INVESTIGATION OF THE CONTENTS OF NATURAL RADIONUCLIDES IN COAL AND ASHES FROM KOSOVIAN POWER PLANTS

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ABSTRACT

The basic aim of this work was investigation of the contents of natural radionuclides in the samples of coal and in the products of its burning in Kosovian power plants, as the beginning steps to estimate total radioactive effects on the surrordning, having in mind that coal power plants are one of the more influental source of the redistribution of natural radionuclides.

The investigation has been done by gamma spectroscopy analysis using HP Ge detector, with relative efficiency of 20% and resolution of 1,8 keV in energy of 1332 keV ^{60}Co. The activity concentation of natural radionuclides in measuered samples of coal, ashes and slag were from 3,1 to 67 Bq·kg^{-1} for ^{226}Ra; from 1,7 to 32 Bq·kg^{-1} for ^{232}Th; from 0,3 to 6,5 Bq·kg^{-1} for ^{235}U; from 6,5 to 138 Bq·kg^{-1} for ^{238}U and from 14 to 234 Bq·kg^{-1} for ^{40}K.

INTRODUCTION

In the frame of the Kosovian basen there are more than as much as 10 billion tons of coal. In order to use this natural resources have been built some of the Industrial plants such as are : Thermal power plants Kosovo A and Kosovo B with the total instaled capacity of 1470 MW; dry plant with the capacity of 1.220.000 tons, gas plant with the capacity of 48 x 10^7 m^3, fertilizer factory with the capacity of 360 000 tons per year of KAN-a and other plants in the connection with the coal production.

Kosovian coal belongs to the group of the typical lignite. It is known for its high content of ashes (over 15%) and low thermal capacity (from 5 400 kJ·kg^{-1} to 10 500 kJ·kg^{-1}). The largest amount of this coal are used as unrefined energetic solid fuel in Kosovian power plants. The firebox is in the process is deposition of the slag in the firebox what is the cause of the increasing of ashes and the emission floated ashes in atmosphere.

Power plant Kosovo A belong to the old type plant. It is consist of 5 blocks which by its chomneys emits in atmosphere about 15% of producing ashes, what amounts for 5 000 h of yearly working of the plants about 1200 000 t per year. The second power plant is Kosovo B it consists of two energetic blocks and belongs to the contemporary plants. Its emission of ashes is about 1 000 000 t per year.

The air of this work is the monitoring of the content of natural radionuclides in coal and the products of the combustion in the process of the work of Kosovian plants. The influence of chemical products polution like as ashes, dust and gases from the smoke of stacks are is much more than radionuclides do it. To the risk of the radionuclides, which release in the process of the work of the power plants intented for producing of electrical energy, unsatisfactory pays attention and the negative contribution of this sourse becomes significant for the environment. So as it is well known according to estimates that power plant of 1 GW yearly release the collective effective doze of 20 man Sv (1).

MATERIALS AND METHODS

The analysed samples of coal have been collected from the surface mines of Kosovian basen Belaćevac and Dobro Selo. The first patterns were by means of the furrows which are placed in the coal drawings of the mine. But of that manner of collecting the samples gave up because of some reasons: The floors were as high as about 10 m , steeps and incomprehensible and therefore very dangerous for the gatherers of the samples. In addition to these facts, it was umpossible to reach some floors because of enormous maisture of the soil and coal appeared by the underground waters. Taking into consideration that facts the samples of the coal were done by the method of the raudomly samples. The samples were taken from the given quantities of coal on the conveyer belt and the freight cars for definite timing intervals. The samples size of coal were of the piece, cube, nut, hazelnut and coal dust. The samples of coal dust have been taken on coal depos on given places and different depths. The samples of deposited ashes have been taken from all phases of the electriphylters and in the some way on depos and lagoons . The samples of the slags have been taken below of the bunker for the slag

(on that place the slag is in the heaty state) and from the places where are in teh coal state. Some of these samples have been taken from lagoons where ashes and the slag are in the mixture state.

All samples after complex guartering and dreying at 105 % grinded to the granulation of the fine powder and brig down to the some volume. After done of the homogenous of the samples the samples were measuered and filled in the standard Marinelli plates. The Marinelli plates are then welded by beeswax because of the airtight of the samples. Prepared is such way, they are left to repose 30 days (before of the begninung of the measuring) in order to esstablish the radioactive equilibrium. The measuring gamma activity of the radioactive meterials in the samples has done by multy shanel gamma analyzer ORTEC with HP Ge detector with the relative efficiency of 20% and resolution (FWHM) of 1,8 keV at 1332 keV ^{60}Co. The callibration of energy has been done by the standard series of points sources (Coffret d´etalon ECGS-2, Sacle) which contain the radionuclide ^{133}Ba, ^{60}Co, ^{137}Cs, ^{22}Na and ^{241}Am (activity of 10^3 Bq at day 29.11.1977.). The geometrical efficiency was given by the referent material-soil, contaminated by series of radionuclides ^{22}Na, ^{57}Co, ^{60}Co, ^{88}Y, ^{133}Ba and ^{137}Cs with the activities between 122-355 Bq/kg (total 1461 Bq/kg at the day 1.7.1991.) with the total uncertainity of 5% (National Office of Measures OMH, Budapest) (2).

