IMPACT OF INDUSTRIAL E Y AT THE BELAT RIVER,

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ABSTRACT

Industrial wastewater entering a water body represents a heavy source of environmental pollution in the Belat River. It affects both the water quality as well as the microbial and aquatic flora. The objectives of this study were to determine the effects of industrial activities on water quality in the Belat River and classify the river water based on Water Quality Index (WQI) and National Water Quality Standards (NWQS) Malaysia. Surface waters were sampled from February until March 2015 to access the water quality of the river. Results revealed that industrial waste water are the main source of pollutants in the study area. The study also showed that the station 1 and 2 were slightly polluted and classified as class III, while station 3 was polluted and classified as class IV. A study of water quality in the Belat River need to be done by certain parties in the future so that the data obtain can be compared from time to time.

ABSTRAK

Air sisa perindustrian yang mengalir ke dalam air sungai merupakan sumber berat kepada pencemaran alam sekitar di Sungai Belat. Ia memberi kesan kepada kedua-dua sama ada kualiti air dan juga mikrob dan flora akuatik. Objektif kajian ini adalah untuk menentukan kesan aktiviti perindustrian terhadap kualiti air di Sungai Belat dan mengkelaskan air sungai berdasarkan Indeks Kualiti Air (WQI) dan National Standard Kualiti Air (NWQS) Malaysia. Prises pensampelan air sungai telah dijalankan dari Februari hingga Mac 2015 untuk mengetahui kualiti air sungai. Hasil kajian menunjukkan bahawa air sisa industri adalah sumber utama pencemaran di kawasan kajian. Kajian ini juga menunjukkan bahawa stesen 1 dan 2 adalah sedikit tercemar dan dikelaskan sebagai kelas III, sementara stesen 3 telah tercemar dan dikelaskan sebagai kelas IV. Kajian kualiti air di Sungai Belat perlu dilakukan oleh pihak-pihak tertentu pada masa akan datang supaya data yang diperolehi boleh dibandingkan dari semasa ke semasa.

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LIST OF ABBREVIATIONS

BOD	Biochemical Oxygen Demand
COD	Chemical Oxygen Demand
TSS	Total Suspended Solids
NH_3N	Ammonium Nitrate
DO	Dissolved Oxygen
EC	Electrical Conductivity
TDS	Total Dissolved Solids
Cd	Cadmium
Pb	Lead
WQI	Water Quality Index
DOE	Department of Environment
STN	Station
mg/L	Miligram per liter
%	Percentage

LIST OF ATTACHMENT

CHAPTER 1

INTRODUCTION

1.0 INTRODUCTION

Have you ever thought why water is really important in our life? Water is a basic molecule that forms a strong bond from the combination of two hydrogen atoms and oxygen atoms by shared electrons. Over 70 % of the earth's surface is covered with the water. In its odorless, purest form, colorless and tasteless, water actually playing a main role in our life. Its presence in our daily life activities is really important and living things can only survive for a short period without water. As one of the earth's natural resources, water is important in order to maintain a stable ecosystem on earth as well as to ensure a sustainable development in the proses of preservation of our environment.

Nowadays, freshwater resources are really stretched thin. A source of fresh water on earth is limited, which is only about 4.5%, while the other remaining source is saline water from the sea.As we all already know, now, our country, Malaysia is emerging, especially in the sector of industry. Now, Malaysia is striving towards industrial development, especially in oil and chemical-based industries. Being a developing country is something that we can be proud of but without we noticed this development proses has affected our rivers, lakes and seas

Improper management of wastewater from the industrial area will give the most critical problems to the environment especially water. This poor wastewater management practice will affect the quality of water as well as the aquatic life. In urban areas, the careless disposal of

industrial effluents and other wastes may contribute greatly to the poor quality of water (Mathuthu, 1997).

The quantity and quality of water are really important in ensuring the better life. Water quality is closely linked to water use and to the state of economic development. The poor wastewater management practice can cause water pollution. Water pollution is a change in terms of content, condition and color of the water that can give an impact on humans when used it. This contamination occurs either in terms of biology, chemistry and physics. Pollutants can be found in various forms of gas, liquid and solid. Water pollution is not only happening in the river, but also in the sea, the beach and other watery areas.

