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A Study on Clean Water Quality in Taman Pagoh Jaya

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Abstract:

Water is one of the most basic requirements for survival. Therefore, this study aims to assess the quality of cold water system, which has an impact on the supply of direct and indirect clean water in the study area. The objective of this research is to determine the physicochemical parameters of water quality at Taman Pagoh Jaya. Then the results obtained were analyse with direct and indirect water supply and the data was compared based on the standard method Malaysian Drinking Water Quality Standard (MDWQS). The implementation method was carried out through sample analysis in 4 sampling stations which are Taman Pagoh Jaya 3/11 (S1), Taman Pagoh Jaya 2/13 (S2) for direct system and Taman Pagoh Jaya 3/11 (S3), Taman Pagoh Jaya 3/4 (S4) for indirect system. The parameters that were analysed to determine the physicochemical parameters are pH, temperature, DO, TSS and COD, which were measured based on the standard method Malaysian Drinking Water Quality Standard (MDWQS). For pH, temperature, DO, TSS and COD the range for each parameter are between 7.35 to 7.64, 26.2 ˚C to 27.4˚C, 6.04 mg/L to 6.74 mg/L, 13 mg/L to 24 mg/L and 3 mg/L to 6 mg/L respectively. Based on the results, the parameters of pH, temperature, TSS, and COD are not exceeded, indicating that tap water for all four sampling stations is safe to use, while DO indicated that the water quality of all sampling stations required conventional treatment. It is also recommended to continue more sampling stations and physicochemical parameters at Taman Pagoh Jaya in the future.

Keywords: Water Quality, Cold Water System, Physicochemical Parameters

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1. Introduction

Water is an essential component of human life and activities such as industry, agriculture, and others, and it is regarded as one of the most vulnerable parts of the environment [1]. It is a necessary component of life and is required for the survival of all organisms [2]. The increased demand for fresh water has resulted from the accelerated pace of industrial development and population growth over the last few decades [3]. All forms of life could not exist and not survive without water. Water is essential for human needs in a variety of fields, including drinking water, domestic use, and industry.

Pagoh is a large town in Malaysia's Muar District, Johor. The distance from Bandar Muar is approximately 25 kilometres. It is connected to the main road which is Jalan Muar-Labis. Taman Pagoh Jaya is a housing located in Pagoh, Johor and Taman Pagoh Jaya is a large town with terrace housing. Taman Pagoh Jaya is divided into three sections which are Taman Pagoh Jaya 1, Taman Pagoh Jaya 2 and Taman Pagoh Jaya 3. Water samples were collected from 4 sampling stations and the selection criteria of the sampling locations was based on the types of tanks, types of valves, types of pipes used and types of cold water system that could contribute to the decline of water quality in the sampling locations from the main water supply.

There is a paucity of detailed data on the quality of clean water in the Taman Pagoh Jaya. So, in order to resolve this problem, this study aims to assess the quality of cold water, which has an impact on the supply of clean water for directly and indirectly in the study area. The objective of this research is to determine physicochemical parameter of water quality at Taman Pagoh Jaya. Then the result obtained was analyse from direct and indirect water supply and to compare the data based on the standard method Malaysian Drinking Water Quality Standard (MDWQS). The research findings was helpful in determining whether the water in the study area is safe for consumption.

2. Materials and Methods

The study was conducted at Taman Pagoh Jaya, Pagoh Johor. This study was carried out to determine the quality of cold water system that affects the supply of direct and indirect clean water. In this study, the parameters that were analysed to determine the physicochemical parameters are dissolved oxygen (DO), pH, temperature, total suspended solid (TSS) and chemical oxygen demand (COD) were measured based on the standard method Malaysian Drinking Water Quality Standard (MDWQS). The implementation method was carried out through sample analysis in 4 sampling stations which are Taman Pagoh Jaya 3/11 (S1), Taman Pagoh Jaya 2/13 (S2) for direct system and Taman Pagoh Jaya 3/11 (S3), Taman Pagoh Jaya 3/4 (S4) for indirect system. Water samples are taken at the same location for sampling stations S1 and S3 because the location is a two-story terraced house that covers both systems, namely the direct system on the lower floor pipes and the indirect system on the upper floor pipes.

