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DEVELOPMENT OF GAMMA-BASED NONDESTRUCTIVE TESTING SYSTEM FOR MATERIAL DISCRIMINATION

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ABSTRACT

In this work,   a simple gamma non destructive system has been developed for discriminating samples with respect to their spectrum . Based on radiation spectra of Alumina ceramic, borated glass, aluminum and iron. The variation of the transmitted intensity with energy was considered to explore the possibility of discrimination between materials under test. The spectra characteristic peaks of Alumina ceramic, borated glass, aluminum and iron was found to be 13kev, 40eV, 20eV ,and 17eV respectively .

Keywords- *Non-destructive Testing System, Gamma etc.*

I.   INTRODUCTION

Identification of elemental contents of material samples is very essential in industry .This is since the elemental content shows the material element and the degree of contamination .The identification of elements in samples is done usually by using spectrometers like x-ray fluorescence, atomic absorption photo spectrometer .

The surface condition of industrial components can be affected by deposition and erosion. For example, corrosion on the inside walls of pipelines and vessels can cause the condition of internal walls to deteriorate, creating safety and operational concerns. [1-3]

While deposition causes the addition of undesirable material, erosion results in the loss of primary material. Therefore, both processes change the apparent thickness and density of affected walls, or in other words, the areal density (density ×thickness). This makes such measurements particularly amenable to the radiation transmission method discussed in section.[1-4]

Gamma-ray beam transmission is useful for scanning for thickness defects in flat rolled products. With a narrow (well-collimated) beam, a rapid scan of a wall can be performed to detect changes in the transmission signal, which can be an indication of the occurrence of thickness defaults. Gamma-radiation is particularly useful for such applications due to its high penetrability, ease of collimation, portability (due to the small size of gamma-sources) and mobility (due to the self-powered nature of isotopic sources).[4-11]

II.   MATERIALS AND METHOD

The present study is directed to identify the elements or minerals that exist in material sheets of industrial products such as; ceramic, glass, aluminum and iron. This is accomplished by measuring the spectral energy of the radiation which has been transmitted by the material at different energies.

A source of gamma radiation is positioned so as to provide the radiation beam perpendicularly through the sheet material. A radiation detector is positioned on the opposite side of the sheet material from the radiation source to measure the beam attenuation. The radiation detector is coupled with a signal processing unit which feeds the electrical outputs to a monitor. A processor then determines the spectrum of the material based on the values of these outputs.

III. RESULT AND ANALYSIS

Several measurements were carried out to identify the material sheat element by using gamma ray spectra in metallic and non metallic samples such as; Alumina ceramic, Borosilicate glass, Aluminum and Iron. The results were analysed using SigmaPlot10 software,

Based on the measurement procedures ,one obtained the results in terms of transmitted flux with respect to samples under test. The variation of the transmitted flux with energy was considered to explore the possibility of discrimination between materials under test.

The measured values at which transmitted intensity peaks for each sample were plotted against the corresponding

energies to determine the performance of the system in discriminating between the four samples under investigation.

The results are shown in figure (1,2,3)

