the strength of the association.

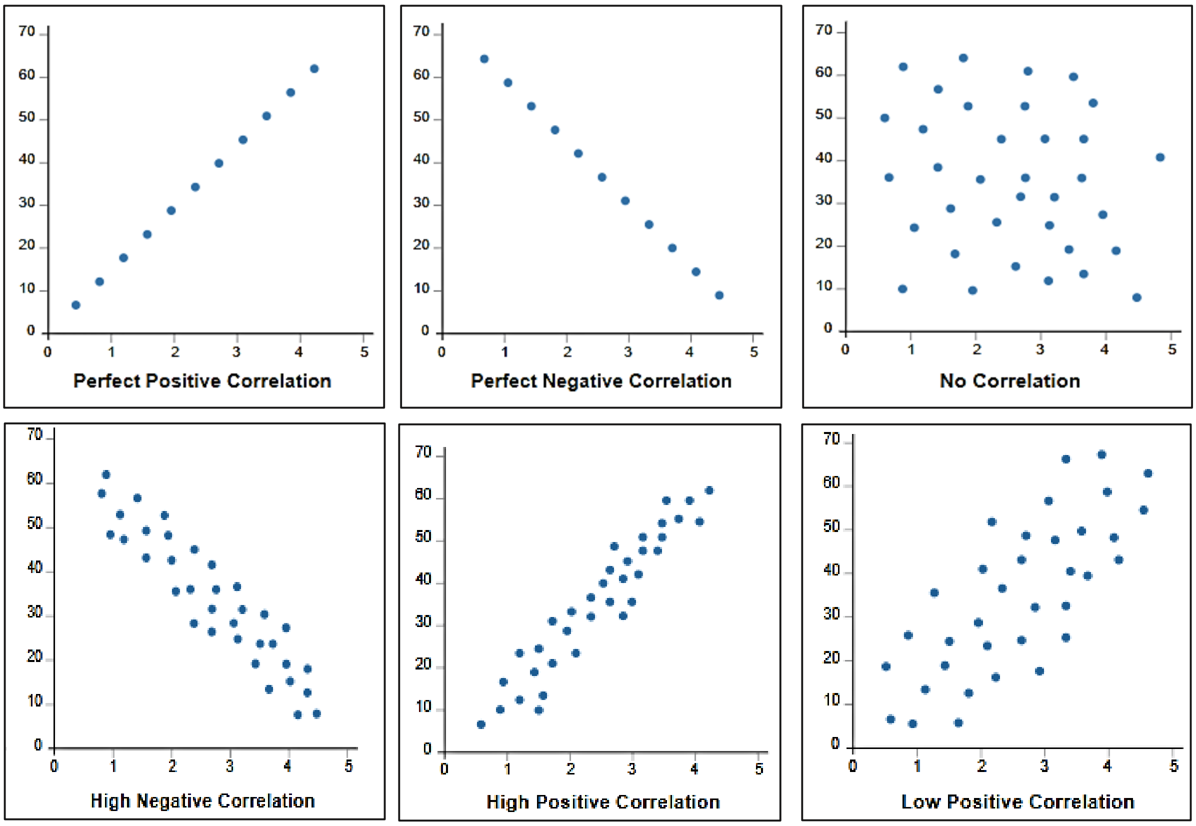

Figure 3: Degree of relationship scatter plot between variables X and Y [10]

3. Results and Discussion

3.1 Level of COD, Ph and Turbidity

Table 4 showed all parameters comply with recommended limits of standard B set by EQA 1974. The data shows the mean score of COD high range and low range for L1 which are 202.42 mg/L and 103.67 mg/L respectively. Meanwhile, the mean score of the high range and low range for L2 are 136.65 mg/L and 33.83 mg/L respectively. Parameter COD high range for both locations exceed the limit of effluent water due to high concentration of chemical oxygen demand in the samples. Furthermore, the mean score of pH reading for L1 and L2 such 7.24 and 7.01 respectively. Lastly, the mean score of turbidity reading of L1 is higher than L2 with 17.89 NTU and 9.62 NTU respectively.