The selection criteria of the sampling locations were based on the types of tanks, types of valves, types of pipes used and types of cold water system that could contribute to the decline of water quality in the sampling locations from the main water supply. Water samples were collected from 4 sampling stations and each of the locations was visited two times a day. A total of 8 samples were collected during the sampling period, each in the morning and at night. Each of water samples was taken from the home's sink pipe and were collected in plastic bottles of 1500 mL.

To ensure no sample exchange, each bottle of the water samples storage was labelled first and then filled with water samples for all sampling stations. The water sample storage bottles were cleaned first to avoid contamination of the sample. The water sample bottles were placed in an ice box for transportation to the materials laboratory at UTHM Pagoh. The transportation of the water samples to

the laboratory were conducted within 6 hours after collection process as recommended by American Public Health Association and the data was analyzed according to the Standard Method of Water and Wastewater [4]. The data was also analyzed using Microsoft Excel for the physicochemical parameters of water samples based on the standard method Malaysian Drinking Water Quality Standard (MDWQS).

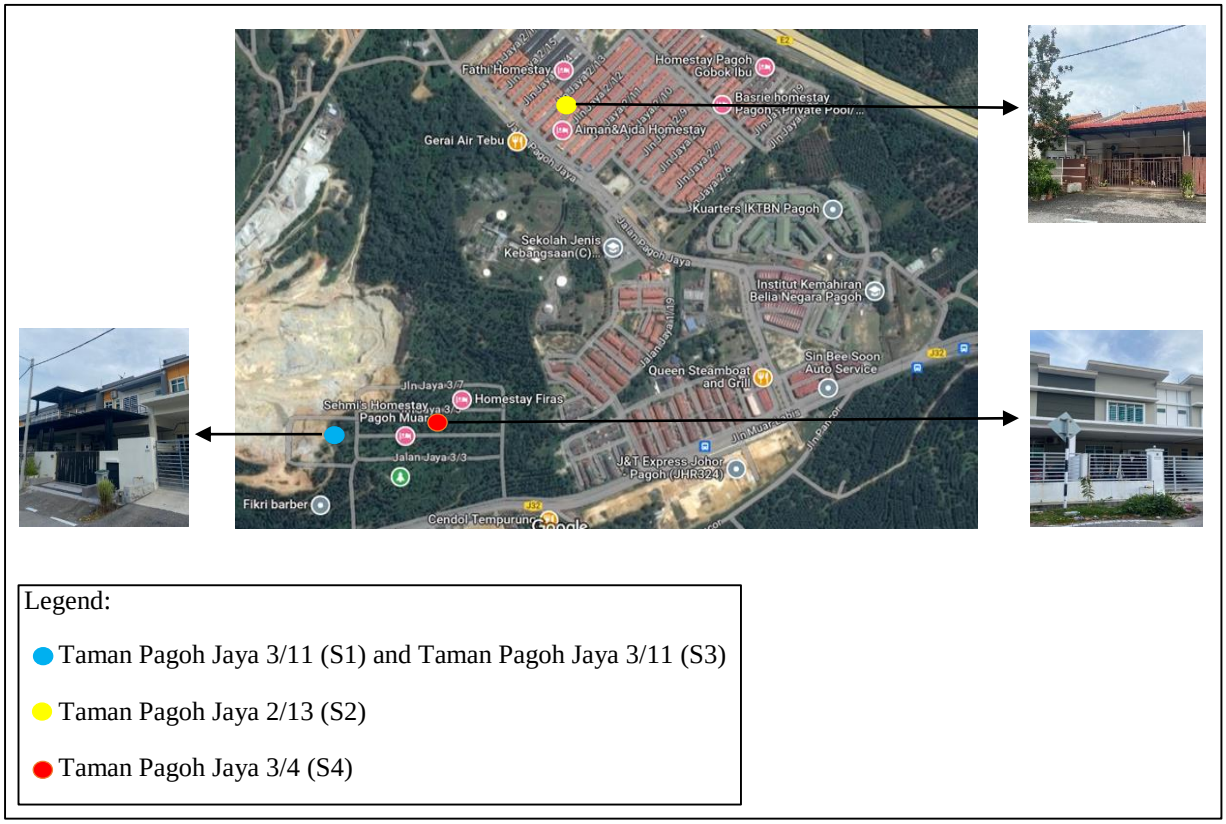

Figure 1: Area of study

The experiment was carried out using the method mentioned in Table 1. Total 5 parameters were measured, which are pH, Temperature, Dissolved Oxygen (DO), Total Suspended Solids (TSS) and Chemical Oxygen Demand (COD).

