International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2015): 78.96 | Impact Factor (2015): 6.391

Synthesis of Zinc Nanoparticles and Its Application in Treatment of Municipal Water of Anantapur

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Abstract: ***Water is polluted by the industries like construction and mining, food processing from domestic and agricultural wastes and by micro logical agents. There are different methods are worn for purification of water, but these water treatment techniques require large area, high capital investment, operation and maintenance cost. The contamination of water is a major problem in the global consequence. The metal oxide semiconductor like ZnO is capable of in service effectively and efficiently for the water treatment. ZnO nanoparticles are synthesized from direct precipitation method. Zinc nitrate showed best performance, yielding ZnO particles with the smallest average grain size. At optimal conditions, ZnO nanoparticles with average size of 16 nm were obtained. The synthesized ZnO nanoparticles were characterized by scanning electron microscope (SEM), X-ray diffraction (XRD), UV–Vis absorption spectroscopy. After synthesis of ZnO nanoparticles, The ZnO nanoparticles are coated on filter candles by using non-woven fiber. These filter candles are fitted into the equipment of water filteration. The treatment of nanoparticles to the drinking water has been examined by various water testing analysis. The work resulted economically feasible and Environmental freindly in all aspects.***

Keywords: contamination, nanoparticles, direct precipitation, X-ray diffraction, non-woven fiber

1. Introduction

Muncipal water is used for drinking, cooking, cleaning, agriculture, etc. In which only 0.1% is used for the drinking purpose,remaining percentage of water is used for the domestic usage. Recent advances of nanotechnology used for purification water. The nanomaterials used for ZnO has the antibacterial properties. The zinc oxide occurs in a very affluent in variety of structures and offers a wide range of properties. The variety of methods for ZnO production, such as vapour deposition, precipitation in water solution, hydrothermal synthesis, the sol-gel process, precipitation from micro emulsions and mechano chemical processes, makes it possible to obtain products with particles differing in shape, size and spatial structure. ZnO is having the high surface area, Due to this property ZnO used as water treatment.

2. Synthesis of ZnO nanoparticles

ZnO nanoparticles were synthesized by direct precipitation method using zinc nitrate hexa hydrate and KOH as precursors brought for SL SCIENTIFICS. In this work, the aqueous solution (0.2M) of zinc nitrate (Zn(NO3)2.6H2O) and the solution(0.4 M) of KOH were prepared with deionized water, respectively. The KOH solution was slowly added into zinc nitrate solution at room temperature under vigorous stirring, which resulted in the formation of a white suspension. The white product was centrifuged at 5000 rpm for 20 min and washed three times with distilled water, and washed with absolute alcohol at last. The obtained product was calcined at 500 °C in air atmosphere for 3 hr.

2.1. Processing of zinc oxide nanoparticles coated fiber glass mat:

The synthesized ZnO nanoparticles are mixed with the distilled water, the colloidal solution of ZnO nanoparticles with water is obtained. Then the prepared solution is poured into the spray bottle. By using the spray bottle, the nanoparticles are sprayed on the fiberglass mat. The nanoparticles are stick to the surface of the fiber glassmat. Then the fiber glassmate is encircled on the ceramic filter candle. After nano particle coated filter candles are fix them into water purifier.

2.2. Water sample analysis of Municipal water:

After the synthesis of Zinc Oxide nanoparticles. The particles were coated onto candles with fiber glass .then the filters were dried at Room temperature for a period of 12Hrs.the obtained filters were used as nano filter candles that are used for the treatment of Municipal tap water . After the process treatment which was treated in double store tank. After the process the treated water was used for the analysis of the samples taken and to to check the presence of minerals and acids that's leads to the cause of ill health.

2.3. Desiging the purifier:

Figure5:fiber glass mate

Figure6:ceramic candles

Figure7:ZnO coated ceramic candles

Figure8:Double store tank

3. Results and Discussions

3.1. Characterization of ZnO

3.1.1. UV-Visible spectroscopy

The UV-Vis spectrum showed absorption band at 324 nm. The band-gap energy obtained was 3.32 eV.