According to the **Table 4** the mean score of COD reading for the high range between both locations is different as the COD reading at L1 is higher than the COD reading at L2. On the other hand, the COD reading for both locations for low range is showing that the L1 is having higher COD reading than L2. This shown the water capacity at L1 to consume oxygen during the decomposition of organic matter and the oxidation of inorganic chemicals is higher than water capacity at L2. According to the Parameter Limits of Effluent Standard B, COD reading for both of locations exceed the limit except for COD low range in L2. Therefore, this can be concluded that UTHM Campus water has more organic matters than MPH. Higher COD levels mean a greater amount of oxidized-able organic material in the sample, which will reduce dissolved oxygen (DO) levels. A reduction in DO can lead to anaerobic conditions, which is deleterious to higher aquatic life forms [11]. Influent COD in normal domestic sewage is generally 300 mg/L and it is then treated to at least 25 mg/l (as per European norms) before discharge to minimize pollution potential [12]. Thus, the mean score of COD reading at both locations for high range shows the water quality is not polluted yet however the UTHM Campus is more likely to get polluted without any treatment ways than MPH. Application of filtration method for drainage using annona seeds filter media is believed to be able to increase the effluent water quality. Annona diversifolia and A. muricata contain polysaccharides which are capable of reducing the COD, turbidity, and electrical conductivity in wastewaters [13]. Moreover, the drains can be cleaned at a time from the suspension, organic material and more.

Meanwhile, the mean score of the pH reading for both location is approximately similar for L1 and L2. The pH reading is still in range of standard. This level of pH can be considered as neutral pH, the reasons of the similarity of both location is these two locations located in same region of area or nearby. Therefore, the rainfall falls in both places if there is raining. Thus, the sources of water is most likely to be same. As pH affected by the rainfall thus both locations shows similar level of pH reading. Moreover, both locations are not exposed to any acidic substances. However, the pH reading of the UTHM Campus is a bit more towards basicity than the MPH. This is due to the cafeteria which has flowing dishwater towards the drains at the UTHM Campus while the MPH does not have any main possible sources of its basicity. At the same time, the reading of the pH been taken during the pandemic of COVID-19 which decreasing the activities around the area that could possibly affected the pH reading a little bit.

On the other hand, the mean score for the turbidity for both locations are distinctive as the L1 is higher than L2. Higher turbidity reading shows more amount of suspension in the water. Therefore, location 1 has more suspension in water or less transparency of water than location 2. The reasons behind the high turbidity level is probably caused by phytoplankton, algae growth, water discharge and urban runoff [14]. As the UTHM Campus drains have less volume of water than MPH, this could be the reasons why the mean score of turbidity reading is almost twice different. This is not good as the suspended particles absorb heat from the sunlight which warmer the turbid waters then reduce the concentration of oxygen in the water as oxygen dissolves better in colder water. Furthermore, some organisms also not able to survive in warmer water. The suspended particles scatter the light, thus decreasing the photosynthetic activity of plants and algae, which contributes to lowering the oxygen concentration even more. As a consequence of the particles settling to the bottom, shallow lakes fill in faster, fish eggs and insect larvae are covered and suffocated, gill structures get clogged or damaged. Besides, the more suspended particles will increase the amount of organic material as soluble organic compounds are most likely to contribute to escalated COD concentrations [15]. Therefore, the higher turbidity, the higher the COD. Thus, both drains need good flow of water to ensure the transparency of water by designing some elevation. Moreover, cleaning the drains from suspended particles using net once in two weeks also can do. This also can be solved by using drain filters that could trap the suspension from spreading more towards another area.