Table 1: Equipment and Method

Characteristic	Equipment	Method	Unit
pH	pH1500 Eutech pH meter	APHA 2012	-
Temperature	pH1500 Eutech pH meter	APHA 2012	˚C
DO	HI-2004 Edge Dissolved Oxygen Meter	APHA 2012	mg/L
TSS	Filtration pump	APHA 2012	mg/L
COD	DRB 200 & DR 6000 Spectrophotometer	Reactor Digestion Method 8000	mg/L

3. Results and Discussion

Table 2 shows the result for the pH of tap water samples for four sampling stations at morning and night time. According to the Malaysian Drinking Water Quality Standard (MDWQS), the standard maximum acceptable pH value ranges between 6.5 and 9.0. The pH scale which ranges from 0 to 14 measures the acidity or alkalinity of a solution. If the pH of a sample is less than 7.0, it is considered acidic. Meanwhile, if the pH is greater than 7.0, it is alkaline. Based on the table below, the water sample values for the four sampling stations are found to be in the range between 7.35 to 7.64.

Table 2: pH Analysis of Water Sample at Sampling Stations

	Morning	Night
S1	7.47	7.49
S2	7.44	7.53
S3	7.35	7.43
S4	7.48	7.64

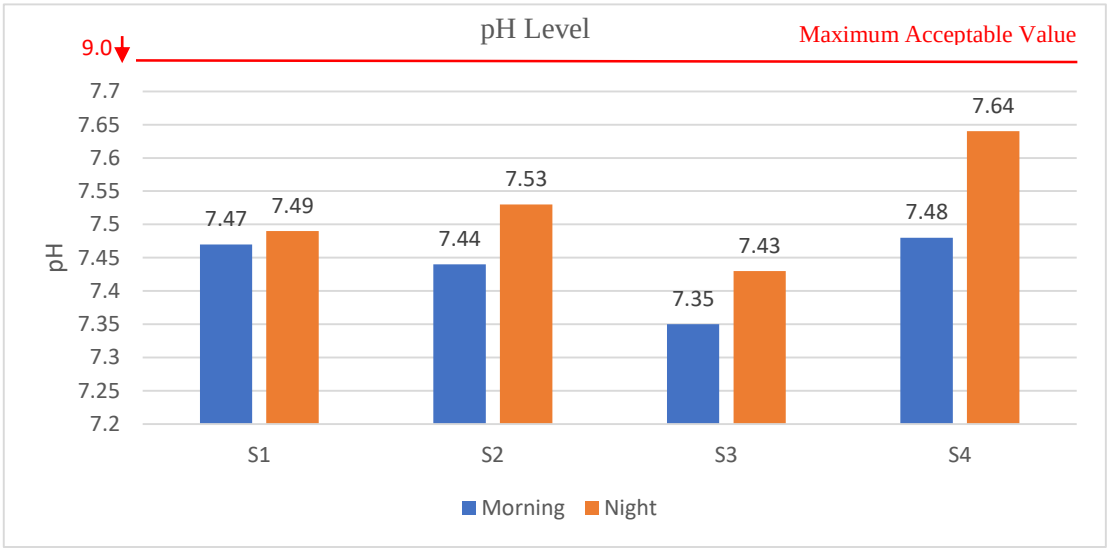

Figure 2: pH Analysis of Water Sample at Sampling Stations

Based on Figure 2, the highest pH value shown in the bar chart above is 7.64, obtained from Sampling Station 4 at night in Taman Pagoh Jaya Phase 3/5 and the lowest is 7.35, obtained from Sampling Station 3 in the morning at Taman Pagoh Jaya Phase 3 / 11. There was no statistically significant difference between direct and indirect systems for all four sampling stations where all pH values are in the range of 7. Chemicals, minerals, pollutants, soil or bedrock composition, and any other contaminants that interact with the water supply causes an imbalance in the water's natural pH of 7. In short, environmental factors, whether high or low, is the most important contributor to water pH [5]. Since the value of each pH for both systems are not less than 7 or more than 9, the overall pH value in Taman Pagoh Jaya is neutral and safe to use for both systems.

