# Nanocomposite and nanomaterials

## Synthesis of nanocomposite adsorbent for removal of Sr radionuclides from contaminated waters

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There is a growing interest in the application of nanomaterials as effective adsorbents for the removal of pollutants due to their unique physicochemical properties. In nanomaterials most of the atoms on the surface are unsaturated and can bind to other atoms by hydrogen bonding and/or heteroatoms. In additional nanomaterials are characterized by high surface area, large pore volume, high pore sizes and absence of internal diffusion resistance.

It has been shown that manganese oxides ($MnO_2$) have excellent adsorption properties for the removal of radionuclides (U, Th, Ra, Sr, Co) from contaminated waters. However, the excessive pressure drop and poor mechanical rigidity are the main obstacles for their direct application. Furthermore, the fine particle size of $MnO_2$ makes it difficult to separate the solid from the aqueous phase or to allow ready penetration through the bed. However, synthesis of composite adsorbents by coating manganese oxide onto a solid support allows overcoming these technical drawbacks.

In this study we propose novel nanocomposite adsorbent based on $MnO_2$-coated polyacrylonitrile (PAN) fibers, which was prepared by *in situ* formation of $MnO_2$ nano-sized grains within and on the fibers' surface by redox reaction between $MnO_4^-$ and $Mn^{2+}$ in alkaline conditions.

The original PAN fibers have cream color, but composite fibers became black. XRD data confirmed the formation of composite fibers with the birnessite ($\delta$-$MnO_2$) phase. The SEM images of fibers' surface and cross-cut revealed the formation of the birnessite nanograins (100 nm) within the fibers' pores.

The composite adsorbent was tested for removal of Sr ions from the model solutions in the presence of excess of competitive calcium ions. It was found that the synthesized composite adsorbent has high adsorption capacity for both Sr and Ca and no selectivity towards of Sr ions. The composite fibers were subjected to thermal treatment at 120-200 $^oC$ for several hours. It was found that thermal treatment leads to increase of both adsorption capacity and selectivity of the composite fibers towards of Sr in the presence of excess of competitive Ca ions.