In addition, there might be possible errors while running the study. First, the reading of COD and Turbidity might affected by unwanted particles outside the tube. This will obviously mix up the reading. Therefore, the tube should be wiped first before putting into the machine. Moreover, there might be less accuracy and precision while running the reading. However, the calculation of average data for few reading of same sample will increase the accuracy and precision of the data.

Table 4: Mean value of water quality parameters for both locations with Parameter Limits of Effluent Standard B by EQA 1974.

Parameter	Unit	Range	Mean L1	Mean L2	Parameter Limits of Effluent Standard B
COD	mg/L	High	202.42	136.65	100
		Low	103.67	33.83	
pH	-	-	7.24	7.01	5.0-9.0
Turbidity	NTU	-	17.89	9.62	-

3.2 Correlation of Water Quality Parameters Between Location 1 and Location 2

Table 5 represent the results analysis of Pearson's correlation coefficient (*r*) and its interpretation. The correlation coefficient of COD high range shows the value of r is 0.959 which can be considered as high correlation between these two locations and its interpretation of correlation indicate to be very high positive correlation as the result of correlation is from range (+) 0.90 to 1.00. This result is significant at the p = 0.01 level. Next, the correlation coefficient r of COD low range is -0.212 which can be considered as no correlation between these two locations and the interpretation tends to be negligible correlation because the result of correlation is ranged from (-) .00 to -0.30. Furthermore, the rows correlation coefficient of pH shows the r-value of pH is -0.195 where there is no correlation between L1 and L2 as the result of correlation also ranged from (-) 0 to 0.30. Lastly, the correlation coefficient of turbidity shows the value of r is 0.223 where there is no relationship between L1 and L2 as the result of correlation is ranged from (+) 0 to 0.30. However, analysis indicated these three correlations which COD low range, pH and turbidity is not statically significant because the p-value is higher than 0.01 at apha level.

Table 5: Results Analysis of Pearson Correlation Coeffiecient and Its Interpretation

Parameter		Unit	Pearson Correlation, *r*	Sig. (2-Tailed)	Interpretation
COD	High Range	mg/L	0.959	<0.01	Very high positive correlation
	Low Range		-0.212	0.864	No correlation
pH		-	-0.195	0.486	No correlation
Turbidity		NTU	0.223	0.424	No correlation

The results analysis of Pearson's correlation after running SPSS software demonstrate as shown in **Figure 4** below.

