

Synthesis and Characterization of Zero Valent Iron Nanoparticles

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Abstract. In the present work, nano zero valent iron (nZVI) were synthesized by the method of hydrated ferrous sulphate ($\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$) reduction using sodium borohydride (NaBH_4) as a reducing agent under ambient conditions. Characterization of nZVI was performed using XRD and FTIR. The acquired iron nanoparticles are mainly in zero valent oxidation state. The obtained results were close agreement with other experimental works.

INTRODUCTION

Zero valent iron is an elemental iron in zero oxidation state. This simply introduce to iron in an uncombined state. Zero valent iron facilitates successful and reliable degradation of waterborne pollutants in the environment groundwater [1]. The utilization of zero valent Iron as a cheap reducing agent for the treatment of wide range of environmental contaminants and in iron wall remediation has been studied [2]. Furthermore, Zero valent iron is referred to as a green material owing to the quantity of Iron gladly available as recycled materials, its capability to degrade most contaminants with little contamination and its mild toxicological characteristics [3]. The development of nanoscale dimension of zero valent iron has created an individual class of zero valent iron material with broadly improved reactivity owing to its very small size and large surface area. In the last decade, Nano zero valent Iron has absorbed much attention for its future application for the treatment of polluted soil and impure groundwater. Zhu et al [4] stated that different technologies were available to extract toxic metals from water, but nanoscale zero valent Iron was reported an ideal and more effective material for the in-situ remediation owing to its large reactive surface area and high affinity for toxic metals. The nano zero valent Iron has capability to transform the injurious materials to non-injurious materials; it can also be used to encourage the reduction and precipitation of harmful and carcinogenic metals [5]. In the present study the nanoparticles were formed by using $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$, Kaolinite and sodium borohydride. These nanoparticles were characterized by XRD and FTIR.

EXPERIMENTAL METHOD

Production of nZVI involved a reduction method using three main chemicals which were $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$, Kaolinite and NaBH_4 . The NaBH_4 functions as a reducing agent in order to reduce the $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ in form of solution to produce zero valent iron. Dissolve 8.3406g $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ in 24ml ethanol and added 6ml distilled water. Now added 1.50g Kaolinite in this solution. Also prepare sodium borohydride solution by dissolving 3.7830g NaBH_4 in 100ml distilled water. Filled sodium borohydride solution in burette. Keep ferrous sulphate solution on magnetic stirrer with hot plate at 30°C. Now added 90ml sodium borohydride solution in ferrous sulphate solution drop by drop with constant stirring and black coloured particles are formed. These particles filtered by using whattman filter paper No.1 and wash it twice with 25ml ethanol. Dry it overnight at 50°C in hot air oven. Yellowish brown particles are obtained.

RESULTS AND DISCUSSION

In the present work nano zero valent iron (nZVI) has been synthesized in aqueous medium by the method of $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ reduction with the help of sodium borohydride as a reducing agent under atmospheric condition.