1.1 PROBLEM STATEMENT

Belat River, which is situated at Tanah Putih, Kuantan is one of the focal points for fishermen around Malaysia. This river is known as a hotbed of catfishes and lobsters. For some fishermen in Kuantan, Belat River is like fields for their livelihood.

Unfortunately, the process of development around the Belat River has given the negative impacts, especially on its water quality.The Belat River was contaminated with black oil, garbage and also the waste water from the nearby industrial. The river was silt with the oil spills.

Tanah Putih is one of the industrial zones in Kuantan. Among the industrial activities in this area are factories of fish filleting, automobile factories, wood manufacturing plant and so on. In my observation, the problem arises when the chemical liquid released into the river is not treated properly and contains toxins that can pollute the river. Effluents from the nearby industries are disposed into the river almost exclusively without adequate treatment. The poor wastewater management that they practice has given a big impact, which is adverse effects into the water quality of Belat River and causing the water pollution. Most heavy metals in streams of water are commonly in industrial associated with industrial discharges (Mdamo, 2001)

1.2 SIGNIFICANT STUDY

This study will assess the current status of water quality in the Belat River. By this study, it is hoped that with this result will assists the relevant development of industries. Development is important, but it should be planned wisely so that the proses of development do not disturb the earth's natural resources.

This result of study also can assist the authorities and professional in sector of industries to design the appropriate preventive measures to ensure that the water quality of the river will be maintained and improved. Developers of industrial activities need to be done responsibly with the considerations on the impact towards the environment. The proper way on industrial wastewater management practice should practice strict without any excuses.

The result of this study will help authorities to identify the problems that relate with the poor wastewater management practices in industrial area. So that they will find the best solution to overcome the same problem from keeps happening again.

1.3 OBJECTIVES

This study has two main objectives:

a) To determine the effects of industrial activities on water quality in the Belat River.

b) To classify the river water by assessing the Department of Environment Water Quality Index (WQI) and National Water Quality Standards (NWQS) Malaysia.

1.4 SCOPE OF STUDY

The scopes of study for this study are:

a) The study area will be conducted in the Belat River, Tanah Putih, Kuantan.
b) Sampling will be undertaken at three points of stations along the Belat River.
c) Each station will have two replicates of samples.
d) The sampling process will be conducted for two times of the study period.
e) The parameters that will be used in this study are biochemical oxygen demand (BOD), chemical oxygen demand (COD), pH, turbidity, total suspended solids (TSS), ammonium nitrate (NH_3N) , phosphate, electrical conductivity (EC) and sulphate.

1.5 EXPECTED OUTCOMES

This study expects that at the end of the study, we will know the water quality status of the Belat River. From this result, we will find the level of pollutant in the Belat River. Not only that, this study will help to identify whether the wastewater management practice is enough or not. So, if the result shows, the existing wastewater management is not well efficient, the concerned parties, maybe think a better way to ensure the effluents from the industries discharge to the river will give a big impact on water quality of the river.

CHAPTER 2

LITERATURE REVIEW

2.0 INTRODUCTION

River is one of the natural elements that are very important to human. Since river plays many roles to human, it has been very useful to men in all parts of the earth since decades ago. River is used in agriculture, industrial, water supply, hydroelectric generation and many more. Not only that, since very early times, river is also used as the communication and transport system for moving from one place to another place. The hugest use of river that nobody can deny is in the domestic needs. Therefore, river is important in ensuring the development of economy, social and politic.

The importance of river to human cannot be denied. Without us realizing, in the pursuit of development, our river is getting worse day by day. Uncontrolled river exploration for the country development has led to the river pollution. This has made the water quality of the river and its aesthetic values declining.

2.1 EFFECTS OF INDUSTRIAL WASTEWATER ON WATER QUALITY

Both the developed and developing countries will experience the same main problem that is water pollution. Water pollution due to discharge of untreated industrial effluents into water bodies is a major problem in the global context (Mathuthu, 1997). The stream or river that located nearby the industrial area will definitely be polluted. In industrial wastewater, a wide range of organic compound is detected. Industrial wastewater contains colloidal, dissolved

(mineral and organic) and suspended solids. The untreated properly wastewaters from the industries will effluent to the nearby river and as a result, it will disturb the water quality of the river and cause the negative impacts to the human's life and the eco - system. This untreated wastewater also may be contained toxic materials, inert organic and pathogenic bacteria which are at the same time will harmful the aquatic life.

