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Composite Dust-Suppressing Coatings Containing Nanosized Sorbents Selective to Cesium, Cobalt, and Nickel Radionuclides

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Here we report on development, characterization and performance evaluation of new materials based on selective to radionuclides nanosized sorbents stabilized in water dispersible nanoparticles (latexes). These new materials can be applicable as fixatives (dust suppressors), when latexes are film-forming, and as colloid stable sorbents for decontamination of solid bulk materials, when any type of latex, preferably containing carboxylic groups on the surface, is used.
Two different series of polymeric nanoparticles were synthesized and tested as a polymer matrix for inorganic sorbents immobilization. The first type of particles was based on polystyrene and composed of polystyrene either pure (homopolymer) or copolymerized with different amounts of acrylic acid in order to obtain carboxyl-functionalized latex particles. The second type was poly(silane acrylate)-based copolymer nanoparticles, consisting from butyl acrylate, methyl methacrylate, polymerizable silane and functional comonomer (either methacrylic acid or aminoethyl methacrylate hydrochloride). All particles were synthesized in direct (oil-in-water) miniemulsion system by free-radical (co)polymerization.
As selective inorganic materials colloidal SnO2 and MnO2 with mean particle size 10 nm and 200 nm, respectively, have been synthesized. Co(II) ferrocyanides were synthesized directly in the presence of carboxylic latex particles. Composites containing SnO2 nanoparticles selective to radionuclides of nickel and cobalt have been prepared using carboxylic and aminolatexes as a martrix, the maximum loading degree was about 60 mg of SnO2 per 1 g of latex. Sorption properties of composite latex/inorganic sorbent materials have been investigated toward 63Ni, 57Co (SnO2), 137Cs (Co (II) ferrocyanides), 90Sr (manganese oxides) in the presence of competing ions. Distribution coefficients up to 105 ml/g were reached for cesium radionuclides and for nickel and cobalt radionuclides on SnO2 in NaNO3 solutions The highest distribution coefficients of 90Sr (~3500 ml/g) in the presence of competing Ca2+ ions (0.1 g/L) were reached for manganese oxides.
Dust suppressing formulations based on film-forming poly(silane acrylate) latexes containing Co(II)ferrocyanide and poly(silane aminoethyl) latexes containing SnO2 have been prepared and drop casted on model contaminated sand. The leaching of 137Cs and 57Co radionuclides from coated sand surface was efficiently suppressed (leaching degree below 1%), when the content of Co(II) ferrocyanide and SnO2 in composite coatings was as low as 1.3•10-6 mol/cm3 and 8.3•10-4 mol/cm3, respectively.

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