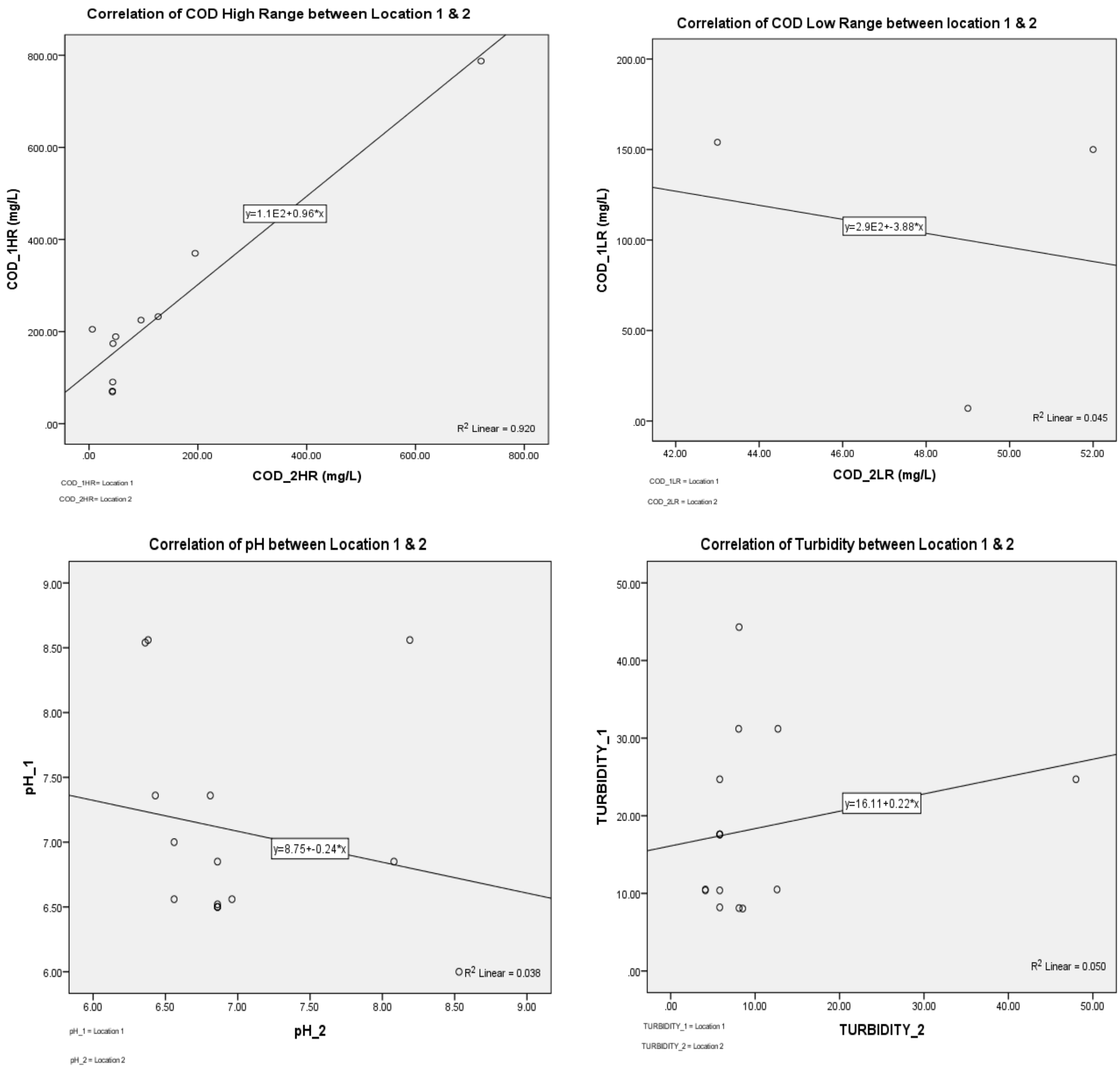

Figure 4: Scatter Diagram of COD High Range, Low Range, pH and Turbidity in both sampling locations

The amount of oxygen required to oxidise soluble and particulate organic matter in water is known as Chemical Oxygen Demand (COD). Based on the interpretation very high positive correlation for COD high range between these two location as shown in **Figure 4**, it shows that the higher COD value will increase the pollution of organic matter by water. COD is most commonly used to determine the amount of oxidizable contaminants in surface water (such as lakes and rivers) or wastewater [16]. There is a greater demand for oxygen when COD levels are higher. This means that wastewater with high COD levels has lower dissolved oxygen (DO) concentrations. Low dissolved oxygen concentrations are harmful to life forms that require oxygen to survive. High levels of COD in water often correlate with threats to human health including toxic algae blooms bacteria from organic wastes contamination discharged from cafeteria. Analysis indicated these correlation is significant at 0.01 level. So that there is sufficient evidence to conclude that there is a significant linear relationship between L1 and L2. That means regression line to graph linear relationship between these two location can be use. We can conclude that high COD levels reduce the amount of dissolved oxygen available to aquatic organisms. Low dissolved oxygen (usually less than 3 mg/L) causes impaired cell functioning, affects circulatory fluid balance in aquatic species, and can result in the death of individual organisms [17]. Polluted drain water also may cause the drain water at these area become smelly which might eventually make students and staffs in UTHM uncomfortable.