3.2 The Temperature Level in Tap Water

Table 3 shows the result for the temperature of tap water samples for four sampling stations at morning and night. According to the Malaysian Drinking Water Quality Standards (MDWQS), no temperature limit is required as temperature differences depend on weather, sunlight, ambient air temperature, humidity and wind movement. Water temperature is related to air temperature due to the

heat transfer between water and air. Based on the table below, the water sample values for the four sampling stations are found to be in the range between 26.2˚C to 27.4˚C.

Table 3: Temperature Analysis of Water Sample for Sampling Stations

	Morning	Night
S1	27.3˚C	27.4˚C
S2	26.4˚C	27.1˚C
S3	26.8˚C	27.2˚C
S4	26.2˚C	26.5˚C

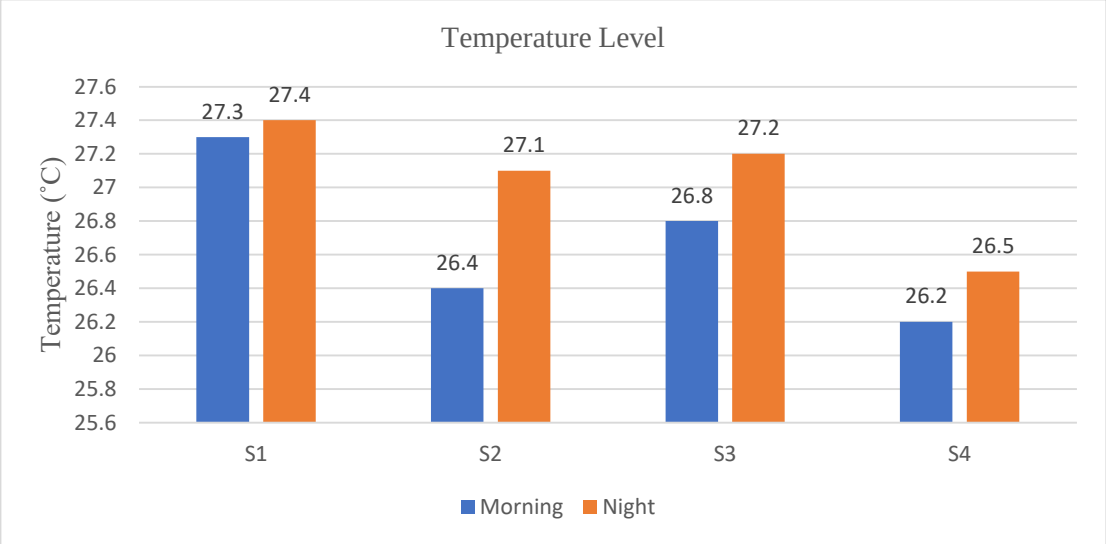

Figure 3: Temperature Analysis of Water Sample for Sampling Stations

Based on Figure 3, the temperature ranges between 26.2°C and 27.3°C in the morning and between 26.5°C and 27.4°C at night. The highest temperature value shown in the bar chart above is 27.4°C, obtained from Sampling Station 1 in the night at Taman Pagoh Jaya Phase 3/11 and the lowest is 26.2°C, obtained from Sampling Station 4 in the morning at Taman Pagoh Jaya Phase 3/5. The average temperature of the water sample at night is higher than the average temperature of the water sample in the morning. Temperature level differences between morning and night may be influenced by local factors such as geographical location, weather patterns and other environmental influences but mostly directly by air temperature [6]. As the temperature of the air rises, the temperature of the water. There is no statistically significant difference between the direct and indirect systems for all four sampling stations. This average temperature is within a normal range and is not expected to have any effect on the life of the consumer.

