STUDY ON SEDIMENT CHARACTERISTICS AND PREDICTION OF SEDIMENT LOAD AT GALING RIVER

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I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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'in the name of God, the most gracious, the most compassionate'

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ABSTRAK

Satu kajian mengenai sedimen telah dijalankan di Sungai Galing. Terdapat tiga sekunder data dan satu data baru yang digunakan dalam kajian ini. Tiga hari yang berbeza di ambil untuk sekunder data adalah pada 28/02/13, 13/03/13 dan 27/03/13 manakala pula data yang terbaru diambil pada 15/11/2017. Tujuan kajian ini dijalankan adalah untuk mengenal pasti ciri-ciri sedimen seperti kepekatan sedimen, saiz sedimen, pelepasan sedimen dan factor yang boleh mempengaruhi pengangkutan sedimen. Empat stesen persampelan telah dipilih, yang pertama di hulu Sungai Galing (Stesen 1dan Stesen 4), pertengahan aliran Sungai Galing (Stesen2) dan Sungai Galing Hiliran (Stesen 3). Parameter yang diukur dalam kajian ini adalah; arus sungaiatau kadar aliran, kedalaman dan lebar sungai. Dalam kajian ini, saiz sedimen diperoleh melalui analisis ayakan. Untuk kepekatan sedimen (mg/L), ia diukur dengan Jumlah Pepejal Terampai (TSS). Sementara itu, pelepasan sedimen dikira menggunakan persamaan Duboys’s. Persamaan ini digunakan kerana melepasi keperluan yang diperlukan untuk mengira pelepasan sediment jika dibandingkan persamaan yang lain. Persamaan Duboys’s memrlukan data seperti median saiz sedimen (D_{50}) dan mean saiz sedimen (D_m). Konklusinya, kajian menunjukkan saiz sedimen berada di skala 0.71mm hingga 1.0mm berdasarkan skala Wentworth yang mana skala ini menunjukkan sedimen ini adalah pasir kasar dan ada satu saiz berada di skala 1mm hingga 2mm yang mana menunjukkan sedimen ini adalah pasir yang sangat kasar. Selain itu, kepekatan sedimen yang diambil di semua stesen menunjukkan data yang berbeza-beza. Nilai di Stesen 1 adalah, 0.010mg/L, Stesen 2 adalah 0.022mg/L, Stesen 3 adalah 0.015mg/L dan Stesen 4 adalah 0.034mg/L. Pelepasan sedimen, data sini menunjukkan nilai yang tertinggi di antara tiga hari data yang diambil di setiap stesen masing-masing. Data di Stesen 1 adalah 0.8009 kg/sec-m, Stesen 2 adalah 0.850 kg/sec-m, Stesen 3 adalah 5.844 kg/sec-m dan di Stesen 4 adalah 0.5222 kg/sec-m. Akhir sekali, factor ynag mempengaruhi pengangkutan sedimen di Sungai Galing telah dikenal pasti dimana faktor-faktornya adalah saiz sedimen, hujan, meliputi tanaman, aktiviti-aktiviti manusia (kumbahan dan sampah-sarap), hydraulic sungai (kadar aliran), hakisan tanah dan geometri sungai (lebar dan kedalaman)

ABSTRACT

A study on sediment was conducted at the various station in Galing River. There were three secondary data and one new data that will used in this research. Secondary data was consumed from three different days in order to take the samples which are 28/02/13, 13/03/13 and 27/03/13 and the latest data was conducted on 15/11/2017. This study was conducted to determine the sediment characteristic such as sediment concentration, size, density, and sediment load with the factors influencing sediment transportation. Four sampling stations were chosen, the first one with to data at upstream Galing River (Station 1 and Station 4), mid-stream Galing River (Station 2) and downstream Galing River (Station 3). Parameter were collected at the station, such as river discharge values or flow rate, depth and wide of river and the density of the river. In this study, sediment grain size is acquired through sieve analysis. For sediment concentration (mg/L), it is measured by Total Suspended Solid (TSS). While, sediment load is calculated by using Duboy's sediment transport function. It is preferred to use Duboy's as all samples passed this function's requirement compare than other function. Duboy's function required median size (D50) and mean grain size (Dm). Overall, the findings of the study show that the sizes of sediment at Galing River based on Wentworth scale fall between (0.71 to 1.0mm) which indicates coarse sand type and has one sizes between (1mm to 2mm) which indicates very coarse sand. On the other hand, the average suspended sediment concentration recorded for each station shows varying values. The values were 0.010mg/L at Station 1, 0.022mg/L at Station 2, 0.015mg/L at Station 3 and 0.034mg/L at Station 4. For sediment load, the values were the highest at the station between four different days at Station 1, Station 2, Station 3 and Station 4 were 0.8009 kg/sec-m, 0.8500kg/sec-m, 5.8442kg/sec-m and 0.5222 kg/sec-m respectively. Lastly, factors influencing sediment transportation at Galing River were identified where the factors are size of sediment, rainfall, vegetal covers, human's activities (effluent and garbage), river's hydraulic (flow rate), soil erosion and river's geometric (width and depth).