The interpretation of COD low range between L1 and L2 shows negligible correlation. The correlation of water quality parameter relationship between L1 and L2 can be associated with lower COD values indicate that there is low oxidizable organic matter in the sample. Analysis indicated these correlation is not significant because p-value is higher than 0.01. So that there is insufficient evidence to conclude that there is a not significant linear relationship between L1 and L2. That means regression line to graph linear relationship between these two locations cannot be use.

Moreover, this study found the interpretation of pH is negligible correlation among the sampling locations. It seems possible that this result is due to the fact that pH influences numerous chemical and biological processes in drainage water, and various species have distinct pH ranges within these two locations where they flourish differently. But the results showed that most of the drain water in different sampling location was slightly alkaline condition which ranged at 7. The presence of carbonate, magnesium, and calcium in water usually implies an alkaline conditions [18]. When carbonate minerals are present in the soil, the alkalinity of the water increases, allowing the pH of the water to remain near to neutral even when acids or bases are introduced to the soil. Additional carbonate minerals can influence neutral water to become slightly basic [3]. Significant of pH shows there is no strong evidence to conclude that the correlation of pH between two locations is not significant linear correlated because the probability of correlation to occur is moderately high.

Lastly, the correlation of water quality parameter relationship between L1 and L2 can be associated with increased turbidity, which changes water color and affects the physical appearance of the waterbody. However, the graph indicates to be negligible correlation between two locations because there is a probability the water seems murkier when a large number of suspended sediments in the drainage water, then increasing water turbidity reading variously. Turbidity was found at dredging sites or in café wash-water discharges as a consequence of sediment re-suspension and sedimentation induced by excess mining material stockpiling and dumping [19]. Exposure to roughly 20 NTU for 150 hours was predicted to have “moderately serious” impacts on fish (likely, reduced feeding efficiency) [20]. There is insufficient evidence to conclude that the correlation of turbidity between two locations is not significant linear correlated because the probability of correlation to occur is also moderately high.

Sewage water is waste water that flows after being used for commercial purposes and other uses. Today in cities, sewage pollution is a major issue. The poor management of sewage treatment at UTHM, as well as the dumping of untreated waste, endangers the lives of students and staff. Alternative methods have to be applied in order to save the water. To implement the method in reducing the water pollution, method that we use need to be done effectively. Here is the recommendation :

i. Wastewater treatment in removing pollutants in drainage water via chemical, physical or biological process is such as UTHM can fabricate drain filter with Annona Muricata seeds. Annona Muricata seeds can give many benefit because those seeds possess many chemical abilities, and an important ability which is relevant to this study is the ability to treat wastewater in a form of bioremediation by decreasing the COD readings in a substance.
ii. Periodic monitoring which aims to collect quantitative data on water's physical, chemical, and biological qualities via statistical sampling. UTHM authorities should monitor regularly at different areas along the drain in order to prevent possible pollution points in UTHM Campus Pagoh.

4. Conclusion

In conclusion, this study had achieved all the objectives. Firstly, this study had shown the level of COD, pH and Turbidity of two sampling locations such L1 and L2 by calculating the mean score of the reading. L1 has the higher mean score than L2 for COD reading in both low and high range. Meanwhile, the mean score of pH for both locations are similar. Besides, turbidity L1 is higher than L2. Secondly, the significance correlation had shown the COD high range was highly correlated between L1 and L2 except for COD low range, pH and turbidity. According to the finding, the parameters shows pollution water quality that needs treatment. The impact towards public's views to UTHM will be condemnatory. Moreover, the aquatic living things will not survive well in that habitat. Besides, the smelly drains will form bad environment to study. Therefore, the drainage for both locations can apply few recommendations to sustain the environment especially water in the drains. Since Annona diversifolia and A. muricata contain polysaccharides which are capable of reducing the COD, turbidity, and electrical conductivity in wastewaters, the drain filter with annona seeds can be installed to reduce the COD reading and increase the transparency of water. Moreover, good flow of drain water can be achieved by designing elevation shaped of drain, thus will increase the transparency of water. Lastly, the enforcement of law to avoid people throwing rubbish and stuff into the drains are crucial to ensure the cleanliness of water.