3.3 The Dissolved Oxygen (DO) Level in Tap Water

Table 4 shows the dissolved oxygen result of tap water samples for the four sampling stations in the morning and night. There is no specific guideline value for dissolved oxygen in the Malaysian Drinking Water Quality Standard (MDWQS), but according to the National Water Quality Standards (NWQS), a value of dissolved oxygen above level 7 is a water value that is safe for use where it is categorized as almost no treatment is required. Dissolved oxygen concentration is affected by changes in water temperature. The higher the temperature of the water, the less oxygen is dissolved in it. Based on the table below, the water sample values for the four sampling stations are found to be in the range between 6.04 mg/L to 6.74 mg/L.

Table 4: Dissolved Oxygen (DO) Analysis of Water Sample for Sampling Stations

	Morning	Night
S1	6.24 mg/L	6.35 mg/L
S2	6.08 mg/L	6.04 mg/L
S3	6.32 mg/L	6.28 mg/L
S4	6.22 mg/L	6.74 mg/L

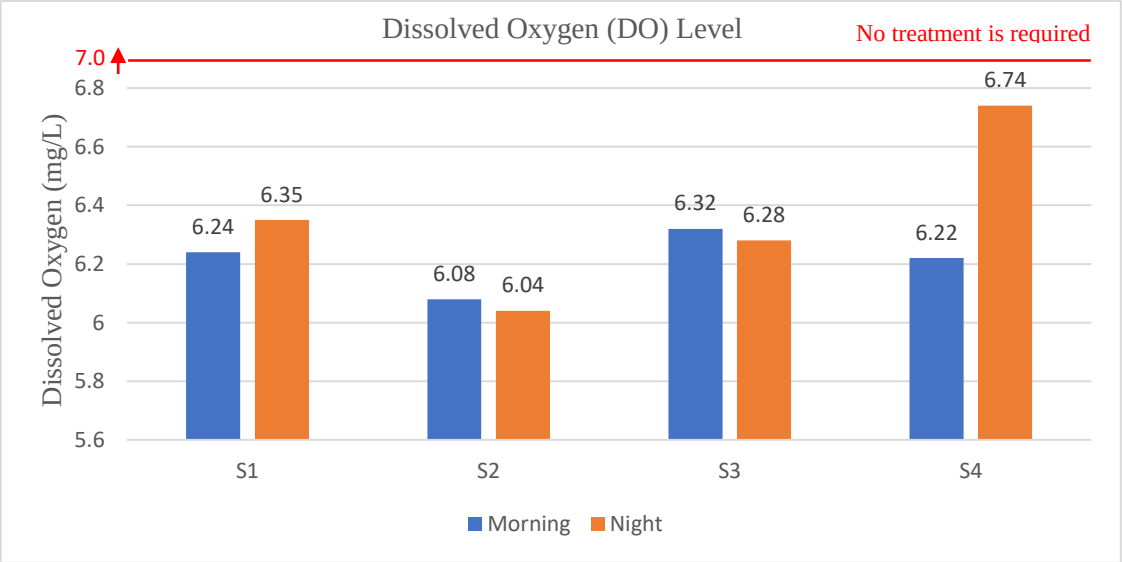

Figure 4: Dissolved Oxygen (DO) Analysis of Water Sample for Sampling Stations

Based on Figure 4, the dissolved oxygen (DO) values for all sampling stations range from 6.08 mg/L to 6.74 mg/L. The highest dissolved oxygen value shown in the bar chart above is 6.74 mg/L, obtained from Sampling Station 4 in the night at Taman Pagoh Jaya Phase 3/5 and the lowest is 6.04 mg/L, obtained from Sampling Station 2 in the night at Taman Pagoh Jaya Phase 3/5. The dissolved oxygen level for all four sampling stations is shown below level 7, which is a value of 6. According to the National Water Quality Standard (NWQS), the value range category for dissolved oxygen falls on class IIA, indicating that the water quality for all sampling stations requires conventional treatment. There is no statistically significant difference between the direct and indirect systems for all four sampling stations where all values for dissolved oxygen are 6.

