New method for radiation shield of cesium isotopes spread over an infinitely extended land after nuclear accident

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Since the Fukushima Nuclear Accident in March 2011, it is widely known that the decontamination alone is sometime ineffective to reduce the ambient dose rate of gammas. For example, forestry areas are left intact because decontamination method is yet unknown. It is therefore evident that a combination of soil decontamination and additional shielding be optimized properly. The important nature of the contaminated land is that the affected areas are so extended that an assumption of infinite area with a radioactivity (Bq/m²) over the land is a reasonable approximation to represent the situation. By knowing this difficulty of decontamination, we propose a new method for radiation shield, which is effective when the affected area is infinite or simply widely extended, which is the present case in Fukushima after the nuclear accident.

The method is elementary, and even “magical” at first sight. It states: cover the land by a thin (NOT thick) material with a reasonable radiation length, where the radiation length is defined [1] as the inverse of cross section of gamma ray in the material. The mechanism is as follows. 1) ambient dose rate at some point is an integral over the infinite surface of the land around the point, 2) mean-free-path in air by gammas from 137Cs is rather long like 107 meters, so that the radiation from far-away land travels in air sideways to reach at the point, 3) therefore even thin material is effective because the effective thickness, where the radiation shall travel to reach at the point from far-away ground, of thin material appears rather thick by the horizontal paths.

For example, in case of 2cm thinness of limonite (50% of the weight is iron) with a radius of 10m, the shielding effect is a factor of 1/6 at maximum. It is clear that this huge effect is a result of the amplification by the inclined path-length inside the thin material. To prove this effect we performed a proper laboratory experiment. Results of field experiments will also be compared with numerical calculations. Notes are also placed before we apply this method to the real field conditions in Fukushima.