Different types of industries will produce different types of wastewater. Each type of industrial activities will produce its own particular pollutants if cannot be well managed. Table 2.0 shows water pollutants produce by each industrial sector.

Table 2.0: Type of pollutant produces by each industrial sector.

Industrial Sector	Type of Pollutant
Mining	Total suspended solids, salts, metals and acids
Iron and steel	Chemical oxygen demand, biochemical oxygen demand, cyanide, acids, oil, metals and phenols
Microelectronics	Organic chemicals and chemical oxygen demand
Chemicals	Cyanide, total suspended solids, chemical oxygen demands, heavy metals and organic chemicals
Textiles and leather	Solids, chromium, sulfates and biochemical oxygen demand
Non-ferrous metals	Total suspended solids and fluorine
Petrochemicals and refineries	Chemical oxygen demand, biochemical oxygen demand, chromium, phenols, and mineral oils
Paper and pulp	Chlorinated organic compounds, solids, chemical oxygen demand and biochemical oxygen demand

2.2 WATER QUALITY PARAMETER

In monitoring the water quality of the stream or river, it requires many different types of parameters to be sampled. Water quality parameters are divided into two which are in situ and ex situ parameters.

2.2.1 In Situ Parameter

In situ parameter refers to the experiments that will be conducted directly on the site.

2.2.1.1 Temperature

Temperature is one of the most important parameters to indicate the quality of water. Temperature plays an important role in maintaining the quality of water due to the fact that it has an effect on chemical reactions that occur in natural water systems. For example, in aspect of solubility and rate of reaction. The increasing in water temperature will also increase the rate of chemical reactions. Not only that, temperature can also give impacts on the biological characteristics of surface water. Growth, metabolism and reproduction will be affected by the temperature of water.

2.2.1.2 Turbidity

The measure of water clarity or haziness is known as turbidity. Turbidity is a measure of the extent to which light is either absorbed or scattered by suspending material in water. Cloudiness of the water river is normally due to the presence of suspended materials that can be seen by the naked eye. Water can lose its transparency by the presence of suspended materials. The presence of suspended sediments will produce high turbidity and lead to a continuous water pollutant.

Silt, rock fragments, metal oxides and also clay that produce from the erosion of colloidal materials are the sources of the most turbidity in the waters. Not only those materials, microorganisms and vegetable fibers also contribute to the turbidity. Industrial wastewater may contribute a larger number of materials that can lead to the producing of turbidity and the discharged of this wastewater can increase the turbidity of the river.

Both total suspended solids and turbidity should be corresponding to each other, but it is only approximate. High turbidity will not give impacts on the aesthetic value only, but also effects on aquatic organisms. This is due to the high turbidity that will disturb the fish feeding and growth. Not only that, cloudiness of water will reduce the penetration of light into the water for the photosynthesis process and lastly reduce the visual range of sighted peoples and animals.

2.2.1.3 pH

pH is a measure of the concentration of hydrogen ions in water. Usually, natural water has a pH value between 5.0 and 8.5. For most living things, the pH value plays an important role and is so critical. The huge changes of pH value can cause death. Aquatic life only can survive in water that has a pH value in the range 6.5 to 8.4. If the pH value of water is more than 9.0 or less than 5.0, it is not suitable for aquatic life and it will affect the aquatic organism.

The value of pH that is less than 7 will indicate that the water is acidic. Acidic water can cause the erosion of stone, metal and so on. Another role of the pH value is in aspect of solubility. It will affect the solubility of nutritive chemicals and toxins. According to Mosley et al., (2004), water with a pH greater than 8.5 indicates that the water is hard. The presence of increasing toxicity number of sulfides and cyanides will decrease the pH value which increases in water acidity.

2.2.1.4 Electrical Conductivity

Electrical conductivity of water is used to estimate the total amount of solid dissolved (TDS) in water. By electrical conductivity, the capacity of water to conduct electrical current can be identified. Electrical conductivity also related to the amount of concentration of salts that dissolved in water. The higher the amount of concentration of salts dissolved in water the higher the electrical conductivity.

