

Synthesis and Characterization of Co_3O_4 Nanomaterial and Study Their Application Antimicrobial Activity and Photocatalytic Degradation Studies

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Mr.Roshan Madhukar Kolhe .
(M.sc Physical chemistry)

Abstract

The method dye by using Co₃O₄ nanopartical technique Co₃O₄ nanopartical photocatalytical degradation studies where carried out the Rosaline Dihydrochloride dye use Co₃O₄ nano partical . In aqese parameter pH adsouerber optimize the density also find out this component.

CHAPTER 1

INTRODUCTION

This research paper are regarding to nanotechnology it use as last technology effluent in order to PH to sanitize colored contaminated waste of dye reduce the risk of environmental pollution . semiconductor surface is crucial method advance process mineralization .

Oxidation a photo catalysis pollutant research nanoparticle their electromagnetic properties study and also study Antimicrobial activity . The dye method are use photocatalysis .Now a day the advance use dye .It has minimization process use to remove contaminated material to remove this method. These use photo catalytically nano composite

The present work is new and simple method for removal and recovery of Rosaaniline Hydrochloride dye by use Co_3O_4 Nano composite as catalyst photo catalytically degradation is carried out and also study the Nanostructure material .Investigate technology .In recent year crystal metal oxide because of their large surface area unusual adsorptive properties surface defect and fast diffusivities, heterogeneous catalytically material and magnetic material 5. Due to their size nonpartical exhibit novel material properties that are significant different from those.

Degradation kinetics of Rosaaniline Hydrochloride on Co_3O_4 nano composite. The method e present work deals with the development of new for the removal of dye aqueous solution by using Co_3O_4 magnetic nanocomposite

The Co_3O_4 nanopartical were synthesized by chemical Co-precipitation .The structure morphology and magnetic properties of as prepared were characterized by X-ray diffraction technique . Co_3O_4 nanoparticalphotocatalytical degradation studies were carried out the Rossaaniline Hydrochloride dye by using CO_3O_4 nano particle in aquese solution .different parameter like catalyst dose contact time pH , and absorbance have been studied to optimize reaction condition .

CHAPTER 2

SYNTHESIS OF NANOPARTICAL : CO₃O₄ MATERIAL

- 1) 0.01M Cobalt Nitrate = 2.910gm Co(NO₃)₃.9H₂O
- 2) 0.02M Cobalt sulphate = 5.622 CoSO₄.H₂O
- 3) Distilled water = 80 ml
- 4) 1:1 Ammonium solution

➤ *PROCEDURE-*

Co₃O₄ nanomaterial preparation method of Co₃O₄ of Co(NO₃)₃.9H₂O & CoSO₄.H₂O as 1:2 in this experiment Co(NO₃)₃.9H₂O dissolve after stirring 80 °c then slowly added 1:1 ammonia up to pH 11 Co₃O₄ are ppt form then after all procedure are completed nanopartical



Fig 1:- Co₃O₄ Nano partical

CHAPTER 3

PHOTOCATALYTICAL DEGRADATION

Photocatalytical Degradation of Rossaaniline Hydrochloride dye by using Co_3O_4 as catalyst. Information about Rossaaniline Hydrochloride dye

A colorless crystal organic base, $\text{C}_{20}\text{H}_{21}\text{N}_3\text{O}$ or more of these base's yellow-brown or green crystalline Hydrochloride salt which form red solution in water derived from aniline & use in the manufacture of fuchsine & other dyes & in Schiff's reagent .

❖ *Experimental Work*

➤ **PART- 1**

Prepare different type of ppm solution of dye with Co_3O_4 nano particles using as a catalyst dissolve both 100ml distilled water and check the absorbance of the solution using Spectrophotometer .then keep all the solution in direct sun light about 2 hrs at time of atmosphere is more after 2hr check the absorbance of all solution of dye and observe the changes .

➤ **PART-2**

After doing above processes the solution which is having absorbance is chosen for the preparation of solution keep the quantity of dye as it is and changes the quantity of Co_3O_4 nanoparticle dissolve in 100 ml water and dye solution .I kept it again indirect sunlight for 2 hr and check the absorbance .I have done the photo- catalytical degradation of Rossaaniline Hydrochloride dye using Co_3O_4 .