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LIST OF SYMBOLS

ρ_s	Density of sediment
ρ	Density of water
Δ	Relative density
γ'_s	Specific weight **(**submerged solid particles)
γ_s	Specific weight of sediment particles
γ	Specific weight of water
R_{NS}	Grains Reynolds number
D_N	Nominal sediment diameter
W	Fall velocity
A	Coefficient associated D_{50}
AF	Adjustment coefficient for water temperature and concentration of fine
CF	Percentage effect for different medium particle size
V	Mean velocity (m/s)
V_c	Critical velocity (m/s)
d	Mean depth (m)
D_{50}	Particle size at 50 percent of bed material by weight is finer
ψ	Coefficient depending on mean size of bed sediment (m^3/kg/s)
τ_o	Bed shear stress (N/m^2)
τ_c	Critical bed shear stress (kg/m^2)
C_m	Sediment discharge concentration, weight/volume
G	Unit weight of water
d_s	Mean particle diameter

D	Effective depth flow
τ	Critical shear stress
g_s	Bed load discharge (kg/s-m)
Q	Total water discharge (m^3/s)
Q_S	Part of water discharge apportioned to the bed in m^3/s
D_{90}	Particle size which 90 percent passing
D_m	Effective diameter of bed-material mixture (mm)
S	Energy gradient (m/m)
n_s	Manning's roughness value for bed stream
q_c	The critical discharge (m^3/s per m of width)
G_s	The bed load discharge (m/s)
T_w	Width (m)
n	Number of size fraction in bed-material mixture
q	Discharge per unit width
D_{si}	Mean grain diameter (m)
i_b	Fraction by weight of bed-material in a given size fraction
g	Acceleration gravity
ν	Kinematic viscosity (m2/s)
u_*	Shear velocity (τ0/ρ) 1/2 in (m/s)
α	Coefficient in the rough turbulent equation with a value 10

LIST OF ABBREVIATIONS

UMP	University Malaysia Pahang
TSS	Total Suspended Solid
S1	Station 1
S2	Station 2
S3	Station 3
S4	Station 4
Q	Flow rate
q_s	Sediment Discharge

CHAPTER 1

INTRODUCTION

1.1 Introduction

Sediment refers to the conglomerate of materials, organic and inorganic, that can be carried away by water. While the term is often used to indicate soil-based, mineral matter (e.g. clay, silt and sand), decomposing organic substances and inorganic biogenic material are also considered sediment.

To develop ecosystem through nutrient replenishment and the creation of habitat and spawning area, sediment is necessary and one of important thing to complete the ecosystem. These occur due to sediment deposition when the suspended particles settle down to the bottom of the river. This process occurs when water flow slows down and heavy particles no longer being support by the bed turbulence.

Sediment transport or another name sediment load is the movement organic and inorganic particles by water. There are two type of sediment transport, there are suspended load and bed load. In the river, sediment can either be suspended means floating in the water or settled on the bottom of a body of water that call bed. In general, the greater flow the more sediment that will transport. Flow can be strong enough to suspend particles in water as they move to downstream. Transported sediment include mineral matter, chemical and pollutant.

1.2 Background of Study

Sediment comes from geologic, human influence and organic factors. All the amount, material and size of the transported sediment may influences in any particular waterway. Many sediment particles are mineral based. The rapid urbanization causing land use degradation and deforestation also contributed to distress flood hazards. Chan (1997) stated that the risk of flash flooding has increased because of constructing buildings, road, which heads to the impervious surface. There may have construction or deforestation at the river which can affect the sedimentation characteristic.

Beside that's, the other thing that influence the sediment rate is the river flow. The rate of sedimentation will increase due to the decreasing the river flow. The velocity become higher and the rate of sedimentation will be decrease.

In Kuantan district there many river that contributes from Kuantan River. Kuantan River is the main river and there was a river that contributes from it, there is Galing River and it was flow in the middle of Kuantan City. Kuantan River was connected and flowing out to the South China Sea. Galing River cover area from Bukit Sekilau, Semambu and Kampung Tok Keratuat. Galing River was flowing out to Kuantan River at the end of Kampung Tok Keratuat. In 2012, a natural disaster was happened in Kuantan district, where was flood and made many massive loss. One of the reason is the Galing River was overflow due the nonstop rain before the day of incident.

1.3 Problem Statement

The sediment characteristic of Galing River need to specify because it may affect the river flow. There are many factors that affect characteristics of the river. Regarding to the (Mann in 1982, Parsons et.al in 1990), there have many natural factors which can be influence to affect the sediment characteristics of the river. For example natural disaster like flood. This study will determine some characteristics at Galing River and factors that will affect it.

1.4 Objective Study

1) To identify sediment characteristic in Galing River at various station.

2) To make comparison of sediment load between measured and predicted in Galing River.

1.5 Scope of Study

This study is carry out at selected point in Galing River. The scopes of this study are shown below:-

- Determine the characteristics of sediment regarding the size, density and velocity of the samples.
- Duboy's equations were used to determine the sedimentation rate.

1.6 Significant of Study

The data about the characteristics of sedimentation maybe useful to researches and local residential for future planning to determine the suitable method for sediment prediction. This study also can determine the sedimentation rate in Galing River.

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