

Resuspension of particles inside packages containing radioactive powders

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In the field of transport of radioactive materials, the products, like UO₂, PuO₂ or MOX (Mixed OXyde Fuel) powders are confined in packaging which should, in normal or accidental conditions of transport, assure a leakage rate compatible with the release regulatory criteria (IAEA, 2005). The above mentioned conditions are characterized by a drop test up to respectively 1.2 m and 9 m high. In the safety demonstrations, the hypotheses usually taken into account by the French applicants are concentrations of aerosols in the cavity of the package equal to:

- in normal conditions of transport: 10⁻³ g.m⁻³;
- in accidental conditions of transport: 9 g.m⁻³ for the first thirty minutes after the drop, and then to 0.1 g.m⁻³ for one week.

The current study aims at discussing the relevance of these hypotheses on the basis of a review of the most recent studies available in the literature (Curren & Bond, 1980; Sandoval *et al.* 1985; Barlow *et al.* 1995; Martens *et al.* 2005) on the one hand and on the other hand of new laboratory experiments with surrogate powders. The objective of these experiments is to evaluate the amount of airborne particles inside a container of powder falling on an unyielding target.

Three alumina powders are used as surrogates for these laboratory experiments. The corresponding particle size distributions measured with the Coulter technique (based on the equivalent volume diameter) are presented in table 1.

Table 1. Characteristics of the particle size distributions of the alumina powders.

Powders	Mass median diameter (µm)	Geometric standard deviation
G1	4.6	1.4
G2	17	1.3
G3	27	1.5

The container, half filled with powder, is dropped from 1 m height. The particles in suspension are sampled in real-time with an optical particle counter (OPC, Grimm 1.108) using a flexible line which is in vertical position after the drop. The total mass of aerosols is determined by weighing the OPC sampling filter. Figure 1 shows the experimental set-up.

Table 2 gives the results obtained for the three powders and two bulk density (packed and non packed). The results are corrected to take into account the particles settling during the sampling period.

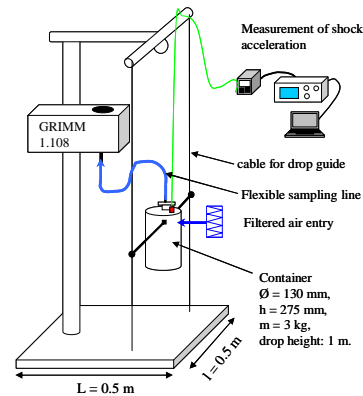


Figure 1. Experimental set-up.

Table 2. Characteristics of the airborne particles after the shock of the container filled with different powders.

Powder	Airborne particles mass (mg)	Initial aerosol concentration (g.m ⁻³)
G1 non packed	20.3	8.07
G1 packed	12.4	4.05
G2 non packed	2.90	1.03
G2 packed	0.30	0.10
G3 non packed	0.78	0.26
G3 packed	0.18	0.06

The results obtained show the effects of the particle size distribution and of the powder bulk density on the particles resuspension.

Nevertheless, as the surrogate criterion used in this experiment was limited to the particle diameter, further experiments are necessary to evaluate, in particular, the impact on the results of the cohesive properties of the radioactive powders and of the high density of plutonium or uranium oxide particles.

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