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CHARACTERIZATION OF RADIOACTIVE WASTE IN KOSOVO THROUGH GAMMA SPECTROMETRY

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Abstract

Characterization of radioactive waste is a process first hand regarding the effectiveness and cost management. Before starting any type of radioactive waste action is necessary to determine the content of their activity, the type of radioisotope, physical and chemical form and the risks associated with their management. This is achieved through a combination of quality assurance processes such as inventory radioisotope balance of activities present in the residue, the composition of the waste material and by direct measurements. The investigation was performed entirely in the ground and was undertaken because of source certification lacks or any other indication for their classification and activity. Waste separation process helps to realize a more effective characterization of them as well as to determine the path of waste management. Probability that a gamma radiation detector and interact with to produce a pulse represents the effectiveness of the detector. In general, large-volume detectors are much more effective by those with small volume. Characterization is essential in the case of waste composition and origin unknown. This is a complex process that is the foundation of gamma radiation spectrometry.

Keywords*:* *radioactive waste, radionuclide's, characterization*.

Introduction

Gamma radiation spectrometry-based analysis that emits gamma radiation radioisotopes. Radioisotope usually emits gamma radiation with energy or some defined. This radiation intercepted by the radiation detectors and transformed into electrical signals, which are subject to an analysis in terms of size as well as their intensity [1].

A gamma spectrometer consists of a detector, electronic devices that process the detector impulses - surround analyzers, as well as devices that generate, display and store the radiation spectra.

More detectors used in gamma spectrometry are counters (sodium iodide, NaJ) and counter with semiconductor (germanium with very high purity, HpGe) [2] .

Radiation detectors interact with gamma radiation through several processes of which the most important are:

a) Photoelectric effect;

b) Compton effect;

c) The effect of the formation of an electron-positron pair.

From the above matter, interactions present photoelectric effect, through which the energy of gamma radiation energy is completely transformed into a corpuscular radiation that carries all the energy of gamma radiation [3].

The one phase in the frame of inventory of radioactive waste was the determination of radionuclides and their activities.

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This investigation was perfomed entirely in the ground and was undertaken because of source certification lacks or any other indication for their classification and activity.

The determination of radioactivity for different sources was performed based in the relationship between the equivalent dose rate *H'*, created in a fixed distance *r* and activity of the sources *a*.

This relationship between the mentioned quantities is as follow:

$$H' = \Gamma a / r^2 \tag{1}$$

Based in mentioned relationship it is possible to get the activity of the source a as function of equivalent dose rate H' and the distance r.

$$a = H' r^2 / .\Gamma \tag{2}$$

For this purpose in each case there was measured equivalent dose rate by a certain radioactive source in a fixed distance which usually has taken 1 m.

Concerning the values of the specific gamma constant (Γ), they were taken by reference [4] where other then specific gamma constant were given half-life of radionuclide as well the values of the attenuation coefficient of gamma radiation in lead μ (cm^{-1}).