Water can conduct electrical when salts that dissolved into water separately into two differences charge ions that are cation (positively charged ion) and anion (negatively charged ion). Pure water, which is water that condensed from the river (distilled water) is excellent insulators that do not conduct electricity as it does not contain any dissolved salts.

Electrical conductivity can be used as the indicator for other water quality problems as its own characteristic that is easy to measure. The sources of dissolved ions in water can be easily detected when the conductivity of water is increasing. Due to the weathering and dissolution process of soil and rock, all types of natural water normally contain with dissolved solids. Not all the dissolved solids that presence in water can be acted as conductor.

Higher values of TDS indicate that the water is potentially unhealthy and unpalatable. Temperature of water is a factor that affecting the electrical conductivity in the water. As the temperature of water increase, the electrical conductivity also increases.

2.2.1.5 Dissolved Oxygen

Dissolved oxygen is a measurement to identify the amount of gaseous oxygen that dissolved in water. Through the rapid movement (aeration process), the process of diffusion of air surrounding and also as well as a waste product from the photosynthesis process, oxygen can be dissolved in water.

Dissolved oxygen is essential for all organisms in the water to run their daily life. Lack of dissolved oxygen in the water will result in death of aquatic life and disturb the river ecosystem. Besides that, dissolved oxygen also can be used as the indicator for the water pollution. Dissolved oxygen in water is the main causes of producing rust and corrosion in water supply systems through the pipe.

Total dissolved oxygen in water must, not more than 110 percent and the concentration above this level can be harmful to aquatic life. Oxygen solubility is inversely proportional to the temperature at which oxygen decreases rapidly when the water temperature increases.

2.2.2 Ex Situ Parameter

Ex situ parameters are experiments that will be conducted at the laboratory.

2.2.2.1 Ammonium Nitrogen

The ammonia nitrogen parameter is one of the parameters that can be used as the water pollution indicator as the wastewater containing the high nitrogen contain. The breakdown of nitrogenous inorganic and organic matter in water and soil, the process of gas exchange with the atmosphere and also the reduction of nitrogen gas in water by microorganisms can produce the arising of ammonia in water. Industrial activities also will discharge ammonia.

The presence of nitrogen is essential for the growth of plant and animal, but the overabundance of certain of it in water can cause a negative effect. Too high a level of ammonium nitrogen in water can be toxic to aquatic organisms. Normally, unpolluted water contains less than 0.1mg/l amount of ammonia. The high level of ammonium nitrogen in water can cause the overstimulation of growth of algae and aquatic plants.

The excessive of these organisms will cause the clogged in water intakes and as they decompose, they will use up the dissolved oxygen, resulting the decreasing of dissolved oxygen level and lastly will block light to deeper waters. Eutrophication will occur if the level of

ammonium nitrogen is higher. It will create conditions that interfere with recreational uses of lakes, the health and diversity of indigenous life.

2.2.2.2 Biochemical Oxygen Dissolved

Biochemical oxygen dissolved is the quantity of oxygen required by bacteria to degrade or oxidize organic materials in the presence of oxygen. Usually the standard 5 day BOD is used to measure the amount of oxygen can be consumed by the organisms. It is the most common indicator used in indicates the water polluted.

In the clean water, the level of BOD should be low while the polluted water, its BOD level should be high. If the effluent has a high BOD value discharged into the river that has the low ability of oxygen supply, then the lack of oxygen will occur. This will lead to anoxic conditions occur in the river. It shows that the BOD will directly attack the amount of dissolved oxygen in the river. The higher the level of BOD, the more rapidly depleted oxygen occurs.

When the DO levels decrease or drops below a critical level, the aquatic life will be in danger zone as these aquatic lives depend on the quantity of dissolved oxygen. If the river's ability to supply new oxygen similar to the BOD values, this means that a balance has existed, where the oxygen demand does not exceed the supply of oxygen from the river. Concentration of domestic, industrial and agricultural wastewater can be determined by the value of BOD in terms of quantity of oxygen concentration that need for decomposition of organic matter.