Preparation of Different ppm solution of Rossaaniline Hydrochloride dye

- 1) 10 ppm solution - 1ml Rossaaniline Hydrochloride dye+0.1gm Co_3O_4 +100ml distilled water
- 2) 20 ppm solution -2ml Rossaaniline Hydrochloride dye+0.1gm Co_3O_4 +100ml distilled water
- 3) 30ppm solution -3ml Rossaaniline Hydrochloride dye+0.1gm Co_3O_4 +100ml distilled water
- 4) 40 ppm solution- 4ml Rossaaniline Hydrochloride dye+0.1gm Co_3O_4 +100ml distilled water
- 5) 50ppm solution -5ml Rossaaniline Hydrochloride dye+0.1gm Co_3O_4 +100ml distilled water
- 6) 60 ppm solution- 6ml Rossaaniline Hydrochloride dye+0.1gm Co_3O_4 +100ml distilled water
- 7) 70ppm solution -7ml Rossaaniline Hydrochloride dye+0.1gm Co_3O_4 +100ml distilled water
- 8) 80 ppm solution- 8ml Rossaaniline Hydrochloride dye+0.1gm Co_3O_4 +100ml distilled water
- 9) 90 ppm solution -9ml Rossaaniline Hydrochloride dye+0.1gm Co_3O_4 +100ml distilled water

10) 100ppm solution- 10ml Rossaaniline Hydrochloride dye+0.1gm Co₃O₄ +100ml distilled water

Part -1 OBSERVATION TABLE

WAVELENGTH -460

DIFFERENT TYPE OF PPM SOLUTION DYE + CATAYST	ABSOURBANCE (INITIAL ABSOURBANCE)	ABSOURBANCE (FINAL ABSOURBANCE)
10 PPM	0.983	0.190
20PPM	1.055	0.330
30 PPM	1.129	0.540
40PPM	1.184	0.710
50 PPM	1.240	0.970
60 PPM	1.256	1.029
70 PPM	1.263	1.057
80PPM	1.289	1.069
90 PPM	1.296	1.082
100 PPM	1.303	1.092

Table 1

➤ *Photocatalytical Degradation*



Fig 2:- Before Degradation (Co3O4)

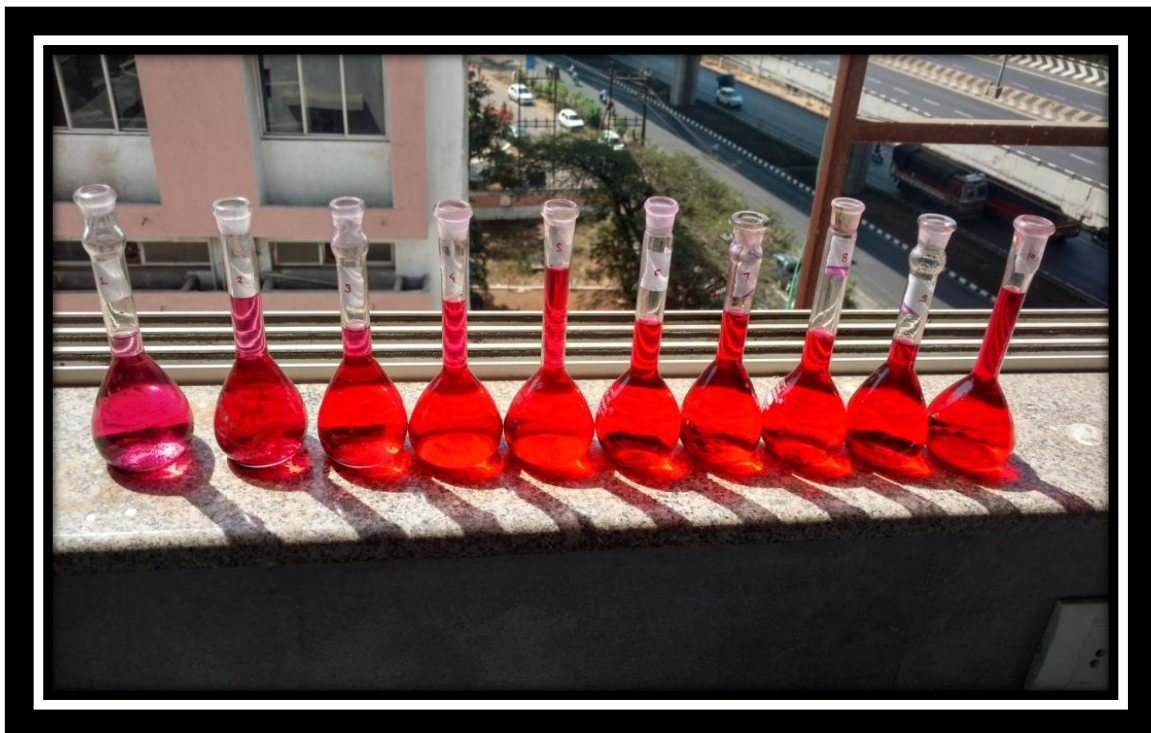


Fig 3:- After degradation (Co3O4)

