Ain Shams University
Faculty of Women for Arts,
Science and Education
Physics Department

Environmental pollutant measurements and natural radioactivity assessment of Egyptian clay using different techniques

Thesis
Submitted in the partial Fulfillment
For M. Sc. Degree in Physics
To
Physics Department
Faculty of Women for Art, Science and Education,
Ain Shams University

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B. Sc. in Physics, 2006

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2014

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A Thesis for M.Sc in Physics
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Title of thesis

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Date of Research: / / **2014** Date of Approval: / /**2014**

Approval Stamp:

Approval of Faculty Council: / /**2014**

Approval of University Council: / / **2014**

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Acknowledgments

First and above all, I praise Allah, the almighty for providing me this opportunity and granting me the capability to proceed successfully.

Wording is not enough to express my sincere respect and gratitude to my supervisor, **Prof. Dr. Nadia Walley El-Dine**, Professor of Nuclear Physics, Ain Shams University, Faculty of Women for Arts, Science and Education for her kindness, guidance and advice throughout this work and encourage me to go ahead with my work.

I wish to express my deepest appreciation to **Prof. Dr. Samia Mohammed el Bahi,** Professor of Nuclear Physics, Ain Shams University, Faculty of Women for Arts, Science and Education for her dedication and interest and assistance during this work.

I would like to express my heartily thanks to **Dr. Soad Ibrahim**, Assistant Professor of Spectroscopy, Ain Shams University, Faculty of Women for Arts, Science and Education for her invaluable advices, continuous constructive discussions God have mercy and forgive her and makes the graveyard paradise.

Special thanks to **Prof. Dr. Sawsan Hamed**, Assistant Professor of Spectroscopy for her supervision and support during the course of this study.

Acknowledgements are also extended to

1- Dr. Aisha Soliman, Head of Physics Department, Faculty of Women for Arts, Science and Education for her kindness

2- Members of Nuclear laboratory Physics Department**,** Faculty of Women for Arts, Science and Education, for their helpful and useful assistance.

3- All My family provided me with useful and helpful assistance. Without their care and consideration, this work would likely not have matured.

Finally, I want to express my best thanks to all those helped me directly or indirectly to finish this work and every one reads it.

Abstract

Natural radioactivity is wide spread in the earth's environment, it exists in soil, plants, water and air. Environmental natural gamma radiation is formed from terrestrial and cosmic source.

In the present study, seventeen samples of Egyptian clay were analysed using gamma-ray spectrometry based on coaxial HpGe detector shielded by cylinders of lead, copper and cadmium. The analysis of data is completed by computerized multichannel analyzer with high level software programs to determine the activity concentrations of ^{238}U, ^{226}Ra , ^{232}Th and ^{40}K. Ten of these samples were analysed using flame atomic absorption spectrometer (FAAS) to determine the concentrations of heavy metals (Cu, Cd, Fe, Mg, Mn, Ni and Zn).

Clay, consisting fine grained materials, is an interesting materials and can be used in a variety of different fields. The knowledge of the radioactivity levels and heavy metals concentrations in these commonly used materials was of great importance in the assessment of possible radiological risks to human health. The purpose of this study was to determine the natural radioactivity due to ^{238}U,^{232}Th and ^{40}K and heavy metals concentration (Cu, Cd, Fe, Mg, Mn, Ni and Zn) in some Egyptian clay samples using gamma ray spectroscopy and flame atomic absorption spectrometer respectively. The activity concentration of ^{226}Ra, ^{238}U,^{232}Th and ^{40}K of all clay samples ranged from (8.44 to 203.09) , (5.93 to 85.26),(2.88 to 99.98) and (8.72 to 428.92) Bq/kg respectively. It was found that the concentration of heavy metals lies between 0.1 ppm for Mn to 68.8 ppm for Fe in clay samples. Radium equivalent activities and various hazard indices were also calculated to assess the radiation hazard. The radium equivalent activities Ra_{eq} ranged from (32.78 to 354.49) Bq/kg was lower than the permissible limit 370 Bq/kg. The calculated values of external hazard index H_{ex} ranged from (0.088 to 0.95) and the representative level index I_{γ} ranged from (0.24 to 2.43). The absorbed gamma dose rate (D_R) nGy/h was determined.

The results show that the values of the absorbed dose rate were slightly high in: Sample (1) Aswanly clay where it helps in treatment. Sample (4) Kaolin was used in the component of ceramic; it was used with small quantity which had no significant hazard on this production .Sample (6) Grog clay was used as high temperature isolation in fire furnace which didn't effect on the human health. Samples (8, 10, 11, 14, and 15) were used in cooking, hazard effects were found on the human health then care must be taken. Sample (16) red brick used in building materials, sample (17) was used for decoration they have indirect effect on the human body. In case of H_{in} we showed that samples (6,8) have values more than 1 we recommended to make good ventilation in case of storing these products to avoid the accumulation of radon gas which have a harmful effect on human health. From these results we recommended using other material for cooking instead of clay.

It was found that the concentration of heavy metals lies between 0.1 ppm for Mn to 68.8 ppm for Fe in clay samples. Also the sensitivity of the determined heavy metals was calculated and it was found to be 0.0062 ppm for Mg to 0.133 ppm for Fe. The results show that the concentration of U, Th and K for most samples are within the values accepted as normal and all heavy metals have low concentration except The concentration of Fe is high in all samples due to Fe is from the constituent of the earth crust.

Therefore Egyptian clay samples can be used for some kinds of fabricated goods such as red brick for building materials, vase for decoration and ceramic industry. Egyptian clays have an important economic effect due to their low cost.

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Introduction and Literature Review

1.1) Introduction

Our world is radioactive and has been since it was created. Over 60 radionuclides (radioactive elements) can be found in nature, and they can be placed in three general categories: Primordial formed before the creation of the Earth, Cosmogenic formed as a result of cosmic ray interactions, Human produced formed due to human actions (minor amounts compared to natural) .

Natural radioactivity is common in the rocks, soil that makes up our planet, water, oceans, building materials and homes. There is nowhere on Earth that you cannot find natural radioactivity they are even found in us.

Radioactive elements are often called radioactive isotopes or radionuclides found in the environment, such as uranium, thorium and potassium and any of their decay products, such as radium and radon. These natural radioactive elements are present in very low concentrations in earth's crust and are brought to the surface through human activities such as oil and gas exploration or mining and through natural processes like leakage of radon gas to the atmosphere or through dissolution in ground water.

NORM is an acronym for Naturally Occurring Radioactive Material, which potentially includes all radioactive elements found in the environment. However, the term is used more specifically for all naturally occurring radioactive materials where human activities have increased the potential for exposure compared with the unaltered situation. Concentrations of actual radionuclides may or may not have been increased; if they have, the term Technologically-Enhanced (TENORM) may be used.

The acronym TENORM, or technologically enhanced NORM, is often used to refer to those materials where the amount of