3.4 The Total Suspended Solid (TSS) Level in Tap Water

Table 5 shows the result for the total suspended solid (TSS) of tap water samples for four sampling stations in the morning and at night. According to the Malaysian Drinking Water Quality Standard (MDWQS), the standard limit acceptable total suspended solid value is 25 mg/L. Total suspended solids (TSS) are all suspended particles and undissolved substances in the air whose particle size is comparable to the particle size of the air and can be filtered with a filter. Based on the table below, the water sample values for the four sampling stations are found to be in the range between 13 mg/L to 24 mg/L.

Table 5: Total Suspended Solid (TSS) Analysis of Water Sample for Sampling Stations

	Morning	Night
S1	24 mg/L	20 mg/L
S2	23 mg/L	20 mg/L
S3	20 mg/L	13 mg/L
S4	23 mg/L	13 mg/L

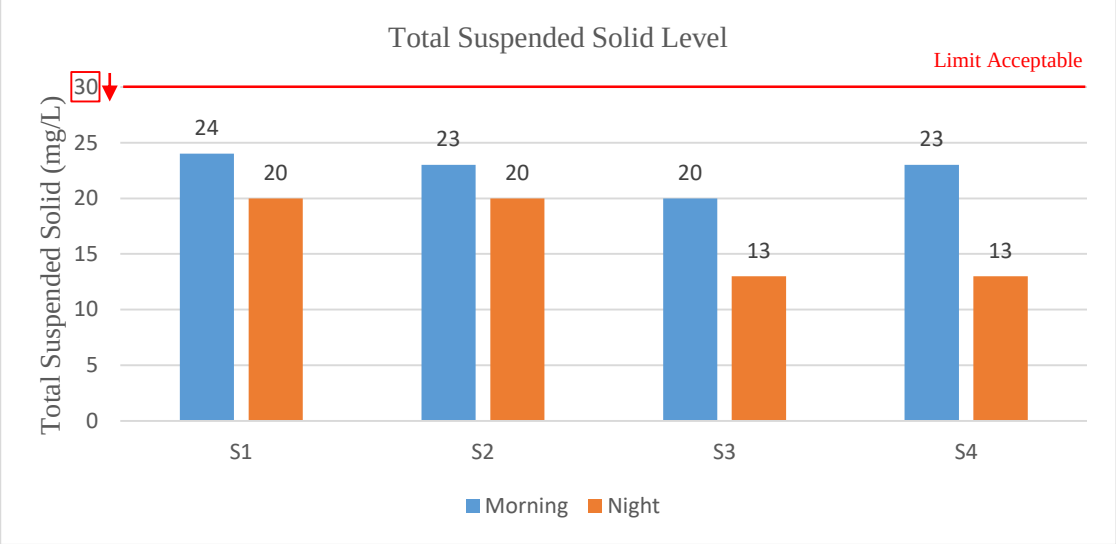

Figure 5: The Total Suspended Solid (TSS) Level in Tap Water

Based on Figure 5, the total suspended solid (TSS) values for all sampling stations range from 13 mg/L to 24 mg/L. The highest total suspended solid (TSS) value shown in the bar chart above is 24 mg/L, obtained from Sampling Station 1 in the morning at Taman Pagoh Jaya Phase 3/11 and the lowest value is 13 mg/L, obtained at night from Sampling Stations 3 and 4 in Taman Pagoh Jaya Phase 3/5 and Taman Pagoh Jaya Phase 3/11. The bar chart shows that sampling stations 1 and 2 have high total suspended solids value ranges of 24 mg/L and 23 mg/L. Both sampling stations use the same piping system, which is a direct system. From the observation when the test lab was carried out, the filter paper revealed a bright brown colour when compared to the filter paper used for the other sampling stations in the indirect system. The average total suspended solids (TSS) are within the acceptable range based on the Malaysian Drinking Water Quality Standard (MWQS), which is less than 25, indicating that the water is safe to drink and consume.

3.5 The Chemical Oxygen Demand (COD) Level in Tap Water

Table 6 shows the result for the chemical oxygen demand of tap water samples for four sampling stations in the morning and at night. There is no specific guideline value for chemical oxygen demand (COD) in the Malaysian Drinking Water Quality Standard (MWQS), but according to the National Water Quality Standards (NWQS), the value of chemical oxygen demand (COD) below level 10 which is the value of water that is safe to use where it is categorized as almost no treatment is needed and the conservation of the natural environment. Based on the table below, the water sample values for the four sampling stations are found to be in the range between 3 mg/L to 6 mg/L.

