Nutrient Value Analysis and Microbial Analysis of Soil to Enhance Site Remediation Process

Praveen. J
PG Scholar, Department of Nanotechnology,
Sri Ramakrishna Engineering College,
Coimbatore 641022,

Jebaselvin. A
PG Scholar, Department of Nanotechnology,
Sri Ramakrishna Engineering College,
Coimbatore 641022

Abstract-Lots **of agricultural sites have been polluted with variety of toxic chemicals, posing serious threat to public health and the environment. Hence a technological revolution is needed to overcome such situation. Emergence of nanotechnology has occurred and the present work deals particularly with synthesis of nanoscale iron particles (NIP) which has provided opportunities to develop innovative site remediation technologies. The reaction of NIP with target halogenated organic contaminants are similar to that of zero-valent iron (iron filings) commonly used in a permeable reactive barrier technology. Due to their small size, NIP can be highly reactive due to their high surface to volume ratio and greater number of reactive sites and higher intrinsic reactivity on reactive sites. In addition, NIP can be injected directly into the contaminated zones, remediation faster and effective. The work also deals with microbial analysis of soil (Black soil and Hill soil) which helps to sort out the whether application of iron is enhanced or retarded by microorganisms present in soil. Characterization techniques such as Ultra Visible Spectroscopy, Dynamic Light Scattering, Fourier Transform Infrared Spectroscopy and X-Ray Diffraction were employed to check out the project progresses on right path.**

Keywords: Agriculture, Microbes, Site remediation, Nanoparticles, soil, Iron particle, Encapsulation.

I. INTRODUCTION

The contribution of agriculture in the national income of India is more, hence, it is said that agriculture in India is the backbone of Indian Economy. Many agricultural products like tea, sugar, oil seeds, tobacco, and spices contribute the major share in export. We are exporting fruits some vegetables and flowers to the other countries. We are exporting basmati rice to foreign countries. The proportion of agricultural goods is to the tune of 50%. In addition to this goods manufactured from agriculture products contribute 20 percent. Thus agriculture contributes 70% in export. Many agriculture produce like food grains, fruits are transported by roadways and railways. It helps in employment of many people in this field. If the agricultural production is good, cultivators will earn more income [1]. They will be in position to Purchase manufactured products and other inputs required in agriculture. In short, we can say that the prosperity of the country will depend upon the prosperity of agriculture.

II. MATERIALS AND METHODS

A. Properties of Iron

Iron is the fourth most common element in the Earth's crust. Iron exists in various oxidation states, −2 to +6, among which +2 and +3 are the most common [9]. Elemental iron occurs in meteoroids and low oxygen environments, but is reactive to oxygen and water. Pure iron is soft and is obtained by smelting. The material is hardened and strengthened by impurities, in particular carbon, from the smelting process. A certain proportion of carbon (between 0.002% and 2.1%) produces steel, which may be up to 1000 times harder than pure iron. Steels and low carbon iron alloys along with other metals (alloy steels) are the most common metals in industrial use, due to their great range of desirable properties and the abundance of iron.

B. Nano Iron Particles (NIP)

NIP can be highly reactive due to their high surface to volume ratio and they also have greater number of reactive sites and higher intrinsic reactivity on reactive sites [11]. Due to their small size, they can be injected into the subsurface to directly react with the contaminants. NIP act as a reducing agent and react with both dissolved oxygen and water. NIP tends to easily agglomerate and settle fast which increases with increase in particle concentration and saturation magnetization. The agglomeration results in losing the unique properties nanoparticles. Quantum effects also influence on the chemical and physical properties of the NIP.

III. SYNTHESIS OF IRON

Liquid-phase reduction and gas phase reduction methods are the most widely employed methods for synthesis of NIP that are used for site remediation purposes. Reduction of iron chloride using sodium borohydride is given by following equation

$$2FeCl_3 + 6NaBH_4 + 18H_2O \downarrow$$

$$2Fe + 6NaCl + 6B(OH)_3 + 21H_2$$

Iron chloride (0.1 N) solution is prepared by dissolving it in water (100 ml) and kept under constant stirring.

