



# Integrated Assessment of Heavy Metal Contamination in Sediments from Gebeng Industrial Estate, Pahang, Malaysia

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## Abstract

Gebeng is one of the most important industrial regions in Pahang, Malaysia. The study was conducted in the Gebeng industrial estate to investigate the effect of industrialization on heavy metal pollution in the surface sediments of the industrial area. In this study, it has been found that the sediments were highly contaminated especially by Co, Hg and As which is supported by the values of enrichment factors, contamination factors, geo-accumulation index, pollution load indexes and contamination assessment by sediment quality guidelines. According to the hierarchical cluster analysis (HCA) the studied heavy metal pollution were ranked as Co > Hg > As > Pb > Zn > Cu > Cr > Cd > Ni > Ba and the sampling stations were ranked as WS1 > DSRS3 > DSRS1 > USRS4 > DSRS2 > USRS3 > WS3 > WS2 > USRS2 > USRS1. Moreover, it was found that all the three zones (the wetland sediments, upstream and downstream river sediments) were polluted by heavy metals. Three principal components were extracted from principal component analysis, they accounted for more than 84% of the total variability and detected the industrial activities was the source of pollution. The results indicated that the industrial dumping is going on indiscriminately. The study will help in the strategic management of the industries through providing heavy metals pollution of sediments.

Keywords: Gebeng, sediment, heavy metals, geo-accumulation-index, pollution load index.

## Introduction

Generally, sediments are being contaminated through industrial activities<sup>1</sup>. The main problem behind sediment pollution is the entry of metals in food chain and consumed by lives<sup>2</sup>. Anthropogenic impact, parent material and weathering processes may influence a lot on heavy metal concentrations. Heavy metals are concerned because of their persistence and toxic effects<sup>3</sup>. As they are chemically and biologically not degradable, so they have been posed major pollution factors<sup>4</sup>. Now a day, heavy metal contaminations are severe in eastern and western part of Johor Strait, Malaysia<sup>5</sup>. It is reported that a large number of industries are active in Gebeng industrial area. The Tunggak is the main river in the studied area that affected by industrial dumping and flows through the Gebeng industrial regions. In addition, the lowlands especially, the wetlands surrounding of the industries are also affected by industrial dumping. In spite of socio-economic importance of the study area, no studies have been conducted to find out heavy metal pollution of the surface sediments. The objectives of this research were to find out the heavy metal pollution of the surface sediments in the study area.

## Material and Methods

Study area and the selection of stations: Gebeng industrial estate (figure-1) is the main industrial area at Kuantan, the capital city of Pahang, Malaysia. The industrial region is located

near Kuantan Port. The sampling stations are situated between 03° 58'34" N 103°23' 17" E and 03°58'13" N 103°23'23E. Sujaul et al<sup>6</sup>, stated that the prominent industries of the study area are chemicals, petro-chemicals, energy, gas, metal, metal work factories, coal mining, rare earth plant, food processing, polypropylene and various manufacturing industries. On the basis of types of industries, topography and discharge points, upstream and downstream of the river, sampling stations were selected from the Tunggakriver and from the industrial area.

Sampling, data collection and analysis: Sediment samples were collected from August 2012 to July 2013 from three zones. Total of 10 sampling points were selected from 3 zones, where five replications of each sample were taken. There were three stations at wetland sediments (WS), four stations from upstream river sediments (URSS) and another three stations from downstream river sediments (DRSS). Sediment sampling was made according to the standard procedure. Sediment samples were collected using Van Veen grab sampler from the study area. The collected samples were put into the polythene bags. All samples were cleaned, air dried, grinded and sieved in the laboratory before analysis.

Laboratory Analysis: Air dried and sieved samples were used for analysis. The amount of heavy metals was analyzed by microwave acid digestion procedure with a mixture of HNO<sub>3</sub> – HF-HCl. After digestion, metals were determined by using ICPMS. Mercury was determined by taking 0.2gm sediment