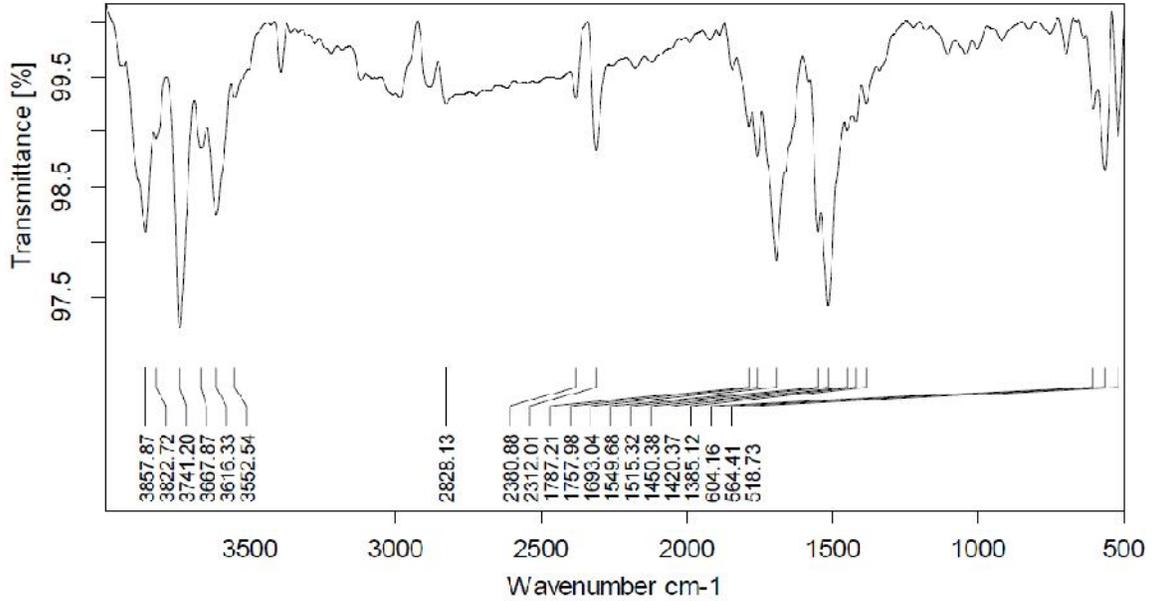


FIGURE 1. FTIR spectrum of nano zero valent iron.

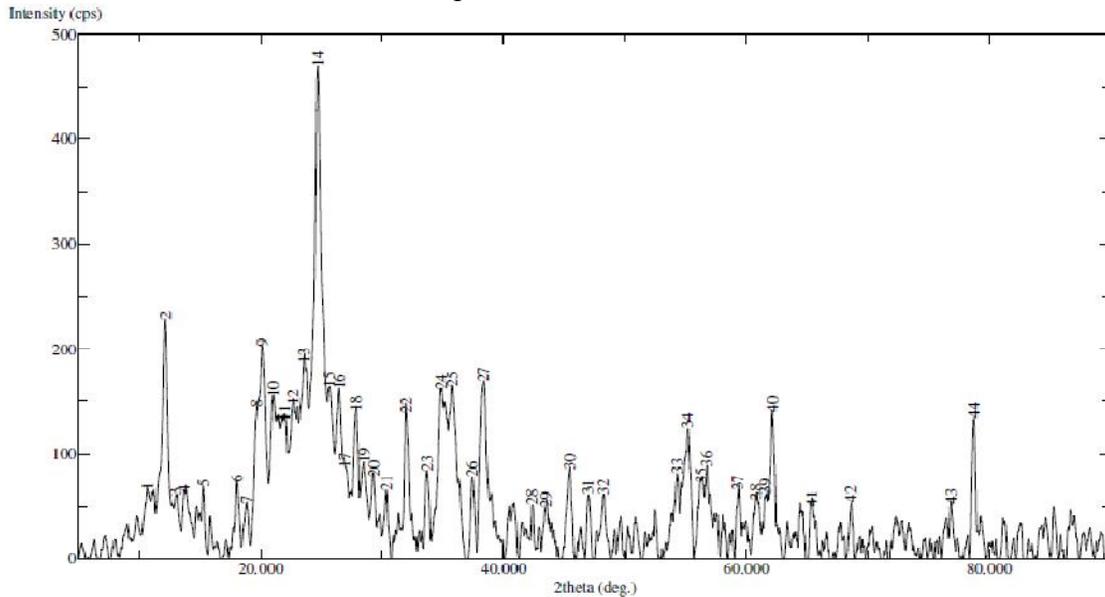


FIGURE 2. XRD spectrum of nano zero valent iron.

A systematic characterization of nZVI has been performed using FTIR and XRD studies. The FTIR spectrum of iron nano particles shown in fig. 1. The broad peak 3741.20cm^{-1} is due to the presence of O-H from alcohol used in washing. 1693.04cm^{-1} may be assigned to H-O-H stretching of deionized water. 518.73cm^{-1} is assigned to zero valent Iron. Fig. 2 shows the powder XRD pattern of nZVI sample under ambient conditions. Formation of nZVI was not found in XRD pattern.

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