Sodium borohydride is added drop wise from burette until the reaction is complete. The moisture content in liquid product is removed by heating in oven. The sample is stored in oxygen less environment. Chelating agents such as EDTA (Ethylene Diamine Tetra Acetate) are added in order to prevent the oxidation process.

TABLE 1
ESSENTIAL ELEMENTS TAKEN UP BY PLANTS

Element	Abbreviation	Form absorbed
Nitrogen	N	NH_4^+ (ammonium) and NO_3^- (nitrate)
Phosphorus	P	$H_2PO_4^-$ and HPO_4^{-2} (orthophosphate)
Potassium	K	K^+
Sulphur	S	SO_4^{-2}(sulphate)
Calcium	Ca	Ca^{+2}
Magnesium	Mg	Mg^{+2}
Iron	Fe	Fe^{+2} (ferrous) and Fe^{+3} (ferric)
Zinc	Zn	Zn^{+2}
Manganese	Mn	Mn^{+2}
Molybdenum	Mo	MoO_4^{-2} (molybdate)
Copper	Cu	Cu^{+2}
Boron	B	H_3BO_3 (boric acid) and $H_2BO_3^-$ (borate)

A. *Calculation*

Normality:

$$\frac{\text{Molarity} * \text{Volume of Solution} * \text{Molecular Eight})}{1000}$$

Molecular Weight of Iron chloride -162
Molecular Wight of Sodium borohydride -38

Weight of iron chloride:

$$\frac{(0.1*100*162)}{1000}$$

Weight of Iron Chloride-1.6g

Weight of sodium borohydride:

$$\frac{(0.1*100*38)}{1000}=0.38g$$

Weight of Iron Chloride-0.38g

IV. ENCAPSULATION

Chitosan of 15 mg is dissolved in 10 ml distilled water. Acetic acid of 21 mg is added to the above solution for stirring. Then separately, the prepared iron sample of 5 mg is dissolved in 2ml of ethanol and Tri poly phosphate (TPP) of 4 mg is dissolved in 4 ml of distilled water. The above two solution separately prepared are added drop wise using syringe i.e. iron solution followed by TPP [15]. The prepared solution is kept for constant stirring and then analysis is carried out.

V. RESULTS AND DISCUSSION

The comparative study between the reference graphs and the graphs obtained ensure that the product formed is iron. The characterization results of UV, DLS, FTIR and XRD are given as follows

A. *Ultra Violet Visible Spectroscopy*

Iron is a metal and the peak value is a result of absorbance. In general Beer Lambertz law is employed to find out the absorbance. Some exceptional cases involve Surface Plasmon Resonance (SPR) where the surface atoms vibration occurs due to incident light. Surface Plasmon Resonance (SPR) is the resonant oscillation of conduction electrons at the interface between a negative and positive permittivity material stimulated by incident light. It is applicable for Ag and Au. The absorbance value of iron synthesized by reduction of iron chloride was is found to be 360nm.

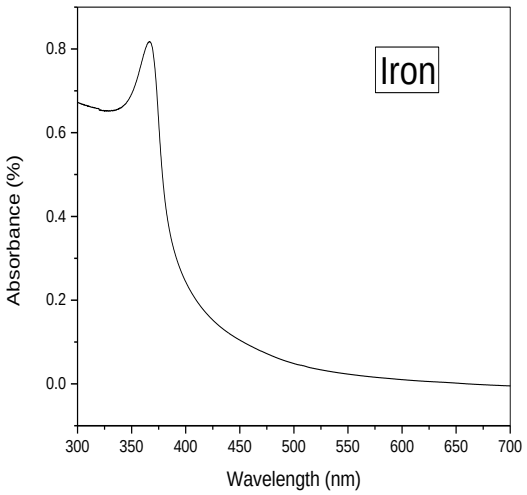

Fig.1 Ultra Violet Visible Spectroscopy (Peak at 330 nm)