Table 6: The Chemical Oxygen Demand (COD) Level in Tap Water

	Morning	Night
S1	4 mg/L	3 mg/L
S2	4 mg/L	4 mg/L
S3	5 mg/L	4 mg/L
S4	6 mg/L	5 mg/L

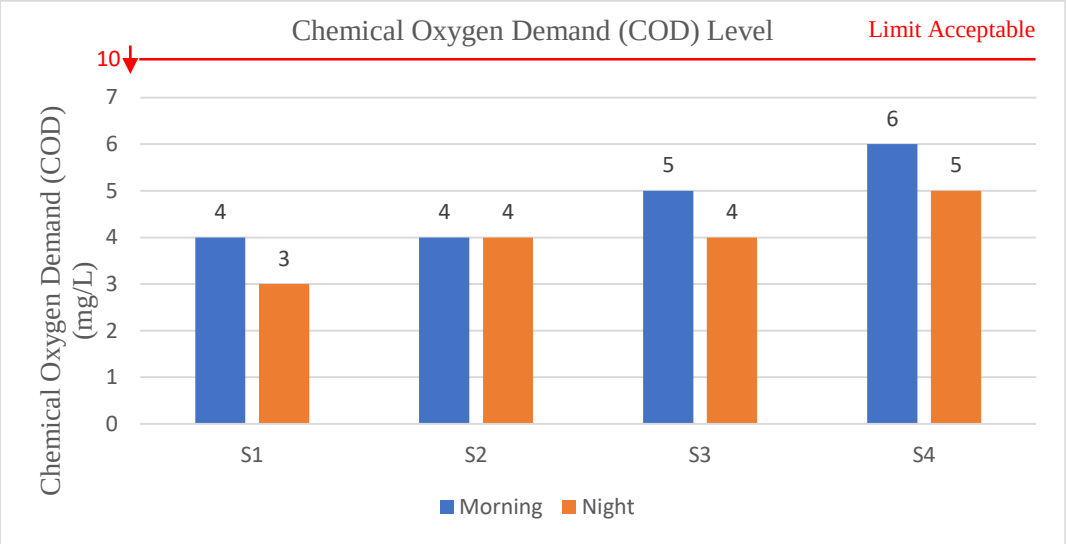

Figure 6: Chemical Oxygen Demand (COD) Analysis of Water Sample for Sampling Stations

Based on Figure 6, the chemical oxygen demand (COD) values for all sampling stations range from 3 mg/L to 6 mg/L. The highest chemical oxygen demand (COD) value shown in the bar chart above is 6 mg/L, obtained from Sampling Station 4 in the morning at Taman Pagoh Jaya Phase 3/11 and the lowest value is 3 mg/L, obtained at night from Sampling Stations 1 in Taman Pagoh Jaya Phase 2/13. The average of chemical oxygen demand (COD) is within the acceptable range based on the National Water Quality Standards (NWQS), which is less than 10, indicating that the water is safe to drink and consume.

4. Comparison to Water Standard Limits

Table 7 shows the parameter values for each sampling station and a comparison with the standard method. For pH parameter, S1 and S3 are sampling stations from the same house and show that the direct system has a higher pH value than the indirect system. The direct systems have a higher and more consistent water flow. As a result, the rapid flow aids in the prevention of the build of harmful chemicals that can lower the pH of the water. While for S2 and S4, the pH value of S4 is higher than S2. In terms of piping system factoring, S2 shows the construction of an older piping system in 2014 compared to the construction of the home's plumbing system for S4. Corrosion of metal pipes and plumbing systems is another effect that can occur as a result of an acidic pH value [9]. The possibility of contamination is lower in a new piping system because the pipes are still in good condition and have not been exposed to the influence of the environment for a long time.