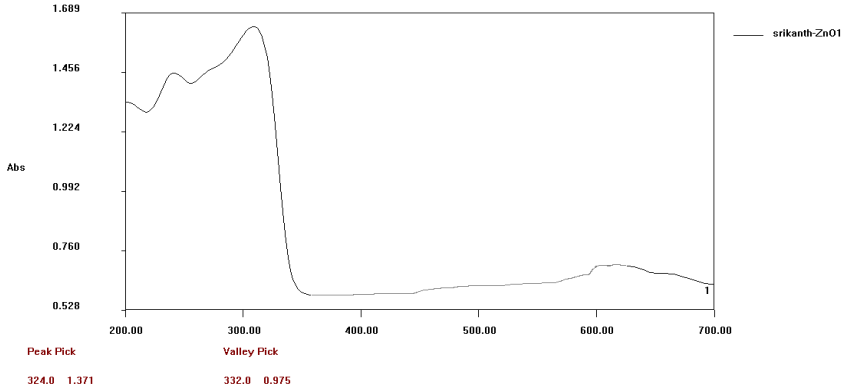

Figure 1: UV-visible spectroscopy of ZnO nanoparticles

3.1.2. FTIR analysis

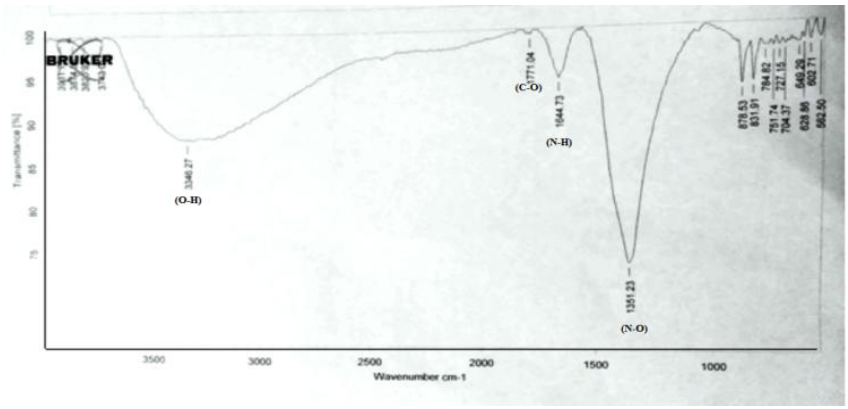

Figure 2: Fourier transform infrared spectroscopy result of ZnO nanoparticles

The O-H and C-O stretch bands are observed at 3346.27cm^{-1} and 1771.04cm^{-1}.The N-H and N-O stretch bands are observed at 1644.73cm^{-1} and 1351.23cm^{-1}

3.1.3. XRD analysis

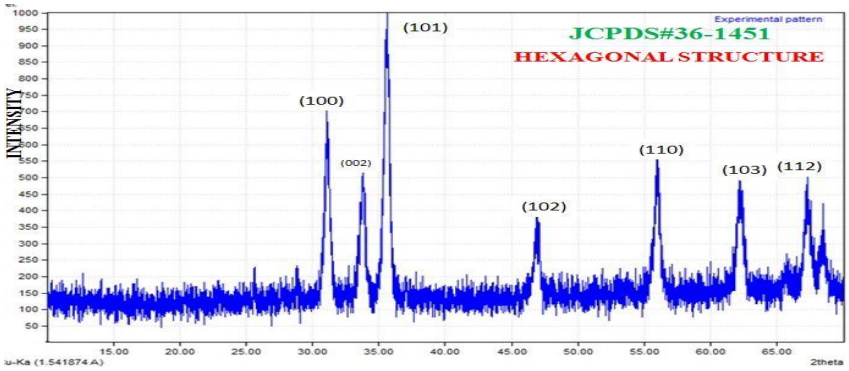

Figure 3: XRD pattern of ZnO nanoparticles

XRD patterns are matching with JCPDS 36-1451 resembling hexagonal wurtzite structure Crystalline size obtained was 20.9 nm using Scherer's equation. The peaks at 2θ = 31.67°, 34.31°, 36.14°, 47.40°, 56.52°, 62.73°, 66.28°, 67.91°, 69.03°, and 72.48° were assigned to (100), (002), (101), (102), (110), (103), (200), (112), (201), and (004) of ZnO NPs.

3.1.4. Water experimental analysis

Volumetric analysis	Normal water	Before ZnO coating water sample	After ZnO coating water sample
pH	8	8.3	7.5
TDS	531	507	188
mineral acidity(mg/l)	50	40	28
Phenolphthalein acidity(mg/l)	60	40	18
Phenolphthalein alkalinity(mg/l)	86	80	70
total alkalinity(mg/l)	480	400	290

4. Conclusions

ZnO nanoparticles are prepared by direct precipitation method having 20.9nm.The UV-Vis spectroscopic study shows confirmed the reduction of metal ion and formation of nanoparticles with peak at 324 nm. The XRD analysis shows that ZnO nanoparticles are having Hexagonal Wurzite structure.TDS values less than the 300ppm is desirable for drinking and the pH value is near to 7.The acidity is closed to 10mg/l and the alkalinity is less than the 200mg/l, this water is desirable for drinking

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