2.2.2.3 Chemical Oxygen Dissolved

Chemical oxygen dissolved is the amount of oxygen required for the chemical reaction to chemically oxidize organic material to produce carbon dioxide and water. The level of COD will show the strength of organic material and the level of water pollution. The value of BOD indicates the quantity of water – dissolved water that the contaminants consumed. The high value of COD indicates a high level of water pollution because it contains high organic material. The value of COD test is usually higher than the BOD test because almost all organic matter are

decomposed while in the BOD test only part of the organic matter are decomposed. According to the Standard Environment Quality Act, the value of COD for the industrial wastewater should not exceed 100mg/L.

2.2.2.4 Total Suspended Solids

Suspended solids can be divided into two types which are organic particles and inorganic particles with sized 10mm to 0.1mm. All particles that do not pass through a filter and suspended in water is called as total suspended solid. Organic particles composed of algae, protozoa, bacteria and so on, while inorganic particles are like clay, silt, and many others.

Soil erosion from the construction activities and agricultural are one of the sources of suspended solid. Industrial and sanitary wastewater also can contribute to the presence of suspended solids. Present of suspended solids can lead to the water turbidity. As the suspended solids increase, the water becomes cloudier. This turbidity of water will prevent the sunlight from penetrating into the riverbed. This will lead to the decreasing quantity of dissolved oxygen, which is will affect the aquatic life. So, the ability of the water body to keep supporting a diversity of aquatic life will criticize.

2.2.2.5 Phosphate

The rocks release phosphorus as phosphate during the natural process of weathering. Phosphates are soluble in water. Phosphorus helps the growth of nutrient in water ecosystem. The low present level of phosphate is not toxic or harmful to human or animal.

Another role of phosphate is as the stimulant for the growth of aquatic plants and plankton. Plankton is a basic material for a food chain. This increasing productivity will increase the population as well as the system of biological diversity. The aging process of the water ecology system will accelerate as the phosphate loading continues. Imbalance nutrient will be occurring when the overproduction of the lake occurs and finally lead to the eutrophication.

2.2.2.6 Sulphate

Reduction of sulphate has contributed to the formation of sulphide. Sulphide will associate with the smell. Wastewater with pH equal or above 8, the reducing of sulphur is occurring in the form of HS^- and S^{2-}. So in this case, they will be not odor problem. Serious odor problems can occur when the wastewater pH value is under 8 because the sulphide will form unionized H_2S that led to the odor problem. The combination of H2S with the presence of oxygen and bacteria will convert sulphide to sulphuric acid which can cause the corrosion problem in the sewer system.

2.3 WATER QUALITY INDEX (WQI)

There are many parameters used to assess the water quality. This includes physical parameters (pH and DO), nutrients (NH_3H and phosphate) and metal (Cd and iron). However, the Department of Environment (DOE 1986) has used six main parameters for assessing the quality of river water, which are DO, pH, BOD, COD, TSS and NH_3H. There are the fixed formulae to calculate the Water Quality Index (WQI) of river.

(Refer to Appendix B)

Not only that, the classes of river also can be identified by using the National Water Quality Standard (NWQS) Malaysia as shown in the Table C1.

(Refer to Appendix C)

Value for the WQI obtain from the calculation can be used to identify the class of water based on the status of the water as shown in Table C5

(Refer to Appendix C)

CHAPTER 3

METHODOLOGY

3.0 INTRODUCTION

Before conducting the study, designing the work that will be done during the study is crucial in ensuring the smoothness of the study. This will give a more clearly and concisely in an effort to achieve the objectives of the study.

3.1 STUDY AREA

Belat River is one of the rivers that are located in Tanah Putih, Kuantan. Belat River is once famous as tourist anglers. The location of Belat River is near the industrial area Batu 3 Tanah Putih, Kuantan. Figure 3.1 shows the location of Belat River. As it is near to the industrial area, this river is exposed to water pollution problems that caused by the industrial sector. The effluent from the nearby industrial area if do not treat well will enter the stream and affect the water quality of the Belat River.

This location was chosen based on preliminary observations made where there is a critical source of pollution due to industrial adventure. Wastewater from the industrial activities is identified as the source of contamination.