For temperature parameter, there is no statistically significant difference between the direct and indirect systems for all four sampling stations. This average temperature is within a normal range and is not expected to have any effect on the life of the consumer. For dissolved oxygen, the dissolved oxygen level for all four sampling stations is shown below level 7, which is a value of 6. If dissolved oxygen is found to be lacking or lost in water bodies, it is due to a combination of factors, including high water temperatures, an increase in organic matter, and the aerobic action of microorganisms that use dissolved

oxygen to decompose organic matter. For total suspended solid, there is a difference between the direct system and the indirect system for all four sampling stations where the value of total suspended solids (TSS) for the direct system is higher than the indirect system. However, galvanized pipes can deteriorate over time, resulting in a variety of issues such as high total suspended solids (TSS) occurring in direct systems compared to water supplied from storage tanks. A high total suspended solid (TSS) value can have an impact on the appearance, taste, and overall quality of water, making it unfit for consumption or daily use.

For chemical oxygen demand, there is a significant difference between the direct system and the indirect system for all four sampling stations where the value of chemical oxygen demand (COD) for the indirect system is higher than the direct system. The water tank's presence should not increase the chemical oxygen demand (COD) in the water. However, several factors, including stagnation, can potentially lead to higher COD levels in tank water. Based on the figure 6, the direct system is higher in the morning than at night. If the water in the tank is not used for an extended period of time, it can become stagnant. Stagnant water promotes the growth of microorganisms and the accumulation of organic matter, both of which can contribute to higher COD levels. Compared with fresh water, stagnant water contributes to bacterial growth and microorganism metabolism, including cell proliferation, in drinking water distribution systems (DWDS) [10].

Table 7: Comparison of water with Water Standard Limits

No.	Parameters (Unit)	Sampling Data			Malaysian Drinking Water Quality Standard (MDWQS) [7] and National Water Quality Standard (NWQS) [8]
		Sampling Station	Morning	Night	
1	pH	S1	7.47	7.49	Acceptable pH value ranges between 6.5 and 9.0. The overall pH value is neutral.
		S2	7.44	7.53	
		S3	7.35	7.43	
		S4	7.48	7.64	
2	Temperature (˚C)	S1	27.3	27.4	No temperature limit is required. This average temperature is within a normal range.
		S2	26.4	27.1	
		S3	26.8	27.2	
		S4	26.2	26.5	
3	Dissolved Oxygen (mg/L)	S1	6.24	6.35	No specific guideline value in the (MWQS) but according to the (NWQS), all sampling stations requires conventional treatment because the value level is above 7.
		S2	6.08	6.04	
		S3	6.32	6.28	
		S4	6.22	6.74	
4	Total Suspended Solid (mg/L)	S1	24	20	The average is within the acceptable range which is less than 25.
		S2	23	20	
		S3	20	13	
		S4	23	13	
5	Chemical Oxygen Demand (mg/L)	S1	4	3	No specific guideline value in the (MWQS) but according to the (NWQS), the value below level 10 is safe to use.
		S2	4	4	
		S3	5	4	
		S4	6	5	

Conclusion

In conclusion, the study achieved the first objective which is to determine the physicochemical parameters of water quality at Taman Pagoh Jaya. All parameters (pH, temperature, dissolved oxygen (DO), total suspended solids (TSS), and chemical oxygen demand (COD) have been identified in the laboratory according to the test procedure. The second objective is to analyse the results obtained from direct and indirect water supply. The results show that the values of the two systems have differences significantly for each parameter. The pH and temperature parameters for both systems show no significant difference, indicating that both systems are neutral and safe for consumption. The indirect system has higher dissolved oxygen (DO) and chemical oxygen demand (COD) values than the direct system. In terms of total suspended solids (TSS) it shows that the direct system is higher than the indirect system for all four sampling stations. The third objective is to compare the data using the standard method Malaysian Drinking Water Quality Standard (MDWS). The pH, temperature, total suspended solids (TSS), and chemical oxygen demand (COD) parameters show that the limits specified in the MDWQS are not exceeded, indicating that the tap water for all four sampling stations is safe to use and not harm users' health. Simply dissolved oxygen (DO) demonstrates that the value range category for dissolved oxygen falls on class IIA, indicating that all sampling stations' water quality requires conventional treatment. As a result, the occupants of every residence in Taman Pagoh Jaya was no longer have to be concerned about the quality of the water.

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