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References

[1] Z. Hu and D. Grasso, "Encyclopedia of Analytical Science (Second Edition)". (2005).

[2] U.S. Environmental Protection Agency (EPA). (2005). Washington, D.C. "National Management Measures to Control Nonpoint Source Pollution from Urban Areas." Chapters 7 and 8. Document No. EPA 841-B-05-004.

[3] F. E. Inc. "pH of Water." Fundamentals of Environmental Measurements. (2013). [Online]. Available:https://www.fondriest.com/environmental-measurements/parameters/water-quality/ph/

[4] T. S. O. K. Hui. Environmental Quality (Sewage and Industrial Effluents) Regulations, 1979. Retrieved from: https://malaysia_sewage-industrial-effluent-quality-mal2509.pdf

[5] APHA (2005). Standard Methods for the Examination of Water and Wastewater. 21st ed. Washington: American Water Works Association, Water Environment Federation.

[6] K. S. University, "University Libraries: Statistic Software." 2021. Available: https://libguides.library.kent.edu/spss/pearsoncorr. [Accessed 28th June].

[7] A. Stephanie. Statistics Handbook. 2017 [Online] Available: https://www.statisticshowto.com/sig2-tailed-interpreting-results/. [Accessed 30th June].

[8] D. Arkkelin, "Using SPSS to Understand Research and Data Analysis. Valparaiso: Valparaiso University." 2014.

[9] Ahammad, P. "How to Interpret Correlation Coefficients." 2016. [online] Parvez Ahammad's Website. Available at: http://www.parvez-ahammad.org/blog/how-to-interpret-correlation-coefficients [Accessed 4 July 2021].

[10] R. Sverdan, "Scatter Plot." 2021 [Online]. Retrieved 25 June, 2021, from https://diagrammm.com/scatter_plot

[11] T. I. Real, "Chemical Oxygen Demand" Importance of COD Wastewater. 2017. [Online]. Available on: https://realtechwater.com/parameters/chemical-oxygen-demand/.

[12] Butler, “Manufacturing Services Sewage Parameters 7: Chemical Oxygen Demand (COD).” (2018). [Online]. Avaibale on: https://www.butlerms.com/sewage-parameters-7-chemical-oxygen-demand-cod/

[13] L. G. Torres, S., Carpinteyro-urban, and L. J. Corzo-rios, “Seeds As Source of Natural Coagulant-Flocculant Sids for the Treatment of Wastewaters,” vol. 1, no. 2, pp. 16–22, 2013.

[14] V.B. Lenntech “Turbidity”. “What are the consequences of high turbidity?” 2021. [Online]. Available: https://www.lenntech.com/turbidity.htm

[15] X. Stormwater, “Chemical Oxygen Demand (COD) Background”, (2011). [Online]. Available on https://www.stormwaterx.com/resources/industrialpollutants/chemical-oxygen-demand-cod/

[16] L., Daoliang and L. Shuangyin, “Water Quality Monitoring and Management.” 2019.

[17] Ambient Aquatic Life Water Quality Criteria for Dissolved Oxygen (Saltwater): Cape Cod to Cape Hatteras, 65 Fed. Reg. 71317, 71318 (Nov. 30, 2000).

[18] A., Begum et al., Heavy metal pollution and chemical profile of Cauvery river water. E-Journal of Chemistry 6(1): 47-52, 2009.

[19] M.A., Ashraf et al., “Sand mining effects, causes and concerns: A case study from Bestari Jaya, Selangor, Peninsular Malaysia.” Scientific Research and Essays 6(6): 1216-1231, 2011.

[20] Newcombe, C. P. “Impact assessment model for clear water fishes exposed to excessively cloudy water.” Journal of the American Water Resources Association 39:529–544, 2003.