

**UNIVERSITI TEKNOLOGI MARA**

**STUDY OF NATURALLY  
OCCURRING RADIOACTIVE  
MATERIAL (NORM)  
DISTRIBUTION IN SOIL FROM  
GEBENG INDUSTRIAL AREA,  
PAHANG, MALAYSIA**

**NURUL IZZATIAFIFI BINTI ISMAIL**

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## ABSTRACT

Naturally Occuring Radioactive Materials (NORM) present naturally in the environment, but the increase of the concentration of radionuclide may come from the anthropogenic activities. NORM at certain limit becomes hazardous to environment and human. The study of radionuclides concentrations (U, Th and  $^{40}\text{K}$ ) in soil from Gebeng Industrial Area, Pahang were carries out from November 2014 to March 2016 to assess its distribution. The major sources of radionuclides in Gebeng Industrial Area may be originating from anthropogenic activities. The amount of concentration and activity concentration of NORM such as U, Th and  $^{40}\text{K}$  is the important factor in assessing whether it is harmful to human or vice versa. The hazard risk of NORM was determined by calculating the pollution and radiological assessment. Then to assess the spatial uptake of radionuclide in the surface soil and *Acacia mangium* plant as potential mitigation strategy. Concentrations of uranium, thorium and potassium were determined using Energy Dispersive X-ray Fluorescence (EDXRF) method. The distribution of radionuclides in soil shows high concentrations of uranium and thorium in the industrial area, meanwhile potassium high concentration detected in green area away from the factory. The pollution level in study area was estimated by calculating the Enrichment Factor (EF), Contamination Factor (CF), Pollution Load Index (PLI) and Geo-Accumulation (I-geo). The radiation exposure based on radium equivalent ( $R_{\text{eq}}$ ), Absorbed dose (D), Annual Effective dose (AED) and External hazard index (Hex) via analysis of U, Th and K was calculated. The results that show most of the location have exceed the safe limit that safe for general public as stated by UNSCEAR 2010. To indicate soil quality, plants were used as bio monitors who give several important advantages over soil analyses particularly on a large scale. *Acacia mangium* is abundance plant in Gebeng Industrial Area and was chosen as plant bio monitor for this study. Based on the radiation index, the study area is considered slightly polluted since the level of radiation is higher than the annual dose limit. As a safety precaution, some remedial actions have to be taken to prevent occurrence of high doses to workers and general public. Therefore, mitigation procedure can be taken as public awareness.

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# CHAPTER ONE

## INTRODUCTION

### 1.1 BACKGROUND OF STUDY

The exposure of radiation will occur to human either externally or internally from the Naturally Occurring Radioactive Material due to various activities. Recently a lot of issues that may cause radiation exposure were reported in Kuantan, such as rare earth processing, bauxite mining, oil and gas activities, quarry activities and ore mining activities. These activities give environmental impact that cause global issue. Since rare earth processing company was developed in the industrial area of Gebeng in Kuantan, it will lead to the increase of radiation, there is a need to do this study in order to measure the level of radiation exposure of the terrestrial area around Kuantan (Abu Samah et al, 2014). When the rare earth processing plant will be built in Kuantan it has become a highlight in the news, then it heat up again with the issue of bauxite mining. Bauxite mining has been an issue of controversy in politicizing in Malaysia. Nevertheless, one major concern about this two issues are this activities can lead the increased of radiation to the environment and people, the study's Naturally Occuring Radioactive material (NORM) distribution in the soil of the Gebeng Industrial Estate, Pahang Kuantan to provide data NORM baseline distribution in the study area

Naturally Occurring Radionuclides Material (NORM), by definition, is naturally occurring and can be found everywhere (America's Nuclear Future Report to the Secretary of Energy, 2012). The UK NORM Waste Strategy, 2014, it define NORM as Naturally Occurring Radioactive Materials that arise naturally in the Earth's crust as a result of radioactive elements created through cosmic processes, and radionuclide created through radioactive decay of these elements (International Atomic Energy Agency, 2007). Based on (International Atomic Energy Agency, 2013) naturally occurring radionuclide are present in many natural resources. Elevated concentrations