

Aerosol emissions from Forest Fires on the territories contaminated the radionuclides

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Introduction.

This report are reviews the experimental data of the aerosol emission from Forest Fires on the territories of “Mayak” Production Association and Chernobyl.

Spontaneous biomass burning (Wildland Fire) is natural phenomenon.

In time Wildland Fire burn down 3-5 billion ton biomass. It is compare with organic mass (oil, gas, coal) using manking.

INFLUENCE OF THE FOREST FIRES ON THE EASTERN-URALS RADIOACTIVE TRACE ON THE SOURCE TERM IN THE AREA AFFECTED BY "MAYAK" PA

The major part of the Eastern-Urals radioactive trace (EIJRT) generated after 1957 large-scale radiation accident was brought back to use recently. Only the head part of the trace area at the territory of the Eastern Urals reserve is characterized with high radiation levels up to 37 MBk/m² (1000 Ci/km²) due to Sr-90 contamination. Fires occur in the reserve almost annually. As a rule, these are ground spring fires (end of April-May). In many cases seats of fires are located outside the reserve as far as the reserve is surrounded with agricultural farms, gardens, hunting grounds. The most frequent cases of fire occurrence are connected with stubble-field burning and burning of the garden waste in the beginning of the gardening season. Fires in contaminated biocenosis are hazardous in terms of transport of the contaminated ash to adjacent territories. In the recent years the most severe fires occurred in 1996 and 2004 when the area affected by fires comprised 4800 and 8000 hectares, correspondingly. The territory of the reserve is being monitored all year round in terms of intensity of radionuclide fallout and their volumetric activity in surface atmosphere as well as in periphery of the reserve.

On the days of fire increase of these parameters in the monitoring locations situated in prevailing wind directions in 10 km from the fire seat, was noticed. In monthly data was 20 times higher than usual, however, even maximum recorded values were two or one order of magnitude lower than admissible specific activity of radionuclides in air. On further days intensity of fallout was approaching to normal. Early in the year monitoring locations outside the EURT are characterized with higher specific activity values that are not connected with fires. This occurs due to wind transfer (July, August, October). Such short-term increase of specific activity at the trace area is caused by short-term increase of specific activity in surface air and intensity of radionuclide fallout in the areas adjacent to EURT.

However, this increase does not result in significant change of the long-lived radionuclide spatial distribution at adjacent areas. This is connected with the fact that fires occur at the western boundary of the HURT and when winds in Southern direction prevail the major share of radioactive ash precipitates at the territory of the reserve.

It is demonstrated that the radiation monitoring system arranged at «Mayak» PA allows to obtain data necessary for evaluation of population effective dose. The calculation of collective dose enables prediction of potentially hazardous impact on big groups of population.

RADIOACTIVE AEROSOLS DURING THE FIRES ON TERRITORIES CONTAMINATED BY THE PRODUCTS OF CHERNOBYL ACCIDENT

Forests mainly consisting of pines occupy about a half of the territory within the Exclusion Zone of Chernobyl NPP. After accident occurred in 1986, they were highly contaminated by deposition of radio-active products, especially in central, western, and northern areas of the zone. The problem of radiation hazard of forest fires, formation and transfer of secondary radioactive aerosols in plume occurred in summer of 1992, when about 20% of Exclusion Zone was passed by the fire. At the same time, "Chernobylles" enterprise was established. Under its activity, there were registered 976 fires within the zone for 1993 - 2004, i.e. annually 81 fires on average (minimum - 39 fires in 2004, maximum — 111 ones in 1994). The most dangerous months are April and May. Absolute monthly maximum (39 fires) was stated in May. Practically, there are no fires in January, February, November, and December. Spring and summer of 1992 within the Exclusion Zone were hot and dry. Most of the fires occurred on 4 - 9 and 23 - 25 of May, 28 - 30 of June, and 1 - 12 of August at the territories with contamination density of ^{137}Cs from 0.04 to 15 MBq/M². Aerosol sampling at 30 stationary points of radiation situation control in Exclusion Zone showed that ^{137}Cs concentrations increased 10 - 100 times, even at the distance of several kilometers from burning area. Mobile filter facility with sampling flow rate of 75 m³/h and gauze plane tables, on July 1992, observations were performed plume of forest fire occurred 15 km westward from Chernobyl NPP. The presence of ^{106}Ru (0,37 Bq/m³), ^{134}Cs (1,22), ^{137}Cs (17), ^{144}Ce (0,34), and ^{238}Pu (0,0064) was stated. Plutonium isotope content exceeded A Ca 2 times. At meteorological conditions under observation, 10-repeated decrease of radioactive aerosol concentration was observed at the distance of 2 - 2,5 km from burning area.

August 1993, the experimental fire on pine forest area with ^{137}Cs contamination activity of about 1.5 MBq/m^2 was performed in Bryansk Region, in the space of 24 hours before the experiment, ^{137}Cs aerosol concentration was 6 MBq/m^3 . During the fire burning, the concentrations varied from $60 - 600 \text{ MBq/m}^3$ near the fire edge. Radiocaesium particle-carriers had bimodal size distribution. Under the measurements of five samples, from 10 % to 40 % of ^{137}Cs were related to the submicron fraction having activity median aerodynamic diameter (AMAD) of about $0.4 \text{ }\mu\text{m}$. The rest of radiocaesium was at the particles with $10-14 \text{ }\mu\text{m}$ of size. Presumably, it was ashes being removed from burning area by convective flows. In the end of April 1996, heavy fire took place 2-3 km west-ward from Pripjat town. Aerosol samples selected at the stationary control units, located in town, showed that the concentrations of ^{137}Cs having been increased 50 - 100 times above the average "non-fire" level. According to calculation, about 1011 Bq of ^{137}Cs was transferred into plume from every 100 hectares. One year later, the fire took place in pine forest at southern-western part of Pripjat. After its elimination, 4 respirators "Lepestok-200" in which the firemen were measured using γ -spectrometer. It was stated that ^{137}Cs concentrations in breathing zone were in average $7 - 10 \text{ MBq/m}^3$. It was correlated with the data of 1993 during the experiments near Bryansk town.

At the beginning of September 2002, a great smoke was observed on ChNPP site. In any sample taken on 2 - 3 of September, ^{137}Cs concentration increased about 1000 times. Analysis of space pictures and data of "Chernobyl" meteorological station showed that aerosols were received from Belarus, where the centers of forest fires were observed during several days at the distance of 20 - 40 km north-eastward from ChNPP.

It should be mentioned that the exposition dose rate of γ -radiation was measured on-site at the stationary control units simultaneously with sampling. It was stated that even at the highest concentrations of ^{137}Cs in flue tail area EDR value remained the same. Hence, during forest fires on radioactively contaminated territories, the additional radiation hazard is not the increase of external irradiation from plume, but aerosol inhalation, especially their submicron fraction.

The peculiarity of aerosols is in radiocaesium concentration regarding other radionuclides. In comparison with initial aerosol precipitation on-site, the higher ratio of Cs/Sr and $^{137}\text{Cs}/^{238}\text{Pu}$ was stated in samples taken from plume during forest fires in 1992, 1993, and 2002. The reason is that caesium itself and its two oxides have high volatility and evaporate at temperature range of 550 - 670 °C. Later on, they accumulate at atmospheric nucleus of condensation and combustion products that lead to the formation of submicron aerosols of radiocaesium.

Thank you for attention