Table (1) the energy peak for 1cm thickness

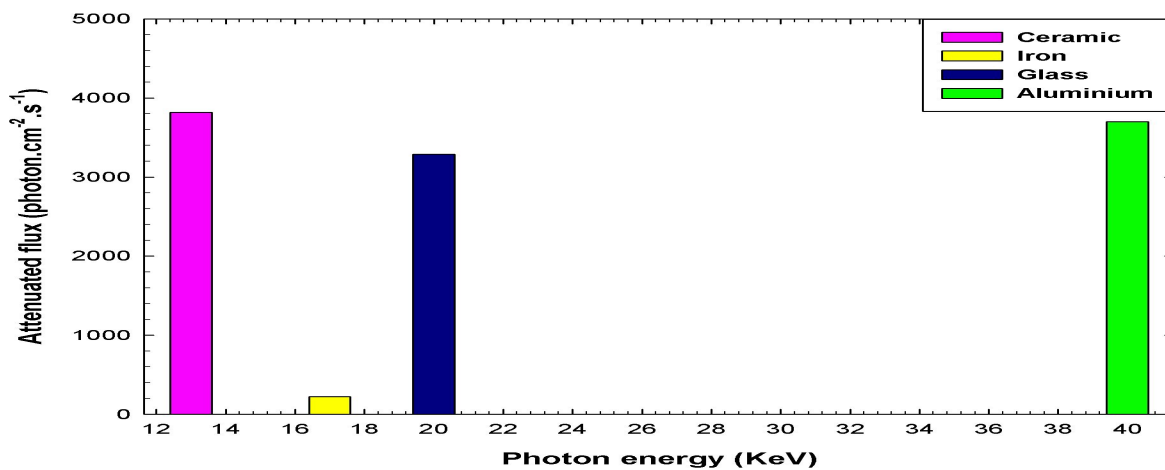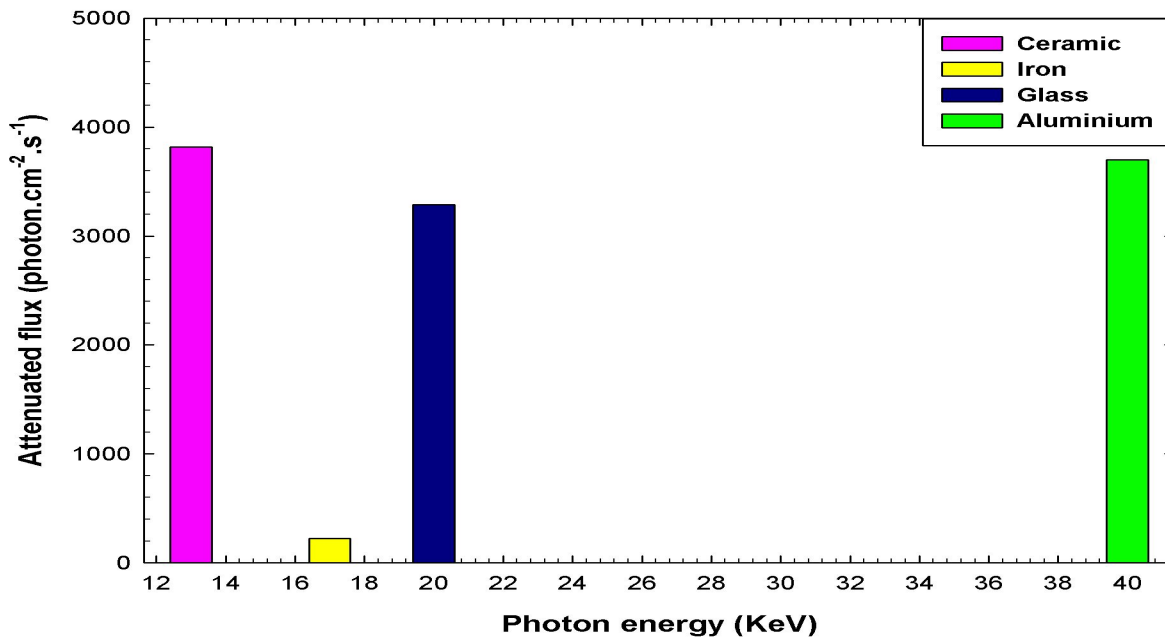| Element	Energy peak ±1 KeV
Alumina ceramic	13
Borated glass	40
Aluminum	20
Iron	17

Fig (1) Peaks of transmitted flux for each sample plotted against the corresponding energies(for 1cm thickness)

Table (2) the energy peak for 2cm thickness

Element	Energy peak ±1 KeV
Alumina ceramic	13
Borated glass	40
Aluminum	20
Iron	17

Fig (2) Peaks of transmitted flux for each sample plotted against the corresponding energies(for 2cm thickness)

Table (3) the energy peak for 3cm thickness

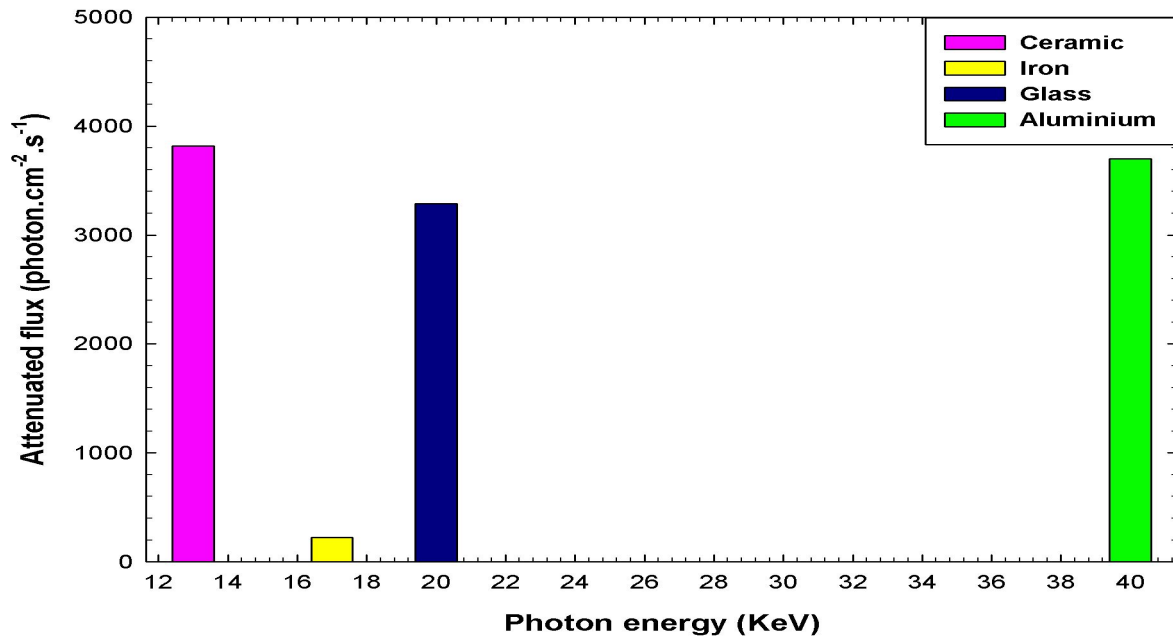| Element	Energy peak ±1 KeV
Alumina ceramic	13
Borated glass	40
Aluminum	20
Iron	17

