

Radioactivity, Radionuclide and Gamma Dose Measurements in Various Types of Building Materials

M.Sc.THESIS

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BY

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SUMMARY

The natural occurring radioactivity concentration in dwelling building materials was detailed investigated. 35 sampling varieties of building dwelling materials was thought crushed in to 200-mesh size powder. The crushed samples were subjected to (i) chemical analyses in order to resolve the different element composition of these dwelling materials in addition to (ii) Radio assay of different radioactivity concentration due to ^{235}U , ^{238}U , ^{232}Th and ^{40}K , in these materials. The chemical analyses of these samples were resolved and measured by UV-visible spectrophotometer as well as Ion chromatography system "IC". The preliminary results of the chemical analyses showed a composition of Al_2O_3 , Fe_2O_3 , K_2O , MgO , H_2O in addition U and Th. Radio assay of activity concentration and Radionuclide types in these materials were carried out by HPGe-pulse height analyzer system. The silent feature of resolved data showed a presence of different activity concentrations of ^{235}U , ^{238}U , ^{232}Th as well as ^{40}K . The injurities rate of that natural occurring radioactivity in dwelling materials were estimated in term of radium equivalent as proposed by UNSCEAR (1993 & 2000) publication as well as absorbed dose estimation recommended by same authors.

A correlation of element composition resolved by chemical analyses and that one due to radio assay techniques showed a beneficial approved results.

The thesis in corporate four chapters in addition to two appendix's, abstract and final conclusion.

The first and second chapter of thesis presented detail information about the recent publication in radioactivity of dwelling materials. Also it presents the recent current problems in such fields not yet solved. More over in second chapter of the thesis detailed physical concepts as well as necessary theories needed in analyses and resolving the experimental data obtained in the present work.

A complete detail of experimental procedures and measuring techniques are noted in chapter 3 of the thesis. The experimental evaluation and analyses procedure of data in addition to the experimental errors are also noted.

Chapter 4 of the thesis explained in details the obtained radioactivity data and its relation with that deduced one by chemical analyses technique. Detailed inter comparison of the present results with that one published internationally, are also noted.

The experimental findings showed that;

- (i) Chemical analyses of samples detect the presence of various solid contents concentration in ppm of Al_2O_3 , Fe_2O_3 , NaO , K_2O , CaO , MgO , H_2O in addition U and Th .
- (ii) Radioassay of radionuclide approved the presence of ^{235}U , ^{238}U , ^{232}Th and ^{40}K , and
- (iii) Intercomparison of solid content concentration in ppm with the radioactivity concentration of ^{238}U , ^{232}Th and ^{40}K showed a linear and regular increase.

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الملخص العربي

يتناول هذا البحث تحديد الكميات الإشعاعية للخلفية المشعة الطبيعية الناتجة عن النويدات

الطبيعية (natural occurring radioactivity)

المتواجدة في خامات مواد البناء و تم تحليل عدد ٣٥ عينة مختلفة النوع باستخدام:

- ١- الطرق الفيزيائية لقياس و تحديد نوع النويدات المشعة الطبيعية وكمية نشاطها الإشعاعية بالبيكريل وذلك باستخدام جهاز مطياف جاما عالي النقاوة المتصل محوريا ببلورة الجيرمينيوم ويتصل المطياف بمحلل متعدد القنوات.
- ٢- الطرق الكيميائية لتحديد وحساب درجة تركيز العناصر المختلفة الموجودة بعينات مواد البناء المدروسة وتقدير كمياتها باستخدام وسائل ضوئية والتي تعرف بالمطياف الضوئي للأشعة فوق البنفسجية (UV-Visible spectrophotometer) وكذلك باستخدام الجهاز الكروماتوجرافي الأيوني Ion Chromatography .

- وقد تم اختيار عينات البناء المختلفة والمتداولة تجاريا من مصادر مختلفة وبيانها كالآتي:-
- ١- السيراميك باختلاف أنواعه والمصنع محلياً و المستورد (بورسلين الجوهرة-اراسمكو- الفراعنة-الاهلية-مصر-ليسيكو-سيراميك إيطالي-سيراميك أسباني-سيراميك تركي).
 - ٢- الأسمنت و الجبس باختلاف أنواعه والمصنع محلياً بالشركات والمصانع المختلفة (شركة القومية للأسمنت-جبس البلاح-جبس سيناء-اسمنت بورتلاند سيناء-اسمنت بورتلاند طرة).
 - ٣- الطوب باختلاف أنواعه (طوب رملي خفيف- طوب رملي ثقيل-الطوب الاحمر-الطوب الاسمنتي- بلاط مازيكو).
 - ٤- الرخام و الجرانيت المصري باختلاف أنواعه (كرارة- أغادير- جاندولا- الابستر- جلالا- اخضر تركي -رخام صناعي- احمر اسواني).
 - ٥- الرمل والزلط والحجر الجيري والمواد الخام التي تستخدم كعامل وسيط في تصنيع مواد البناء.

