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Assessment of Physical and Chemical Parameters of Recreational Water in Port Dickson Beaches, Negeri Sembilan

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ABSTRACT

Background: The study is a descriptive study conducted in three beaches in Port Dickson, Negeri Sembilan which are Teluk Kemang Beach, Cahaya Negeri Beach and Saujana Beach that are known famous for local and tourism activities. **Objective:** The main objective of the study is to assess the level of water quality in term of physico-chemical parameters in three beaches in Port Dickson, Negeri Sembilan. **Results:** The parameters that were studied include pH, turbidity, dissolved oxygen and biological oxygen demand, lead (Pb), cadmium (Cd), copper (Cu) and chromium (Cr) (IV). The study found no violation on physical parameters in the study locations. However, chemical parameters (Pb, Cd, Cu and Cr) have exceeded the standard of National Water Quality Standards. Teluk Kemang Beach had the highest mean concentration of Cd and Pb with 13.2 mg/L and 41.3 mg/L. Cu was found highest in Cahaya Negeri Beach with 1.0 mg/L. **Conclusion:** Continuous study is very important to be conducted at the study locations to identify the adverse health effects towards the people in contact with the chemicals-contaminated water as well as on the marine life in the places.

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INTRODUCTION

According to Ainon, *et al*., (2011), rapid development in Malaysia had caused the increasing of coastal population discharging high amount of treated and untreated wastewater into the coastal water. However, this situation did not receive monitoring from the local authorities and thus causing the problems arouse. Due to the lacking of monitoring on the safety of the coastal water, public health might be affected as the waters are used for recreational activity. Ainon, *et al*., (2011) conducted their study focusing on biological parameters to determine the level of coastal water in Port Dickson beaches. Chemical and physical agents can lead to degradation of aesthetic value of recreational water environment. These contaminants might enter the recreational water through natural or anthropogenic sources. Chemicals in water are derived from industrial and municipal activities as well as runoffs from the surrounding areas or from soil (Kaizer and Osakwe, 2010). According to the WHO (2003) at very low or very high pH in recreational water might contribute to eye and skin irritation.

Chemical hazards in recreational water should not exceed the standard limit as they can threaten the health and safety of the users. According to the United States Environmental Protection Agencies

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(USEPA), lead can cause adverse health effects especially to children below six years old. The sources of lead include from activities of mining, smelting, refining and products used such as paint, gasoline, pipers, and ceramics as well as from natural soil. A study conducted by Sarah *et al* (2008) found that coastal water in United States has been contaminated by nonpoint source pollution from commercial, industrial, residential and agricultural land-use activities. These activities have threatened the marine life.

Physical and chemical parameters of coastal water are very crucial to be studied due to the adverse health effects towards the water users as well as the marine life. As there is no monitoring activity from the local authorities, it is expected that the recreational water could be contaminated by the activities nearby such as commercial and industrial. A study conducted by Yap *et al*., (2011) found that chemicals such as lead and nickel were high in concentration. They found that the releases of untreated anthropogenic wastes in to rivers and coastal waters might cause the problem. This study aims to identify whether physical and chemical parameters in the recreational water at the three beaches is following the National Water Quality Standards for Malaysia.

Research Methodology:

Study location:

The study was carried out at three most famous beaches in Port Dickson, Negeri Sembilan which are Teluk Kemang Beach, Cahaya Negeri Beach and Saujana Beach. The beaches are famous among local people and tourists. **Teluk Kemang** length is 1.6km and located 10 km south to the Port Dickson town. Teluk Kemang is the largest and most popular beach in Port Dickson, located from 7th to 8th mile ending at Ancasa All Suites of the coastal road from town. While, Saujana beach lies along 4th mile of coastal road, stretching south along a 1km beach stretch starting from Avillion Resort until Pantai Cahaya Negeri. Cahaya Negeri is a popular beachside destination between 5th and 6th of the Port Dickson beach road. Figure 1 shows the map showing the three study locations.

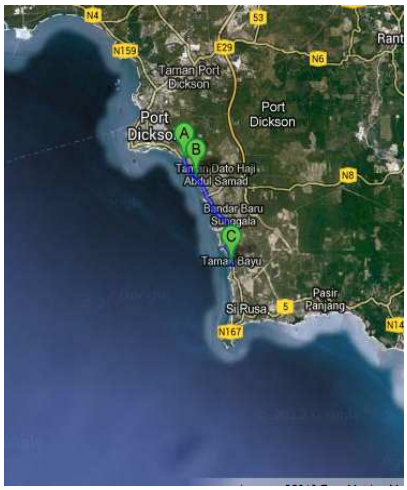

Fig. 1: Study locations.

