Radioactivity of Egyptian oil ashes

The activity concentrations of the Egyptian Heavy fuel oil (HFO) ashes are mainly caused by ^{210}Pb and ^{226}Ra (Fig. 1). The radioactivity due to ^{238}U and ^{232}Th was found to be negligible (2-21 Bqkg^{-1}). The average activities value of ^{40}K was 266 Bqkg^{-1}. The activities of ^{226}Ra was in the ranges of 3205 to 12320 Bqkg^{-1} with an average activity of 9284±2725 Bqkg^{-1}. While The activities of ^{210}Pb was in the ranges of 5960 to 13320 Bqkg^{-1} with an average of 11513±2327 Bqkg^{-1}. It should be noted that, the activities of ^{226}Ra and ^{210}Pb radionuclides for some oil ash samples were found to be higher than the exemption activity level recommended by the IAEA safety standards (10000 Bqkg^{-1}). However, activity concentrations of ^{40}K was lower than the exemption activity levels. This means that Egyptian ashes require attention and continuous monitoring during electricity production.

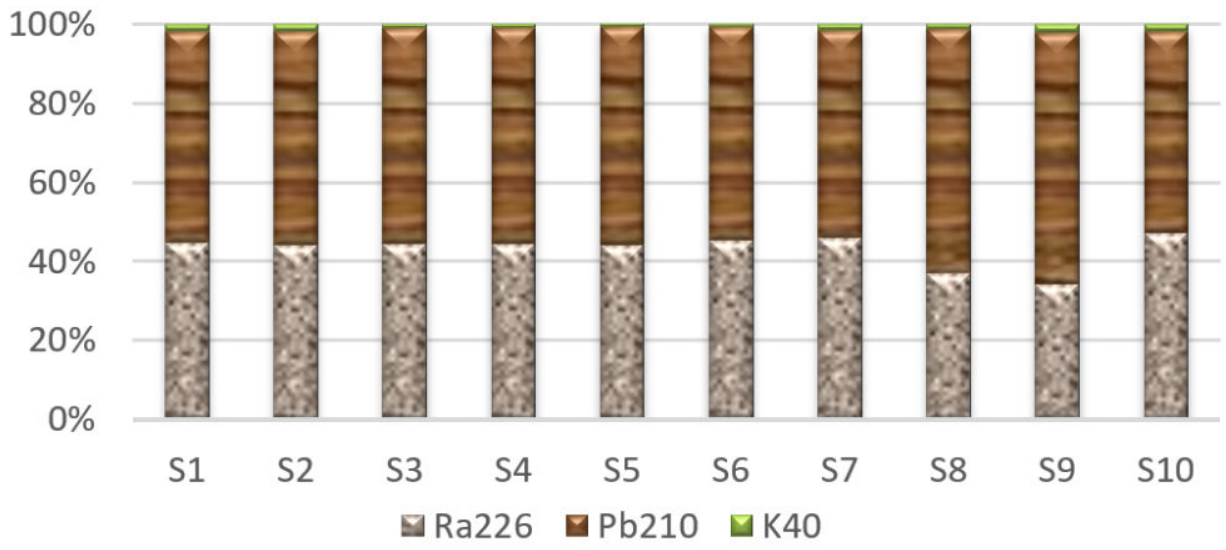

Fig. 1. The relative activity concentrations of 226Ra, 210Pb and 40K in Egyptian oil ashes.

Most previous studies have focused on the indirect determination of U and Th activity by gamma spectrometry. One was recently estimated the activity of these two radionuclides in coal ash directly and accurately by ICP-MS. The present study was the first one which used ICP-MS and INAA for direct determination of U and Th activity in HFO ash samples.

The activity of ^{232}Th in the previous reported Egyptian oil ashes (Assiut power plant) was higher than results obtained in the present study, probably due to that the authors assume secular equilibrium between ^{232}Th and its daughters ^{212}Pb. The activity values of ^{226}Ra in oil ashes were much higher that reported for coal ashes. Many researchers have reported a high ^{226}Ra activity in

the Egyptian oil industry. Definitely, ^{226}Ra increased in the produced oil ashes. In addition, the ^{210}Pb activity concentrations were much higher than those reported. There is a great variability of results for ^{40}K activity which can be attributed to the variability in the feed fuel. The values of ^{40}K activity in oil ashes seem to be higher than that reported from other oil ashes and much lower than that reported in Assiut power plants (10983 Bqkg^{-1}).

None of the Egyptian power plants, situated in a densely populated region is fitted with ESPs. In addition, most of the generated ashes are not used for anything but landfill. Hence combustion of HFO results in high doses to the power plant personnel and constitute a potential health hazard to the population in the area around these plants, due to fly ash releases and depositions. Thus, special attention is to be given to the radiological impact of these power plants to avoid contamination of the environment.

It is clear that both CIP-MS and INAA provided an accurate and powerful technique for the determination of the ^{238}U and ^{232}Th activity as well as the HPGe for the determination of the gamma emitting ^{226}Ra, ^{210}Pb and ^{40}K. The calculated average ^{226}Ra and ^{210}Pb activity concentrations were 9284 and 11513 Bqkg^{-1} for oil ash samples, respectively. Thus, these results indicate that, Egyptian HFO power plants present a radiological hazard to the general public and the environment and need destructive pretreatments before any utilization.

Hesham Samir Mohammed
Production Division, Nuclear Materials Authority, Maadi Kattameya, Cairo, Egypt

Publication

Natural radioactivity and radiological hazard assessment of Egyptian oil ashes.
Mohammed H, Sadeek S, Mahmoud AR, Diab H, Zaky D
Environ Sci Pollut Res Int. 2016 Aug