➤ *PART-2*

After completion the above processes choose that solution which is having high absorbance i.e 100ppm solution which is having high absorbance make the 100ppm solution of dye with variable quantity of catalyst for further process

❖ *SOLUTION PREPARATION*

1) 100 PPM SOLUTION -10ml Rossaaniline Hydrochloride dye +0.1 gm Co₃O₄ nanoparticles +100ml Distilled water

2) 100 PPM SOLUTION -10ml Rossaaniline Hydrochloride dye +0.2gm Co₃O₄ nanoparticles +100ml Distilled water

3) 100 PPM SOLUTION -10ml Rossaaniline Hydrochloride dye +0.3 gm Co₃O₄ nanoparticles +100ml Distilled water

4) 1100 PPM SOLUTION -0ml Rossaaniline Hydrochloride dye +0.4 gm Co₃O₄ nanoparticles +100ml Distilled water

5) 100 PPM SOLUTION -10ml Rossaaniline Hydrochloride dye +0.5 gm Co₃O₄ nanoparticles +100ml Distilled water

6) 100 PPM SOLUTION -10ml Rossaaniline Hydrochloride dye +0.6 gm Co₃O₄ nanoparticles +100ml Distilled water

➤ *PART -2 OBSERVATION TABLE*

Wavelength -460nm

CONSTANT PPM SOLUTION WITH DIFFERENT QUNTITY OF CATALYST	ABSOURBANCE (INITIAL ABSOURBANCE	ABSOURBANCE (FINAL ABSOURBANCE)
100 PPM+0.1gm Co3O4	1.902	1.784
100PPM+0.2gm Co3O4	1.890	1.785
100 PPM +0.3gm Co3O4	1.859	1.797
100 PPM+ 0.4gm Co3O4	1.712	1.655
100 PPM +0.5gm Co3O4	1.605	1.570
100PPM +0.6gm Co3O4	1.583	1.563

