SYNTHESIS AND CHARACTERIZATION OF ZERO VALENT IRON NANOPARTICLES

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ABSTRACT

In the present work, nano scaled zero valent iron (nZVI) were synthesized by the method of ferric chloride($FeCl_3$) reduction using sodium borohydride as a reducing agent under atmospheric conditions. A systematiccharacterization of nZVI was performed using XRD, SEM and FTIR studies. The obtained iron nanoparticles aremainly in zero valent oxidation state.

Keywords-Zero valent iron, Nanoparticles, Synthesis, XRD, SEM, FTIR.

INTRODUCTION

The field of nanotechnology is one of themost active research areas in modern material Science.Nano is raised from the Greek word for goblin. A nanometer is one billionth of a meter and might be represented by the
length of ten hydrogen atoms lined up in a row.Nanotechnology implicates the creation and utilization ofmaterials, devices and systems through the control of matteron the nanometer-length scale i.e. at the level of atoms,molecules and supramolecular structures. Suchtechnology is mainly concerned with synthesis ofnanoparticles of variable sizes, shapes, chemicalcompositions and controlled dispersity and their potentialuse for human interests. However, physical and chemicalmethods may successfully produce pure, well-definednanoparticles, these are quite costly and potentially riskyto the environment. Utilize of biological organisms such asmicroorganisms, plant extractor, plant biomass could bean alternative to physical and chemical methods for theproduction of nanoparticles in an eco-friendly manner. Nanotechnology is a reliable and enabling environmentfriendly process for the synthesis of nanoscale particles.Nanosize outcomes in peculiar physicochemicalcharacteristics such as high surface area to volume ratio,which potentially results in high reactivity.

Recent studies have revealed the effect of zero valentiron nanoparticles for the transformation of organiccontaminants and heavy metals. Moreover, many studiesrevealed that zero valent iron is effective at stabilization ordestruction of a host of pollutants by its highly reducingcharacter. From these aspects, zero valent iron (ZVI) isproposed as one of the best reactive materials in permeablereactive barrier techniques. Past few years, differentsynthetic methods have been developed to produce ironnanoparticles, modify the nanoparticle surface propertiesand enhance its efficiency for field delivery and reactions. The most widely used method for environmentalpurposes is the borohydrate reduction of Fe (II) or Fe (III)ions in aqueous media. In the present study nanoparticleswere formed by using ferric chloride and sodiumborohydride. These nanoparticles were characterizied byXRD, SEM, and FTIR.

EXPERIMENTAL METHODS-

Production of ZVI involved areduction method using two main chemicals which wereanhydrous $FeCl_3$ and$NaBH_4$. The $NaBH_4$ functions as areducing agent in order to reduce the ferric chloride ($FeCl_3$)in form of solution to produce zero valent iron. We Dissolve1.622g ferric chloride ($FeCl_3$) in 100ml distilled water. Alsoprepare sodium borohydride solution by dissolving 1.8915g$NaBH_4$ in 100 ml distilled water. Mix both the solutions. Blackcoloured particles are formed. Filter these particles usingWhattman filter paper No.1 and wash it with 20ml distilledwater and 20ml ethanol three times. Black coloured particlesso obtained are stored in ethanol overnight and dried indessicator.

RESULTS AND DISCUSSION-

The nanoscaled zero valentiron (nZVI) have been synthesized in aqueous medium bythe method of ferric iron reduction using sodium borohydrideas a reducing agent under atmospheric condition. Acareful characterization of nZVI has been performed usingFTIR, XRD and SEM studies.

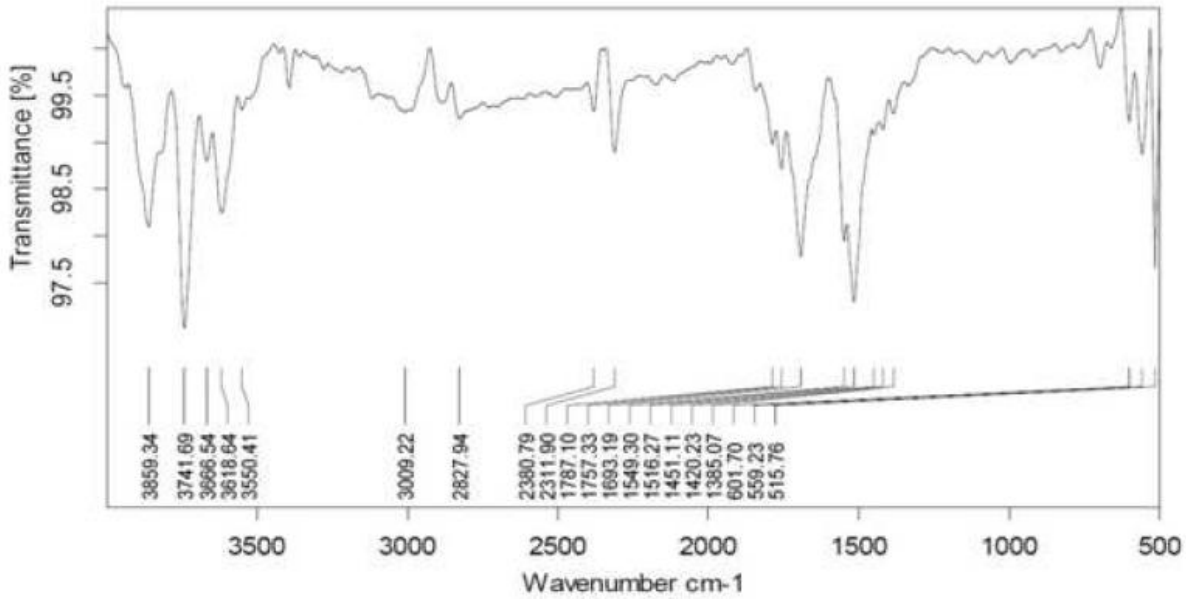

Fig. 1 FTIR spectrum of zero valent iron nanoparticles

Fig. 1 shows the FTIR spectrum of iron nano particles. Thebroad peak 3741.69cm^{-1} is owing to the presence of O-Hfrom alcohol used in washing. 1693cm^{-1} may be attributedto H-O-H stretching of deionised deoxygenated water.515.76 cm-1 is attributed to zero valent Iron.