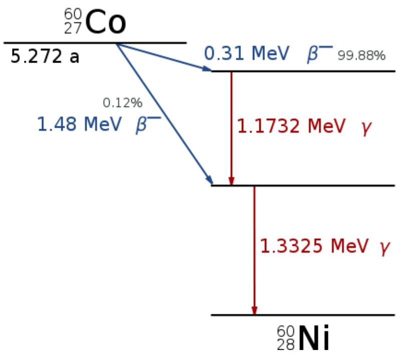

Fig. 1. Radioactive Decay scheme of the isotope Co-60

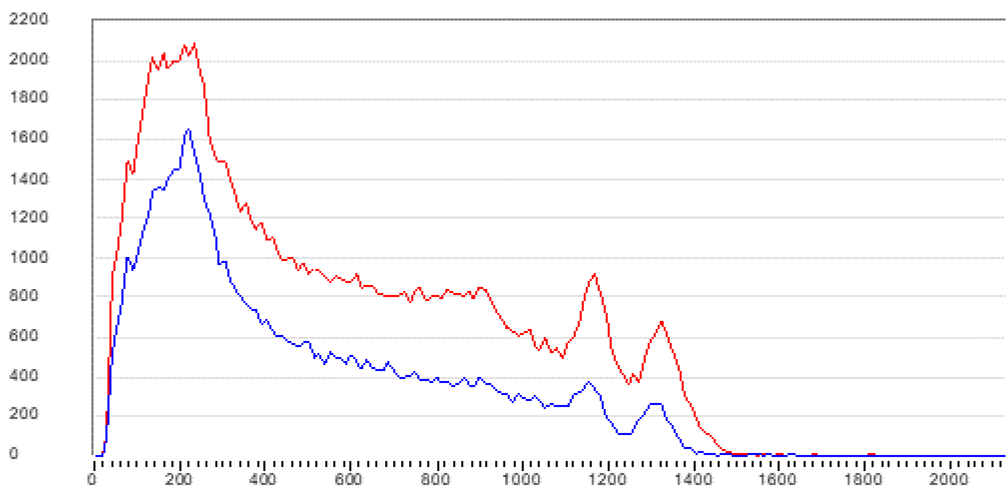

Fig. 2. Display gamma spectrometric two Co-60 sources

Radioactive Waste Management in Kosovo

Classification of radioactive waste

A conceptual illustration of the radioactive waste classification scheme is presented in Fig. 3. On the axis of ordinates is shown the activity of the waste, while on the axis of the abyss is presented the period of halving the radio blocks that are in the remnants.

In most cases, to determine the class of waste, more activity is used than the specific activity. Thus eg. residues containing very small amounts of some radioactive substances such as C^{14} or H^{3} may be excluded from regulatory control.

The criteria for the activity levels or the specific activity of excluded radioactive materials are set out in the Basic Safety Standards [7].

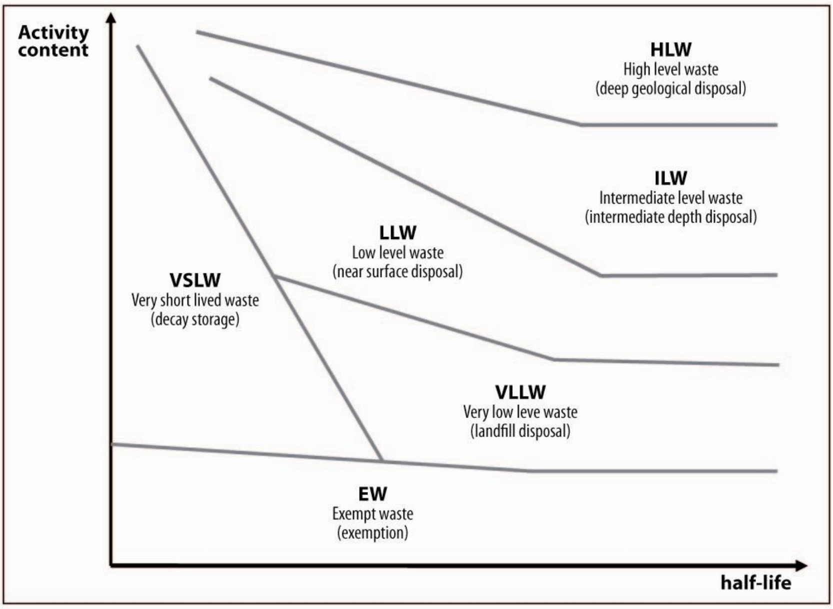

Fig. 3. Conceptual illustration of the radioactive waste classification scheme

To undertake an activity as beneficial and lowest cost in the field of safe management of radioactive waste it will be necessary to define the exemption levels for radioactive sources, either for those who are active in activities as well as for resources that are in the form radioactive waste.

These levels are defined by the International Atomic Energy Agency (IAEA) and are based on values as specific activity (in Bq / g) of radioactive sources, as well as the values of total activity (in Bq) of these resources [8].

The activity of radioactive sources

Radioactive sources whose activity is under exclusion values are treated as ordinary chemical substances and not subject to a Minimum legal and regulatory. In this context, keeping in mind the levels of exclusion creates facilities for users as well as for regulatory bodies regarding the treatment of radioactive sources as in the period of active operations of these resources as and when they come back in the form of radioactive waste.