B. Dynamic Light Scattering

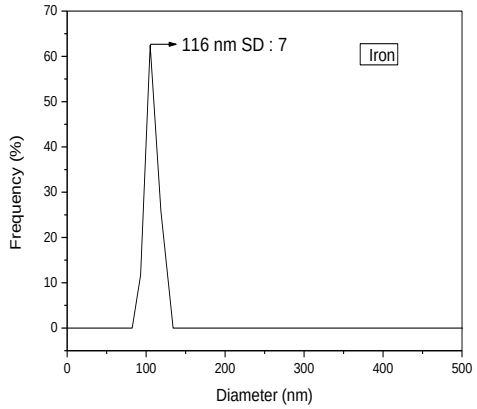

Fig.2 Dynamic Light Scattering (Peak at 116)

Particle size can be determined by measuring the random changes in the intensity of light scattered from a suspension or solution. Particles in the size range of 1 – 100 nm are termed as nano materials. The ion particle size obtained by using reduction of iron chloride by sodium borohydride is found to be 116 nm with standard deviation around 8.

C. Fourier Transform Infrared Spectroscopy

FTIR is a technique for identifying the structural coordination (types of chemical bonds) in the substances such as solids, liquids and gases. The various bonds existing in iron are amide, C–H, O-H and N-H bond. Amide has the formula $C(O)NH_2$ which shows that its derived from ammonia. One hydrogen is being replaced by amine group. A hydrogen bond is electrostatic attraction between polar molecules that occurs when hydrogen (H) atom bound to a highly electronegative atom such as nitrogen (N), oxygen (O) or fluorine (F) experiences attraction to some other nearby highly electronegative atom.

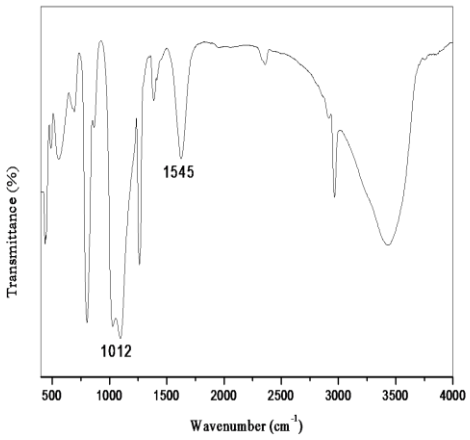

Fig.3 Fourier Transform Infrared Spectroscopy

D. X-Ray Diffractometer

The structure analysis of a compound is well understood when X-ray Diffractometer analysis is done. ICDD (International Centre for Diffraction Data) maintains the particle diffraction data, which are referred with help of JCPDS(Joint Committee on Powder Diffraction Standards). The reference graph peaks are obtained at 110 and 200 planes. The analysis of synthesized powder sample has similar plane peaks which are obtained using Braggs law.

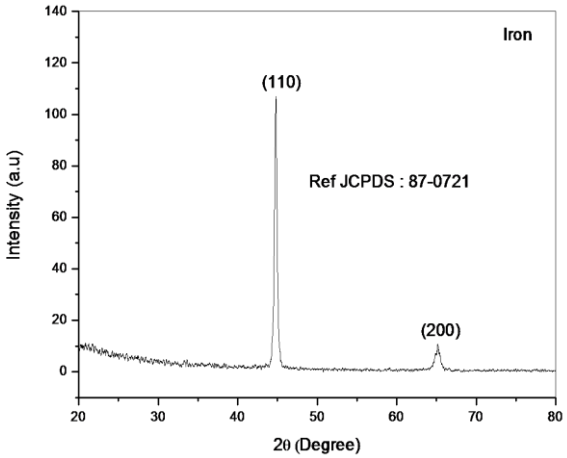

Fig.4 X-Ray Diffraction

VI. CONCLUSION

Nanotechnology provides opportunity in overall scientific development which can be applied to sectors that benefit human beings. The analysis technique that has been done confirms that the particle synthesized is iron. This project deals with the synthesis of iron nano particles and encapsulation, which in future can be applied in the form of nano fertilizers which results in the development of nutritious value of soil.

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