Size distribution of airborne Uranium and Thorium-labelled aerosols near a UF4 processing plant

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Uranium and thorium-labelled aerosols are emitted by the stack of a UF_4 processing plant. Labelled-aerosols may also come from resuspension of soils particles from the surrounding environment and from areas devoted to the storage of waste. At 1.1 km from the plant stack, a size distribution study of aerosol carriers of the radionuclides of interest was conducted. This was performed during two distinct periods: one when the facility shut down for servicing (no atmospheric release) and the other when the facility was in operation. These trials were conducted using simultaneously six High Volume Impactors (HVI, Tisch TE-235) having 5+1 stages. Each sampling lasted two weeks at a flow rate of ~70 m^3/h per impactor and thus an overall flow rate of around 430 m^3/h. Thanks to the elevated air volume sampled (~ 92000 m^3) and very sensitive measurements, activity levels of thorium-234 (^{234}Th) of the ^{238}U decay series were quantified for each stage at some µBq/m^3 corresponding to a cumulative airborne activity of about 15 µBq/m^3 during the shutdown period. (Fig. 1).

Airborne activity levels are on average 5 times higher during operation of the facility except for the finest fraction that remains poorly affected by the releases. During the shutdown period, activity higher levels onto coarse particles can be explained by resuspension of former deposit onto soils. The corresponding Activity Median Aerodynamic Diameter (AMAD) and respective Geometric Standard Deviation (GSD) are listed in Table 1. The presented values are within the range of those compiled by Dorrian and Bailey (1997) but significantly lower than the default AMAD value (5µm) used for occupational exposures (ICPR 66) or those found in the fluoridation and precipitation workplaces of this facility (5.1 and 6.4 µm, respectively; Ansoborlo et al., (2001). The larger AMAD during operation is due to the release of coarse particles from the stack. Some of them remain suspended at 1.1 km. Regardless of the dust concentration, particles having the higher ^{234}Th load are within the [0.95-1.5µm[size range (Fig. 2).

	AMAD (µBq/m^3)	GSD (µBq/m^3)
Shutdown	0.84	17.0
Operation	1.6	4.7

Table 1. AMAD and GSD for ^{234}Th between shutdown and operation conditions

Compared to the typical weighted activity found in the uranium concentrate (yellow-cake), the weighted activity of the aerosols are ~ 4500 times lower.

Such information is useful to strikes and validate environmental dispersion/deposition model at short distance scale. Further investigations on the finest fraction are required to precise the contribution of the particle that enter deeply into the lungs.

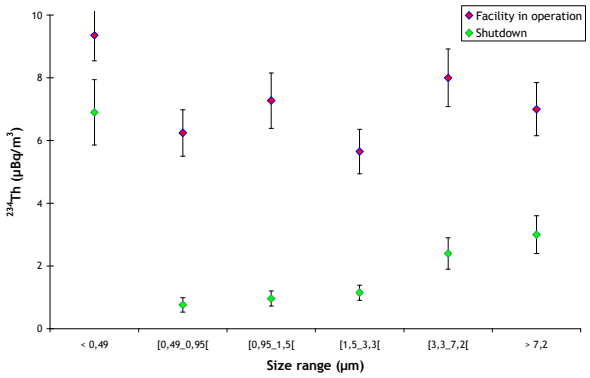

Figure 1. Size distribution of ^{234}Th aerosol carriers

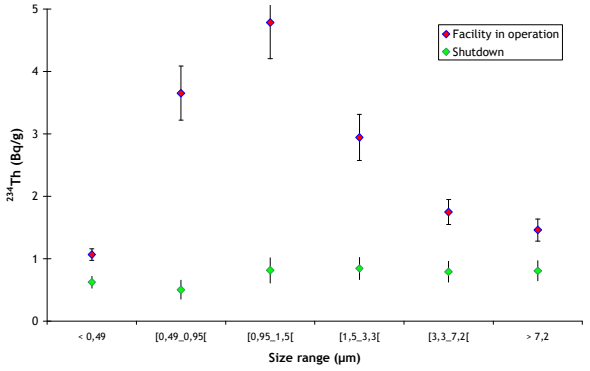

Figure 2. Size distribution of the weighted ^{234}Th

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