In the first case, we will have to do with the excluded sources, these sources are not subject to the permitting requirements for activities with these sources, while only performed their registration.

As regards radioactive sources in the form of waste, keeping in mind the level of exclusion is directly related to solid waste management ways excluded, which as a rule does not require special conditions for their treatment.

IAEA levels along exclusion have also introduced the use of emission levels (clearance levels) in the case when we are dealing with large volumes of radioactive waste [9]. For small volumes and moderate radioactive waste (normally under 3 tons per year), levels of exclusion and liberation are the same.

Radioactive waste in which the resources contained in them have total activity levels lower than the exception will be considered exempt wastes. These remains as a rule after their collection and control for the amount of activity contained in them, are treated as common waste. To facilitate our work are presented in Table 1 values of total and specific activity for radioactive sources found in in the Republic of Kosovo.

Table 1. Values of total and specific activity of radioactive sources found in Kosovo

No..	Type of radionuclide	Activity specific Bq / g	Total activity Bq
1	Cobalt ^{60}	$1{:}10^{1}$	$1{:}10^{5}$
2	Cobalt ^{57}	$1{:}10^{1}$	$1{:}10^{6}$
3	Cesium ^{137}	$1{:}10^{1}$	$1{:}10^{4}$
3	Europium ^{152}	$1{:}10^{1}$	$1{:}10^{6}$
4	Europium ^{154}	$1{:}10^{1}$	$1{:}10^{6}$
5	Thorium ^{228}	$1{:}10^{0}$	$1{:}10^{4}$
6	Teknecium ^{99m}	$1{:}10^{2}$	$1{:}10^{7}$
7	Iodine ^{131}	$1{:}10^{2}$	$1{:}10^{6}$
8	Americium ^{241}	$1{:}10^{0}$	$1{:}10^{4}$

Principle of placing under full control of the radioactive source

The International Atomic Energy Agency (IEAE) adheres to the principle of placing under full control of any radioactive source from the moment of its use for a particular purpose, up to its safe disposal as radioactive waste [10].

Fig. 6. Orphan resources at Kosovo Power plant

On the other hand, mismanagement has led to a so-called orphan resources in the Republic of Kosovo and other countries in the region, resources that have been lost and consequently have no holders but may be hidden or not hidden in unfamiliar places.

These sources usually end up in the scrap metal collection points, causing them to be smelted in the metallurgical plants and radioactively polluting the various products, for example. iron bars used in construction or other areas.

Result and Discussions

Power measurements are performed with the device dose Exploranium GR 130. In Fig. 7 is given the measurement of natural background radiation, measured with this device. By computer processing of the results obtained it appears that the average natural background in space is measured 50 NSV / h, a value which characterizes the value of natural background radiation for many countries in the region [11].

