This project was aimed to development, characterization and performance evaluation of new materials based on selective nanosized sorbents for radionuclides stabilized in water dispersible latexes. These new type of nanomaterials can be applicable as fixatives (dust suppressors) for fabrication of coatings preventing radionuclides migration with liquid media from radioactively contaminated soils and grounds in open air under effect of atmospheric precipitates and ground water leaching. The main project tasks were i) synthesis of latexes and optimization of their properties for application as carriers for nanosized selective sorbents, ii) synthesis of nanosized inorganic sorbents selective to radionuclides of cesium, cobalt/nickel, and strontium iii) development of protocols to immobilize the obtained sorbents into the synthesized latex particles and obtain colloidal stable composite particles, iv) to find an optimum content of selective sorbent in composite providing high efficiency of new materials application as dust-suppressing formulations preventing radionuclides migration from contaminated surfaces.

During project implementation the synthesis of two different series of polymeric nanoparticles to be used as carriers for nanosized selective sorbents was developed and optimized. The first type of particles is 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 is *poly(silane acrylate)*-based copolymer nanoparticles, consisting from butyl acrylate, methyl methacrylate, polymerizable silane and functional comonomer (either methacrylic acid, MAA or aminoethyl methacrylate hydrochloride, AEMH). All particles were synthesized in direct (oil-in-water) miniemulsion system by free-radical (co)polymerization. The attention in the development of the synthetic procedure was paid to obtain stable polymeric nanoparticles having different particle size and density of surface functional groups (carboxylic or amine).

As counterpart to the latex carrier in composites several types of inorganic materials have been synthesized in colloid stable form to be used for preparation of latex-inorganic hybrid particles for selective sorption of target radionuclides (^{63}Ni, ^{57}Co, ^{90}Sr, and ^{137}Cs). Sol-gel synthesis of two types of selective colloid sorbents - TiO_2 and SnO_2 targeted to strontium and cobalt/nickel uptake, respectively, have been developed. Cobalt hexacyanoferrate (CoHCF) was synthesized directly in the presence of carboxylic latex particles. It was shown that the efficiency of nanocrystals stabilization in polymeric matrix depends significantly on the content of carboxylic groups on the latex surface, The preferable matrix for stabilization of CoHCF shall contain at least 1 mmol of -COOH groups per 1 g of latex. All synthesized colloidal materials had ion exchange characteristics very similar to those of known macroscopic materials and high distribution coefficient (>10^4 ml/g) even in the presence of typical competing ions. This allowed their utilization in synthesis of the following types of latex-inorganic hybrid particles: carboxylic latex/CoHCF and amino latex/CoHCF for cesium uptake; carboxylic latex/SnO_2 and amino latex/SnO_2 for cobalt and nickel uptake; carboxylic latex/TiO_2 and amino latex/$TinO_2$ for strontium uptake. These composites have shown good selectivity toward target radionuclides providing in all cases distribution coefficients >10000 ml/g, i.e. immobilization to the latex particles had no negative effect on selectivity and sorption capacity of colloidal sorption materials.

Casting or spray-drying of the obtained latex/inorganic composites on the radioactively contaminated surfaces yields flaw-free coherent coatings. While original latex coatings were highly permeable for all target radionuclides and did not prevent their migration from the surface with liquid media, immobilization of selective sorbents to the latex particles has allowed significant reduction of polymeric coatings permeability and provided fixation of 96-99% of cesium, strontium and cobalt radionuclides on the contaminated surface, when volume fraction of selective sorbent was below 5%. We have shown that distribution coefficients of nanosized sorbents suitable for preparation of composite coatings has to be close to 10^6 ml/g.

The project results may be applicable for deactivation of ground waters and soils around emergency nuclear power plants, including Fukusima NPP, enterprises for nuclear fuel processing, in working nuclear power stations for treatment of spent ion-exchange resins.