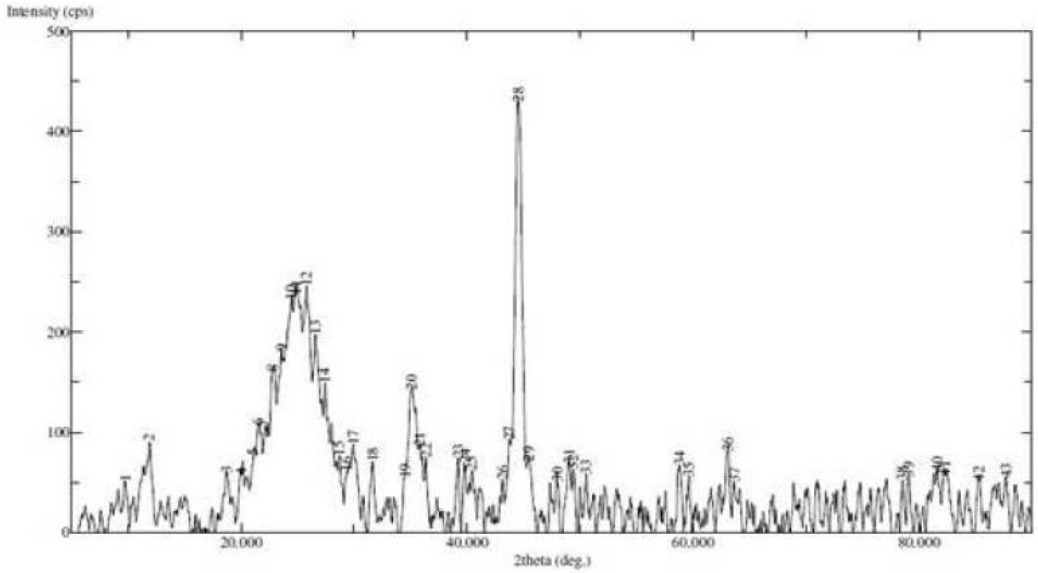

Fig.2 XRD pattern of zero valent iron nanoparticles

Fig. 2 shows the powder XRD pattern of nZVI samplesunder ambient conditions. The broad peak reveals the existenceof an amorphous phase of iron .The characteristicbroad peak at θ2 of 44.55^{o} indicates that the zero valentiron is predominantly present in the sample.

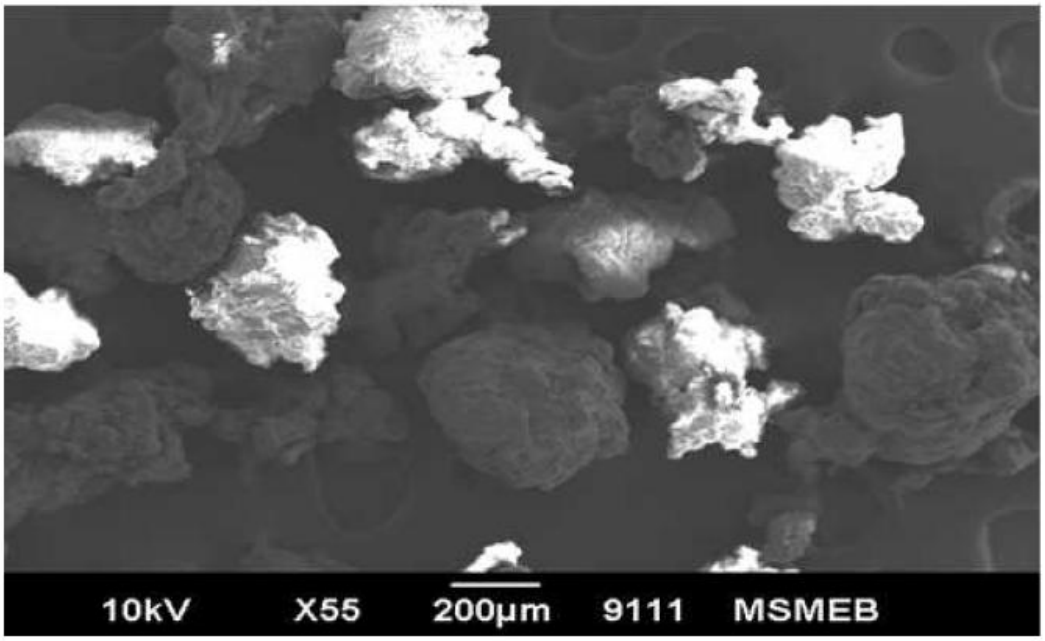

Fig.3 SEM image of zero valent iron nanoparticles

Fig.3 shows the SEM image of freshly synthesized iron nanoparticles. Results indicate that the synthesized nZVI particlesshow dendritic structure. All nZVI were non uniformin size and non spherical in shape.

CONCLUSION-

In this study we have concluded that nZVIhas been successfully synthesized

in the laboratory usinganhydrous $FeCl_3$ and sodium borohydride. Owing to ironmetal is of low cost, zero valent iron can be used to removewaste water pollutants such as heavy metals, pesticides,dyes etc.

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