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Limiting Resuspension of Radioactively-Contaminated Soils by Different Stabilizers

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Resuspension of ground-deposited radioactive particles following an atmospheric dispersion event can cause further expansion of the contaminated areas as well as health risks due to internal exposure by inhalation. Therefore, stabilization of radioactively-contaminated soils and reduced wind erosion can minimize contamination dispersion. The primary goal of this study was to perform laboratory testing of candidate stabilization materials for the purpose of limiting wind-induced resuspension of contaminated soil. Soils were sampled from the Tze'elim sandy area at the western Negev Desert and the Rotem-Yamin plateau at the northern Negev Desert in Israel. The soils were analyzed for elemental and mineralogical composition, particle size distribution, organic matter content, and cation-exchange capacity. The soils were treated by spraying with different brine-based stabilization solutions, including magnesium chloride ($MgCl_2$), calcium chloride ($CaCl_2$), and a solution sampled from the Dead Sea in Israel. The effectiveness of the three brine solutions was tested by a boundary-layer wind tunnel under four wind speeds, 4.0, 6.5, 8.0, and 9.5 m s^{-1}, representing typical natural winds associated with dust emission in this region. Higher resuspension levels were obtained from the untreated soils of Tze'elim sandy soil than the Rotem-Yamin plateau soil, as shown by higher fluxes of PM10 dust (particulate matter < 10 micrometer in diameter) at all wind speeds. At the highest wind speed, an order of magnitude difference in fluxes of saltating particles was obtained between the two soil types. Treating the two soils with either of the brine solutions resulted in reduced PM10 fluxes as well as reduced saltation of sand particles. The least efficient stabilizer was calcium chloride, whereas the most efficient stabilizer was the Dead Sea solution with no PM10 emission nor saltation at all wind speeds. Our study shows that applying brine solutions can provide a simple and efficient method to minimize radioactive dispersion due to resuspension of contaminated topsoil particles.