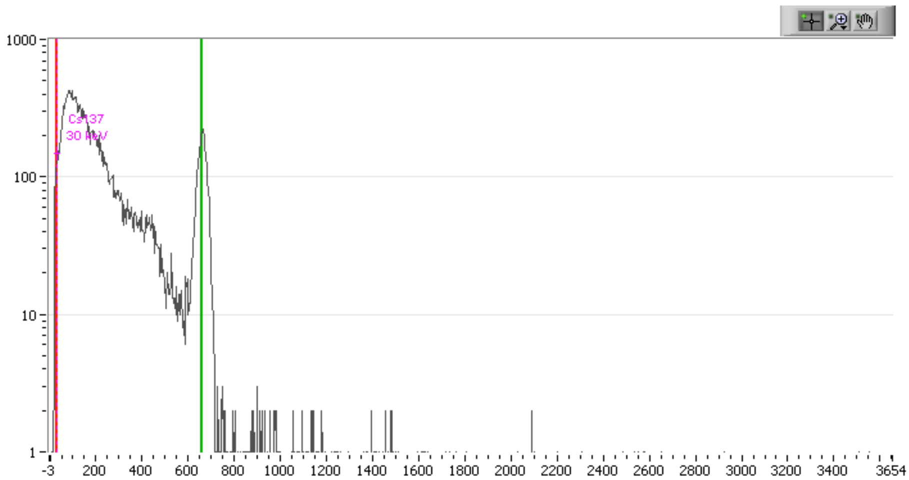

Fig. 7. The radioactive source spectrum of Cs137

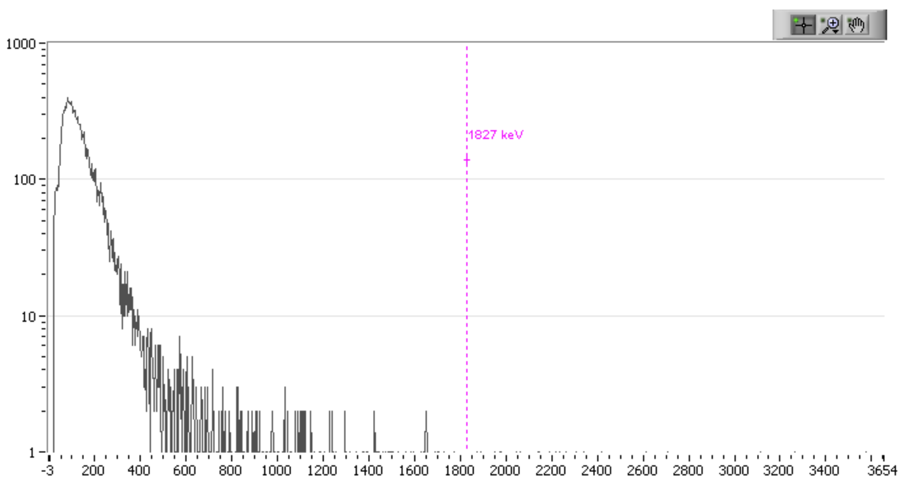

Fig. 8. The spectrum obtained from Lead ore samples, were not recorded the presence of any other element, is roughly similar to the natural

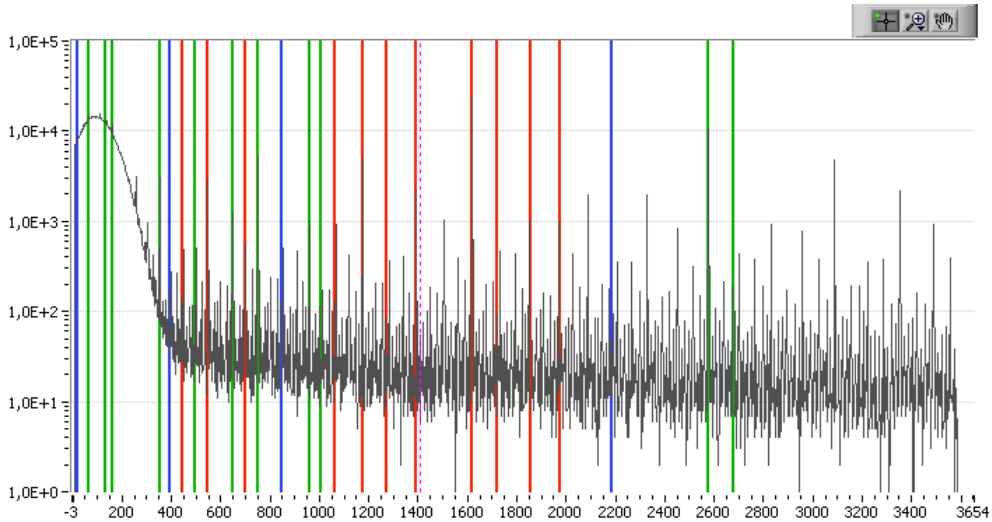

Fig. 9. This is where the gamma spectrum has gained a measure of the radioactive source which by physical shape, location, then, is proving Eu 152/154

Conlusions

Probability that a gamma radiation detector and interact with to produce a pulse represents the effectiveness of the detector. In general, large volume detectors are much more effective by those with small volume.

The effectiveness of the detectors, as well as their ability separator, can be expressed as a percentage.

Vitally important to surround the calibration of analyzers, which makes these instruments effectively used for identifying high as the radioisotope through gamma radiation that they emit as well as quantitative determination of a radioisotope. This is possible because the number of channels is proportional to the energy of gamma radiation, and the radiation intensity in a channel is proportional to the amount of a given radioisotope.

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