# ANALYSIS OF $PM_{10}$ IN KUALA TERENGGANU BY INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS

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**Abstract**

Instrumental neutron activation analysis was used for the determination of trace elements in airborne particulate matter ($PM_{10}$) for air pollution monitoring. For the collection of air samples, the $PM_{10}$ high volume sampler unit and Whatman 41 cellulose filter papers were employed. Samples were collected at 13 selected sampling sites covering areas in the city center, inner and outer city of Kuala Terengganu during the month of March 2005. The average PM10 was 69.64 $\mu gm^{-3}$, 83.58 $\mu gm^{-3}$ and 72.22 $\mu gm^{-3}$ for sampling stations located in the city center, inner and outer city of Kuala Terengganu, respectively. It was found that the mass of air particles in the study area was higher compared to Bangi and Kuala Lumpur. Chemical analysis of selected elements (Al, Fe, Cu, Pb, V, Mn, Zn, Cr, As Cd), ionic species ($Na^+$, $SO_4^{2-}$, $Cl^-$, $NH_4^+$,$Mg^{2+}$, $K^+$ , $Ca^{2+}$) and some rare earth elements (REE) were included in this study. In general, most of the average concentration of trace elements in the city center sampling stations was generally higher than the inner and outer city sampling stations. The concentrations of trace elements in sampling stations follow the general trend of Al>Fe>Zn>Cu>Mn>Pb>V>Cr>As>Ni>Cd. The elements concentration ranged from 680-2119 $ngm^{-3}$, 170-1132 $ngm^{-3}$, 8.13-122.4 $ngm^{-3}$, 8.48-77.3 $ngm^{-3}$, 7.68-14.4 $ngm^{-3}$, 1-90.4 $ngm^{-3}$, 1.47-3.25 $ngm^{-3}$, 1.43-5.03 $ngm^{-3}$, 1.15-4.45 $ngm^{-3}$, 0.24-3.75 $ngm^{-3}$ and 0.28-1.36 $ngm^{-3}$, respectively.

**Abstrak**

Kajian kualiti udara telah dijalankan melalui penentuan paras kepekatan beberapa logam dalam habuk halus (PM10) dengan kaedah pengaktifan neutron (NAA). Pensampel isipadu tinggi PM10 yang dilengkapi kertas turas selulosa jenis Whatman 41 telah digunakan untuk menentukan kandungan zarahan terampai udara. Sebanyak 13 lokasi pensampelan telah di pilih merangkumi pusat bandar, luar pusat bandar dan pinggir bandar Kuala Terengganu. Purata kepekatan habuk halus (PM10) yang diperolehi adalah 69.64 $\mu g\ m^{-3}$, 83.58$\mu g\ m^{-3}$ dan 72.22 $\mu g\ m^{-3}$ pada ketiga-tiga lokasi pensampelan tersebut. Kepekatan habuk halus (PM10) yang dicatat di ketiga lokasi ini adalah lebih tinggi berbanding dengan Bandar Bangi dan Kuala Lumpur. Kandungan kepekatan logam (Al, Fe, Cu, Pb, V Mn, Zn, Cr, As Cd dan REE), cation dan anion ($Na^+$, $SO_4^{2-}$, $Cl^-$, $NH_4^+$,$Mg^{2+}$, $K^+$ , $Ca^{2+}$) dalam habuk halus (PM10) telah dikaji. Secara amnya, turutan logam dalam habuk halus (PM10) adalah seperti berikut Al>Fe> Zn>Cu>Mn >Pb>V>Cr>As>Ni>Cd dan julat kepekatan masing-masing adalah seperti berikut 680-2119 $ng/m^3$, 170-1132 $ngm^{-3}$, 8.13-122.4 $ngm^{-3}$, 8.48-77.3 $ngm^{-3}$, 7.68-14.4 $ngm^{-3}$, 1-90.4 $ngm^{-3}$, 1.47-3.25 $ngm^{-3}$, 1.43-5.03 $ngm^{-3}$, 1.15-4.45 $ngm^{-3}$, 0.24-3.75 $ngm^{-3}$ dan 0.28-1.36 $ngm^{-3}$.

## Introduction

The effects of atmospheric particulate matters on environment and human health have been of great global concern. Many epidemiological studies [1,2,3] have established an association between the particle concentration in the atmospheric and adverse effects on health; the PM10 fraction (diameter < 10 μm), and particularly the PM2.5 fraction (diameter < 2.5 μm) are known to be the primary cause of COPD (Chronic Obstructive Pulmonary Disease), asthma exacerbation, respiratory symptoms, morbidity and mortality, decrement in lung function and possible risk of lung cancer.

Atmospheric aerosol found in urban areas represent a mixture of primary particles emitted from various sources (e.g. vehicles exhausts, coal-fired power plants, oil refineries, forest fires, industrial emission, sea spear, volcano eruption etc) and secondary particles from aerosols formed by chemical reactions [4,5]. The morphology and composition of these particles may change through several processes, including vapor condensation, evaporation and coagulation. The final 'products' usually vary according to origin, chemical composition and physical properties, leading to particular deposition patterns in the human respiratory system. For this reason, intensive