♦ تحتوى الرسالة على أربعة فصول بالإضافة إلى ملخص باللغة الإنجليزية وقائمة بالمراجع .
حيث ان :-

أ- **الفصل الأول:-** يتناول دراسة عامة عن المصادر الإشعاعية الطبيعية وأنواعها وكذلك الدراسات البحثية السابقة في هذا الموضوع والهدف من إجراء هذا البحث.

ب- **الفصل الثانى:-** يتناول دراسة مرجعية متكاملة عن تعريف الكميات الإشعاعية المنشورة دولياً وتفاعل كلٍ من أشعة إكس وجاما مع المادة، كما يتناول الطرق الفيزيائية المختلفة لتحديد النشاط الإشعاعى الموجود فى مواد البناء بإستخدام كلٍ من الكواشف شبة الموصلة و الكواشف الومضية كما يتناول تحديد المكونات الخام لمواد البناء بطرق فيزيائية و كيميائية.

ج- **الفصل الثالث:-** يوضح طرق تجميع وتحضير العينات المستخدمة فى هذا البحث و طرق القياس المختلفة المستخدمة فى تحديد وتحليل النتائج العملية التى تم الحصول عليها فيزيائياً و كيميائياً.
كما يتناول هذا الفصل شرح وافى عن الأجهزة المستخدمة فى كلٍ من الطرق الفيزيائية والطرق الكيميائية وهم:-

♦ جهاز التحليل الضوئى للأشعة فوق البنفسجية UV-Visible spectrophotometer.

♦ جهاز التحليل الكروماتوجرافى الأيونى Ion Chromatography.

♦ جهاز مطياف جاما عالى النقاوة (HPGe-detector) Hyper Pure Germanium.

د- **الفصل الرابع:-** يتناول النتائج المعملية المختلفة الناتجة من التحاليل الفيزيائية والكيميائية.

وقد اتضح من هذه الدراسة الآتى:-

I - النويدات المشعة الطبيعية الموجودة فى هذه المواد كالاتى:-

اليورانسيوم - ٢٣٥ و اليورانسيوم-٢٣٨ و الثوريوم- ٢٣٢ و البوتاسيوم - ٤٠ .

II- أتضح من التحاليل الكيميائية لمواد البناء وجود تركيزات مختلفة من اكسيد الألومونيوم

AL₂O₃ - اكسيد الحديد Fe₂O₃ - اكسيد البوتاسيوم K₂O - اكسيد الماغنسيوم MgO

الى جانب اليورانيوم و الثوريوم.

III- تم حساب مدي الخطر الأشعاع السنوى علي عموم الجمهور نتيجة تعرضهم لجرعات إشعاعية الناتجة من النويدات المشعة الطبيعية.

IV - أوضحت النتائج العملية بأن الكميات الإشعاعية لنويدات اليورانيوم وكذلك البوتاسيوم بوحدة البيكريل لكل كجم تزداد زيادة خطية منتظمة بزيادة نسبة تركيز هذه العناصر بوحدات "PPM" والتي تم تحديدها بالطرق الكيميائية.

V - أوضحت النتائج العملية كالاتي :-

أ- الكميات الإشعاعية بوحدات البيكريل لهذه العناصر الآتي:-

اليورانيوم ٢٣٥	٦,٣-٠	بيكريل/كجم
اليورانيوم ٢٣٨	٤٣ - ١٣١	بيكريل/كجم
الثوريوم ٢٣٢	٩٥ - ٣٠	بيكريل/كجم
البوتاسيوم ٤٠	١٠٠٠ - ٥٠	بيكريل/كجم

أوضحت هذه الدراسة ايضا بأن معدل الجرعات الإشعاعية على مسافة ١ متر في مواد السيراميك يتراوح بين ١-٢ ميكروجراي/ساعة.كجم.

ب- درجة تركيز البوتاسيوم و اليورانيوم و الثوريوم والتي تم تحليلها كيميائياً أوضحت الآتي:-

- يتراوح البوتاسيوم بين ٢.٤ % - ١٢ % من مجموع الكميات الكلية لدرجة تركيز العناصر المختلفة المتواجدة في عينات مواد البناء

- يتراوح اليورانيوم بين ٠ - ٦٠٥ جزء من مليون "ppm"

- يتراوح الثوريوم بين ٠ - ٤٤٠ جزء من مليون "ppm"