Fig (3) Peaks of transmitted flux for each sample plotted against the corresponding energies(for 3cm thickness)
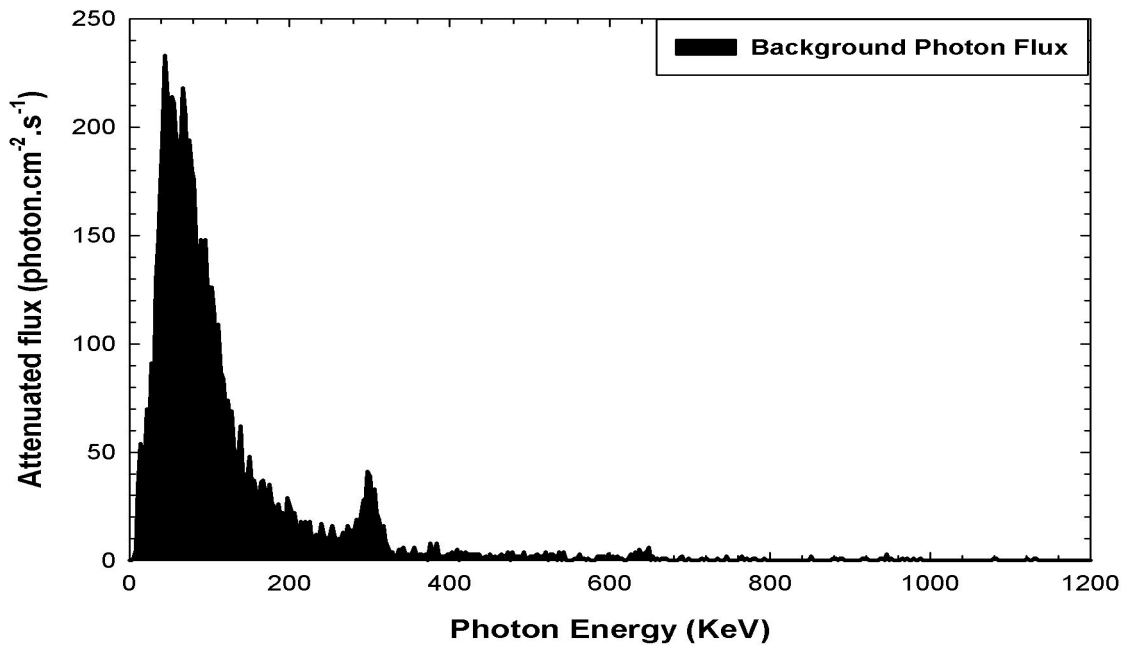

Fig (4) Background flux of photons

IV. DISCUSSION

In view of tables (1,2,3) and figs (1,2,3) for Alumina ceramic, borated glass, aluminum and iron, the transmitted flux peaks are at the energies, 13 KeV, 40 KeV, 20 KeV and 17 KeV, respectively. These results suggest the possibility of using such energies to identify each of the four samples used. The value of these peak are less than that of the exciting source ,which is shown in fig (4) to be in the range of 100Kev this is a obvious since some of the absorbed emitted energy is lost by different physical process .Thus may explain why nuclear transition above 100Kev was not observed.

 The corresponding energy can be related to the nucleon energy according to nuclear shell model .Since each nuclei has its own energy levels ,thus one expect the to emit different characteristic photons . The fact that the photon energies are in the range KeV suggests that the energy are emitted due to nuclear transions .

V. CONCLUSION

The gamma non destructive system can be utilized to determine the sample elemental content. Thus it can act as a simple economical spectrometer .

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