Table I shows the descriptions of the three sites of the study. As the locations were places that were visited by tourists, a lot of restaurants and hotels were found. Markets and jetty were also located in Saujana beach.

Data collection:

The study was conducted from December 2012 until June 2013. The physical and chemical parameters sampled during the study are based on the standard by National Water Quality Standards for Malaysia 2006 under Class IIB for recreational use body contact. The physical parameters that were measured in-situ include pH, turbidity, and salinity. The chemical parameters measured were cadmium, chromium (VI), copper and lead. Each beach was sampled at twelve sampling points which were done in weekends and weekdays for mean readings. Water samplings were conducted at surface water about 0-20cm depth. The samples were stored in ice box during transportation and analyzed within 5 hours of collection. Samples for biological oxygen demand (BOD) were collected using dark glass bottles for incubation and subsequent dissolved oxygen determination. Analysis was done at Faculty of Health Sciences' laboratory in UiTM Puncak Alam, Selangor.

Table II shows the sampling parameters based on the National Water Quality Standards for Malaysia (2006). Table III shows the parameters based on site analysis, sampling method, test method and equipments and source of analysis.

Table I: Descriptions of sampling sites.

Site	Location	Site description
Teluk Kemang Point 1	N° O2 27.160' E° 101 51.323'	Many restaurants in the vicinity. Markets and restaurant nearby.
Teluk Kemang Point 2	N° O2 27.218' E° 101 51.308'	
Teluk Kemang Point 3	N° O2 27.325' E° 101 51.274'	
Cahaya Negeri Point 1	N° O2 29.309' E° 101 50.568'	In front of aparments and hotel area
Cahaya Negeri Point 2	N° O2 29.348' E° 101 50.53'	
Cahaya Negeri Point 3	N° O2 29.414' E° 101 50.465'	
Saujana Point 1	N° O2 30.355' E° 101 50.126'	Near to hotel and resort area. Markets and restaurant nearby. Near to small jetty in the estuary.
Saujana Point 2	N° O2 30.25' E° 101 50.119'	
Saujana Point 3	N° O2 30.155' E° 101 50.112'	

Table II: Standard of Sampling Parameters.

Parameter	NWQS 2006
Temperature	NIL
pH	5.5-8.5
TDS	NIL
Conductivity (ms/cm)	NIL
Salinity	NIL
Turbidity (NTU)	50
DO (mg/l)	5-7
BOD	3
Cadmium	0.01
Copper	0.02
Chromium (IV)	0.05
Lead (ug/l)	0.05

Table III: Instruments and Methods for Analysis.

Parameter	Site Analyzed	Sampling Method	Test Method and Equipments	Analyse Source
Turbidity	In-situ analyzed	Environmental Protection Agency	Nephelometric Method Turbidity Meter	APHA, 1995
Others Physical	In-situ analyzed	Environmental Protection Agency	Hanna Multiparameter HI 9828	USGS, 2007
Chemical	Lab analyses	Environmental Protection Agency	DR 2800 Spectrophotometer Procedures Manual, 2nd edition	US EPA

For physical quality, the water was analyzed using Hanna Multiparameter. Turbidity Meter was used to measure the turbidity level. Chemical quality of water was analyses using DR 2800. Statistical test was done by using statistical package for social science (SPSS) version 18.0 and Microsoft Excel 2007. Descriptive frequency test was used to generate the mean and standard deviation of the parameters for the three beaches.

RESULTS AND DISCUSSION

Based on Table IV below, the parameters for physical water quality at the three beaches show no violation of standards following National Water Quality Standards 2006 except for dissolved oxygen. Dissolved oxygen will not have a direct effect on users, but it will influence microbial activity and the chemical oxidation state of various metals, such as iron. This situation may lead to aesthetic issues. Dissolved oxygen is the most important parameters among other physical parameters due to the fact of aerobic metabolism that requires dissolved oxygen (Yovita, 2003).

It was found that among the three beaches, Teluk Kemang was the most commercialized beach in Port Dickson. Thus, many activities such as littering on beach, industrial development, and sewage effluetns from commercial area such as shop and restaurants nearby can influence the turbity to Teluk Kemang beach. During observation, it was found that there were fewer visitors in Cahaya

Negeri beach compared to other two beaches. This proved that less activity in the water caused less turbidity.

Results shows that pH of the waters were reaching maximum reading standard which is pH 8.5. Dissolved oxygen at Teluk Kemang Beach was higher compared to Cahaya Negeri Beach and Saujana Beach. Photosynthetic activity and microbial respiration as well as decomposing activities in the river will affect the pH value. In Teluk Kemang and Saujana beach, there is a market in the vicinity and many organic wastes flowed into the river. There is a restaurant at the Teluk Kemang beach sampling site which discharged sewage (Yap, 2011). These activities might caused high pH level of the water.

