

Radioactivity of Coals and Ash and Slag Wastes at Coal-Fired Thermal Power Plants

D. A. Krylov^a and G. P. Sidorova^b

^a National Research Centre “Kurchatov Institute,” pl. Akademika Kurchatova 1, Moscow, 123098 Russia

^b Transbaikal State University, ul. Aleksandro-Zavodskaya 30, Chita, 672039 Russia

Abstract—This paper presents an analysis of published data on the content of radioactive nuclides in coals originating from various coal deposits, and in ash and slag wastes produced at coal-fired thermal power plants, as well as in fly ash emitted from thermal power plants into the atmosphere.

Problems related to the use of coals with an elevated content of natural radionuclides (NRNs) and methods of their solution implemented at the Urtuyskoe coalfield are dealt with. Data on the analysis of Transbaikal coals for the NRN content, as well as weighted mean content of uranium and thorium in coals from the Siberian Region, are given.

In order to reduce irradiation of plant personnel and the population of the areas where coal producers and coal-fired thermal power plants are located, it is necessary to organize very careful control of the NRN content in both coals and products of their combustion that are released into the environment. To solve the problem related to the control of radioactivity, the centralized approach and creation of a proper normative base are needed. Experience gained in developing the Urtuyskoe coalfield shows that it is possible to create an efficient system of coal quality control with respect to the radiation hygiene factor and provide protection of the environment and health of the population.

Keywords: coal, ash and slag wastes of thermal power plants, natural radionuclides, specific radioactivity

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Among the most important indicators of the quality of coals, in ecologists' opinion, are their radiation hygiene parameters. Uranium mineralization in coals has been noted as far back as in 1875 at the Old Leyden coalfield (USA). Uranium-coal deposits in the Russian Federation, Kazakhstan, and Kirghizia were the initial mineral and raw-material base of the uranium industry of the USSR.

NATURAL RADIOACTIVE ELEMENTS CONTAINED IN COALS

According to data given in [1], the specific activity of natural radionuclides (NRNs) contained in coals from various deposits in the world differs by a factor of 100–1000 and even more. In this case the content of ^{238}U varies in the range between 0.6 and 3600 Bq/kg, with the average content ranging from 18 to 28 Bq/kg.

If there are uranium anomalies in the areas where coal deposits are located, then the specific activity of NRNs may vary from 3.6 to 8.4×10^4 Bq/kg [2].

Table 1 gives information [2] on the specific activity of NRNs in coals from various deposits in different countries (as of the year 1988). It can be seen that in the world, as a whole, the average content of ^{238}U and ^{232}Th is estimated at 20 Bq/kg, while that of ^{40}K , at 50 Bq/kg.

In Russia radioactivity of brown coals in the Transbaikal Region in the Kharanorskoe, Tagaurskoe, Urtuyskoe, Kutinskoe, and Okino-Klyuchevskoe coalfields has been examined most thoroughly. Shown in the figure is the content of uranium in coal, ash, and slag.

Experience that has been gained and implemented over many years in the production of Urtuy coals and firing them at the Krasnokamensk combined heat and power (CHP) plant and in domestic stoves, may serve as an example of handling coals with an elevated content of NRNs.

Industrial development of the Urtuyskoe coal deposit by the Priargunsky Production and Mining Chemical Works (OAO PPGKhO) began in 1996. Geological exploration of the Urtuyskoye deposit was carried out by the Sosnovskoe Production Geological Association, which specializes in prospecting for and exploration of radioactive raw materials, while development was carried out by the PPGKhO, whose main types of activity are extraction and processing of ores from these deposits, and due to this fact, a professional approach to the questions concerning radiation safety in both prospecting for and extraction of coal and in the process of its use was provided [3].

Experience that has already been gained helped to identify problems related to the provision of radiation