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Editorial Open Access

Innovative Materials for Removal of New Generation Pollutants from Aquatic Environment

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Editorial

Wide spread application of Nanoparticles (NPs) for various uses like antibacterial materials, drug delivery systems, cosmetics, pesticides and electronic gadgets leads to developments in nanotechnology. Improvement in properties of these product due to NPs are leading to a rapid proliferation of new materials that are likely to become a source of Engineered Nanoparticles (ENPs) to the ambient environment, where their possible ecotoxicological impacts remain unknown. These ENPs can be termed as new generation pollutants in aquatic and terrestrial environment. The potential toxic effects of these nanoparticles on aquatic as well as soil-plant environment, have drawn much special attention due to their higher production, usage and unintentional release into the environment without any systematic regulation by government agencies as in case of conventional pollutants.

As a common practice, pollutants from aquatic medium in general removed by using adsorption phenomenon, in which the pollutants are accumulated on any solid surface. Understanding of new adsorbents have been developed with the materials advancement over the years and used for water treatment but isolation of nanoparticles from aquatic stream is still a challenging task. Nano-filtration or ultra-filtration can be useful, but they are not cost effective and practical field application for a large quantity of water may not be physically viable. In order to address this issue, core shell materials using silica microspheres which were in practice for the for the removal of various pollutants from aquatic environments including dyes and heavy metals are tried for the removal of ENPs from aquatic environment. These materials have great potential for removal of pollutants as they have large surface area, well-defined and adjustable pore structure and narrow distribution of the pore size. These materials can be obtained by the synthesis of core-shell type particles. These core-shell particles often exhibit properties that are substantially different from those of the template core because of higher surface area, different surface chemical compositions, increased stability and different optical and magnetic properties. Such particles can be applied in various fields including catalysis, coatings, capsule agents for drug delivery, composite materials.

Methods of fabrication of hollow or microspheres mostly involve removing the core by dissolution into solvents or by calcinations. This can be achieved in two different steps, i.e., formation of composite particle, followed by removal of inner structure leaving behind the shell with hollow space. It is also possible to synthesize the silica microsphere in one-step process, which meant that the formation of the inorganic shells and the dissolution of core particles occurred in the same medium. In order to ease the separation of core shell material from the aquatic medium the material can be impregnated in alginate matrix by using simple displacement reaction. The use of alginate as an immobilizing agent in most applications rests in its ability to form heat-stable strong gels which can be developed at room temperatures and are quiet stable. The details of same were discussed elsewhere [1-5].

The resultant material is normally characterized by using various techniques like Zeta-sizer for size characterization, SEM-EDS, FTIR and XRD for the surface and structural characterization. The porosity and the degree of immobilization of the embedded materials can be controlled over a wide range of concentrations. Homogeneous distribution of the embedded material within the alginate matrices is ensured by using surface morphological techniques (SEM-EDS/TEM). The stability of the prepared material and changes in the particle size distribution has to be monitored with time. Kinetics and sorption capacities for various combinations of hybrid materials were also evaluated. One of the major advantages of these impregnated core shell materials is the ease with which they will recovered back and desorption of pollutants using desired eluent. Quantification of inorganic pollutants in the eluent can be carried out by using absorption/emission spectroscopy while the ultra-trace level of radionuclides is measured by using gamma and alpha spectrometry. In case organic pollutant measurement can be done by using GC-MS (Gas Chromatography coupled with Mass Spectrometry). Second major advantage associated with these core shell materials is that they will not leach into experimental solution. This can be verified by quantifying various drinking water quality parameters after decontamination in case of potable water. Some of core impregnated material which was already practiced by our group is Silica Microspheres (SM) impregnated in calcium alginate used for removal of TiO_2 NP from aquatic environment. In these material, sufficiently high sorption capacity could be achieved by because of high specific surface areas i.e., smaller size and hollow or porous nature of the microspheres. In future, the demand of these innovative materials will be increased exponentially to remove the new generation pollutants from aquatic environment.

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