Table IV: Compliance of Physical Parameters.

Parameter	Beach	N	Mean	Obligation of standards
Turbidity	A	12	11.2 ± 3.3	Comply
	B	12	5.7 ± 1.6	
	C	12	9. ± 3.9	
DO	A	12	2.4 ± 0.7	Violate
	B	12	2.7 ± 0.77	
	C	12	2.9 ± 0.6	
pH	A	12	8.4 ± 0.6	Comply
	B	12	8.1 ± 0.99	
	C	12	8.3 ± 0.72	
BOD	A	12	1.3 ± 1.1	Comply
	B	12	1.4 ± 0.4	
	C	12	1.3 ± 0.08	

A=Teluk Kemang
B=Cahaya Negeri
C=Saujana

Table V shows the mean readings on chemical parameters studied. The study found that the chemical parameters studied which majority have exceeded the National Water Quality Standards 2006 at all sampling locations. Cd mean concentration was the highest at Teluk Kemang Beach with 0.13 mg/L, followed by Saujana Beach with 0.04 mg/L and Cahaya Negeri with 0.06 mg/L. The violation of the Cd concentration was high from the normal standard that should not exceed 0.01 mg/L. The highest amount of copper was found in Cahaya Negeri Beach with 0.10 mg/L followed by Teluk Kemang and Cahaya Negeri Beach. Cr (IV) was found exceed the standard at Cahaya Kemang Beach with 0.07 mg/L while the other two beaches were not exceeded the standards. The study found no violation of Pb in the recreational water.

Table V: Compliance of Chemical Parameters.

Parameter	Beach	N	Mean± SD	Obligation of standards
Cadmium	A	12	0.13 ± 0.001	Violate
	B	12	0.04 ± 0.03	Violate
	C	12	0.06 ± 0.05	Violate
Copper	A	12	0.08 ± 0.03	Violate
	B	12	0.07 ± 0.01	Violate
	C	12	0.10± 0.07	Violate
Chromium	A	12	0.04 ± 0.03	Comply
	B	12	0.07 ± 0.08	Violate
	C	12	0.03 ± 0.02	Comply
Lead	A	12	0.04 ± 0.03	Comply
	B	12	0.03 ± 0.01	Comply
	C	12	0.03 ± 0.02	Comply

A=Teluk Kemang
B=Cahaya Negeri
C=Saujana

It is believed that high concentration of heavy metals such as chromium, copper and cadmium in the beaches will cause adverse health effects to the users especially bathers and public that is in contact with the water.

According to Kaizer and Osakwe (2010) heavy metals are toxic and can accumulate in the body without being noticed. However, the study could not prove the toxicity of the heavy metals towards users because no data were collected to identify the problems. These chemicals can potentially give adverse health effects to the recreational water users. The use of wet suits by water users will create a micro-environment that contributes to the chemicals absorption through skin and cause skin irritation and allergy (WHO, 2003).

Therefore, bathers and swimmers in the beaches might get effect even though they are using swimming suits whenever the heavy metals are there. Thus, it is very crucial that the heavy metals are

reduced by identifying the sources so that mitigating measures could be taken.

Ezeonyejiaku and Obiakor (2013) stated that high concentrations of heavy metals in water bodies are due to high population density and improper waste disposal Industrial activities, manufacturing, domestic and commercial activities generating wastes and natural factors are among the sources that influencing the concentration of heavy metals in the water (Kaizer and Osakwe, 2010). The sources of heavy metals in the recreational waters cannot be identified as the study only focusing on the status of water quality.

Cadmium, copper, chromium and lead are known toxic if exposed to high concentration or low concentration in long time. Chronic toxicity caused by the heavy metals could impair the functions of organs in the body and could cause death. Furthermore, the heavy metals can also affect marine life as supported by Ezeonyejiaku and Obiakor (2013) that heavy metals could affect species diversity when introduced into the water bodies.

Conclusion:

The findings suggested that extensive study should be conducted to identify the sources and causes of high concentration of cadmium, chromium and copper in the three beaches which are Teluk Kemang Beach, Cahaya Negeri Beach and Saujana Beach. As the three study locations are among famous recreational waters in Port Dickson beaches, the safety of the waters towards people should be preserved. It is also very crucial that the toxicity of the heavy metals to be identified and studied. Further study towards the water users should be conducted as to identify whether they are affected with the heavy metals.

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