Cadmium (II) removal from aqueous systems by the use of nZVI functionalized high silica zeolitic particles

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Abstract: Among various methods used for removal of heavy metals from contaminated water, adsorption is the most sought after method. Fortunately, nano-science in synergy with relevant adsorbent materials can be used to change the adsorbent morphology, increase the adsorbent surface area there by enhancing the activity, rate of adsorption and adsorption capacity for contaminant adsorption. In this context, the adsorption advantages of zerovalent iron (ZVI) in nano-forms has been applied for removal of heavy metal present in drinking water. The purpose of present work is to study the modification of adsorbent, zeolite material for improved adsorptive performance. In the present work, adsorption dynamics for the removal of cadmium [Cd(II)]from contaminated water using nano zerovalent iron (nZVI) functionalized zeolitic particles has been reported.

Environment and human health is greatly affected due to water contamination by the presence of heavy metals as they result into various harmful end products[1].Several physical, chemical and biological techniques have been reported in order to address these problems. However, all of thesetechniquessufferfromoneormorelimitation[2]. Adsorption is known to be the most economic and cost-effective method for metal ion removal from contaminated water. Nanoscale zero-valent iron (nZVI) is a promising material for the removal of heavy metals from wastewater owing to its wide availability and high adsorption capacity[3], yet it has a very limited efficiency due to poor stability and aggregation property.

In the present work, adsorption dynamics for the removal of heavy metal ion Cd(II) from contaminated water using nZVI modified zeolitic particles has been reported. Concentration variation and time variation studies has been conducted to determine the adsorption mechanism of the functionalized zeolitic particles. Results indicate that functionalization of zeolite with nano form of zerovalent iron increases the surface area and surface roughness of the zeolite which leads to heavy migration of Cd(II) ions from aqueous media to the surface thus showing a higher adsorption capacity for functionalized particles as compared to pure zeolite CBV 500. Physio-chemisorption of Cd(II) on the outer coating of the ZVI shell provides a lesser adsorption time than zeolite which adsorbs only by chemisorption as indicated in the kinetic studies. Multi-layered heterogeneous adsorption along with physio-chemisorption prove that nZVI functionalized particles are more rapid with a higher equilibrium adsorption capacity as compared to zeolite

5th International Conference on Nanotechnology for Better Living (NBL-2019), Jointly organized by National Institute of Technology (NIT) Srinagar and Indian Institute of Technology (IIT) Kharagpur; April 7 – 11, 2019 at SKUAST, Shalimar Srinagar, Jammu and Kashmir, India; Editor: Dr. M. A. Shah and Prof. P. Banerji, ISBN:978-81-939516-0-6; Published by Applied Science Innovations Pvt. Ltd., Pune, Maharashtra, India.

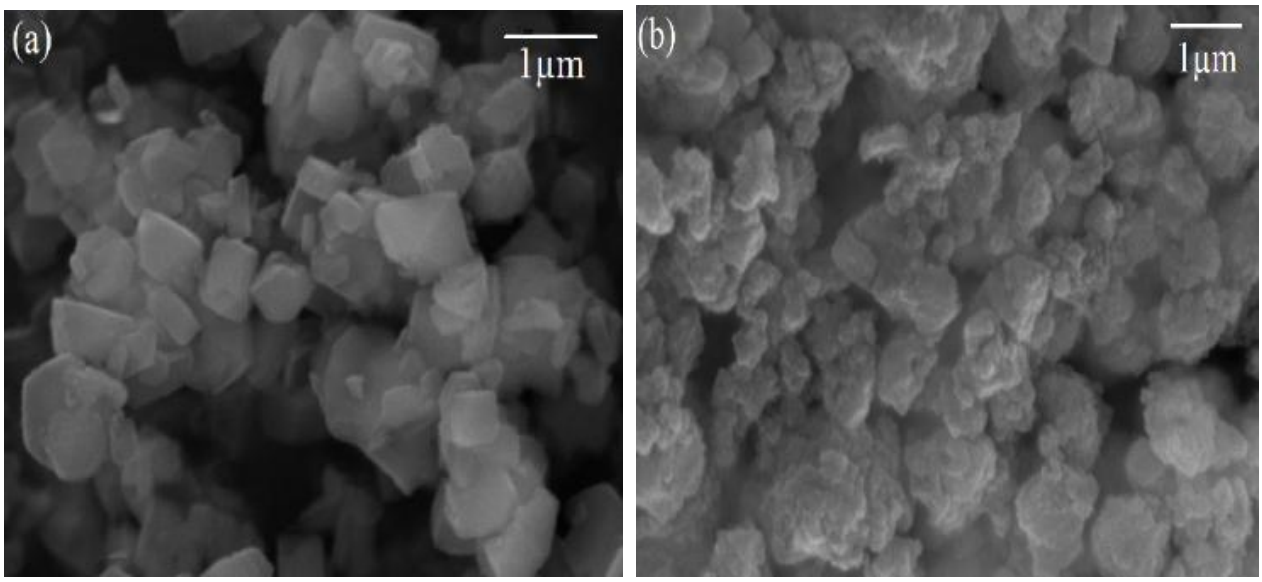

Figure 1 : (a) FE-SEM image of zeolite (b) SEM image of nZVI@zeolite particle

In conclusion, nanoscale zerovalent iron functionalized zeolitic core-shell particles have been specifically engineered to increase the adsorption capacity of the zeolite in an effective manner. The modification also increases the rate of adsorption thus providing fast removal of metal ions from water. Besides having ease of separation, the material is also regenerable, recyclable and reusable. Hence the materials non-toxic and highly efficient for the removal of heavy metals from wastewater

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