The activity of ^{226}Ra and ^{232}Th is determined, using their descendants ^{214}Bi ,^{214}Pb and ^{228}Ac , ^{208}Tl , respectively. The activity of ^{235}U is determined on energy of 185,83 keV with correction on ^{226}Ra (186keV). The activity ^{238}U we computed using natural relate of the activity of ^{235}U/^{238}U which is 0,04604. The activity of ^{40}K we computed using its only tranzition an 1460,8 keV. The correction taking into consideration the autoapsorption was not done, because there were not significant difference among obtained concentration for ^{226}Ra and ^{232}Th in the selected spectrum lines (3). The time of collecting the pulses i.e. recording time of the spectrum, was from 10^5 to $3x10^5$ s depending of the activity of the samples.

RESULTS AND DISCUSSION

The results of the experimental measuring of specific activity of ^{226}Ra, ^{232}Th, ^{235}U, ^{238}U and ^{40}K in samples of coal are shown in Table 1. It descibes intervals of the concentration of the activity for monitored radionuclides for each kind of the coal samples for diferent radiuses.

In Table 1. has been seen that analysed samples of coal contents almost the same concentracion of the activity of monitored samples with the except the samples of the coal dust. The reason for enlarget concentration of the activity in the coal is affter all in the prensence of the floating ashes emited by the chimney of the power plants and it deposits in the depos. On the base of obtained results may be appraissed that the concentration of activity of the natural radionuclides in the monitoring samples of Kosovian lignite are relatively lower in comparison with the concentration of activity in other countryes in the world (4)

Tabele 1. The range specific activity of the natural radionuclides (Bq kg^{-1}) in the samples Kosovian lignite

Kind of the samples	^{226}Ra	^{232}Th	^{235}U	^{238}U	^{40}K
coal piece	3,1-4,9	1,7-4,2	0,29-0,42	6,5-9,1	14-87
coal cube	4,5-7,7	3,5-4,3	0,43-0,52	9,4-11	19-20
coal nut	3,5-5,8	4,1-4,9	0,56-0,71	12-15	14-25
coal hazelnut	4,2-14	4,8-8,6	0,47-1,1	10-23	25-32
coal dust	7,3-25	8,0-18	0,61-4,5	13-45	49-97

The experimental results of the measuring of the specific activity of ^{226}Ra, ^{232}Th, ^{235}U, ^{238}U and ^{40}K in samples of ashes and slag as the products of the combustion in Kosovian plant are shown in Table 2.

In analysed samples of ashes the biggest concentration of the majorits of the tested radionuclides is presented in the samples of ashes of the bottom of the chimney funnel. Because of that fact we my suppose that the content of U and Ra enlarges with the lowering the diameter of the particles (5). In Table 2. can be seen that the concentration of activity ^{40}K is the biggest in the samples of the slag. The reason of that facts we should to try in the physical-chemical features of potassium as and that facts that the slag is waste materials which consists of enough uncompletely burned organic material in coal.

Table 2. The range specific activity the natural radionuclides (Bq kg^{-1}) in the samples of ashes and slag because of burning of Kosovian lignite

Kind of the samples	^{226}Ra	^{232}Th	^{235}U	^{238}U	^{40}K
ashes from the bunker	12-20	14-20	1,9-2,2	43-48	150-199
ashes from the palettyser	15-67	16-31	2,1-4,5	45-138	179-219
ashes from the electrofilter	14-23	16-18	2,0-3,5	46-65	108-179
ashes from the chimney funnel	23-48	22-32	3,6-6,5	89-146	128-236
ashe from the substation	22-65	20-30	2,5-5,5	56-109	167-229
ashes from depos	29-44	17-25	3,0-4,8	65-104	170-210
ashes and slag from the lagun	10-18	24-30	3,0-5,0	91-109	211-239
slag from from the bunker	12-14	13-15	1,7-1,9	37-42	163-198
slag from the substation	14-20	18-23	2,1-2,9	63-77	184-243
slag from the depos	24-28	24-28	3,5-4,6	77-87	177-183

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