Table 2

➤ *Photocatalytic degradation*



Fig 4:- Before degradation – Co_3O_4



Fig 5:- After degradation – Co_3O_4

Graph of removal of dye % Removal of dye is carried out by using following

$$\% \text{Removal} = \frac{A_i - A_f}{A_i}$$

Where

A_i = Initial absorbance

A_f = final absorbance

➤ *GRAPH OF CONC. OF DYE MG/LIT VS %OF DEGRADATION OF DYE*

IS SHOW AS FOLLOW

set- 1

Rossaaniline Hydrochloride & Co₃O₄

WAVELENGTH -460 nm

PPM	% REMVOAL
10	0.399
20	0.689
30	0.521
40	0.400
50	0.210
60	0.180
70	0.163
80	0.170
90	0.165
100	0.161

Table 3

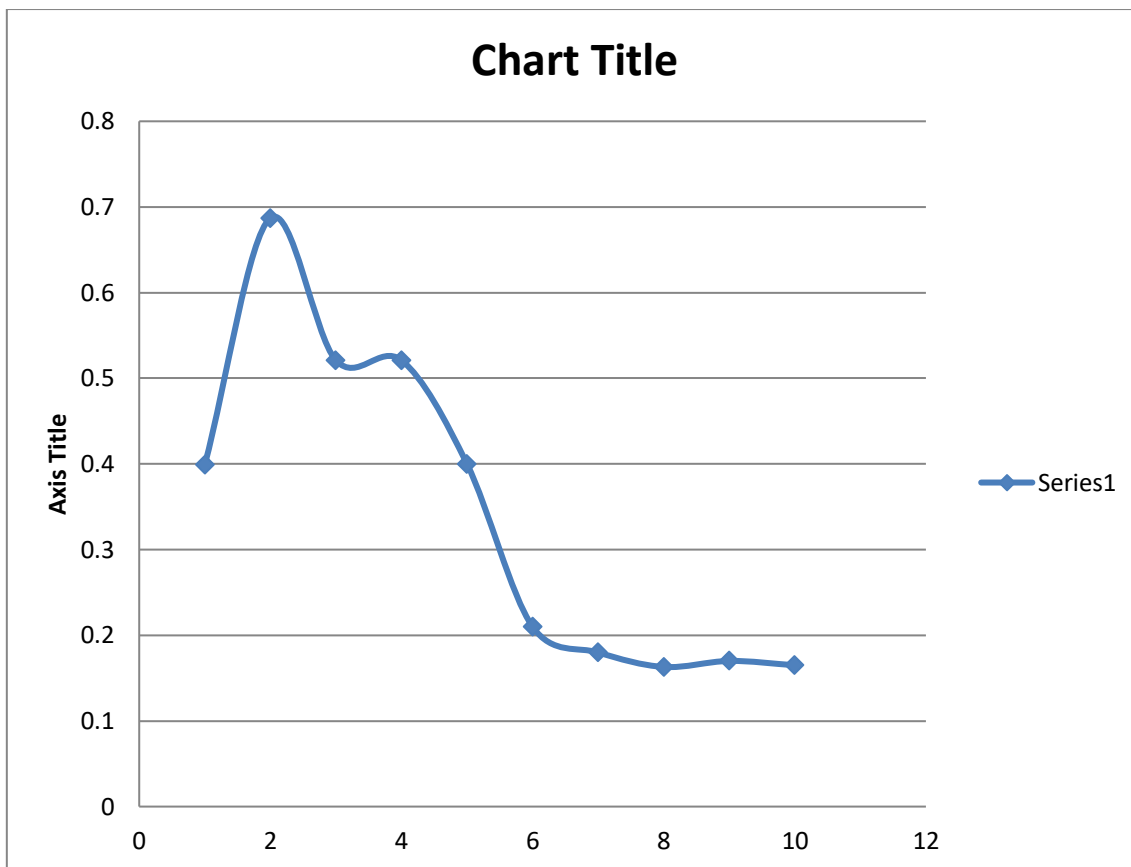


Fig 6

set- 2

Rossaaniline Hydrochloride & Co3O4

WAVELENGTH -460 nm

AMOUNT OF Co3O4 WITH 100PPM	% REMOVAL
0.1	0.062
0.2	0.055
0.3	0.033
0.4	0.032
0.5	0.021
0.6	0.012

Table 4

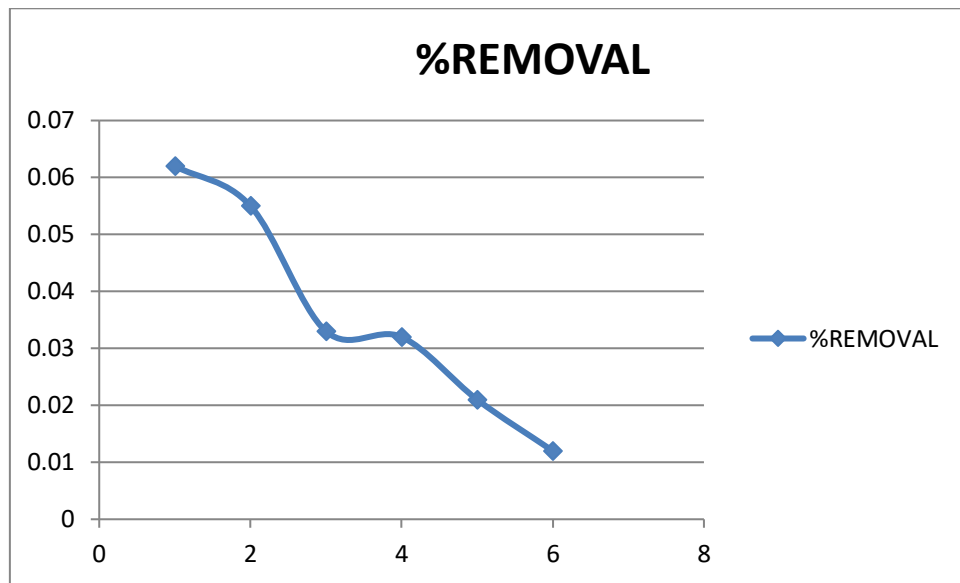


Fig 7

➤ *Result Of Photocatalytical Degridation*

SR.No	DEGRIDATION	% of Removal
1	SET -1	20%=0.689
2	SET-2	0.1=0.62

Table 5

CHAPTER 4

DENSITY

In general, nanoparticle of Co_3O_4 are denser than water. The magnitude of ρ , in the case of nanoparticle depends upon the constituent of cation and anion. For the instance, the ρ value of nanoparticle varies with % concentration the density of comparable ionic liquid increases with increase in concentration.

Further, the density of nanoparticle also depends upon the mass. Normally of nanoparticle varies in the range of 1.22 to 1.33 at room temperature.



Fig 8:- Gravity bottle

➤ *Observation*

The empty weight of gravity bottle (W_2) = 17.18gm

Sr No	Percentage of solution	Weight of gravity bottle of solution	$W_2 - W_1$	Density = mass/volume
1	1%	29.380	12.2	1.22
2	2%	29.710	12.5	1.25
3	3%	30.130	12.9	1.29
4	4%	30.270	13.09	1.30
5	5%	30.540	13.3	1.33

Table 6:- Observation Table

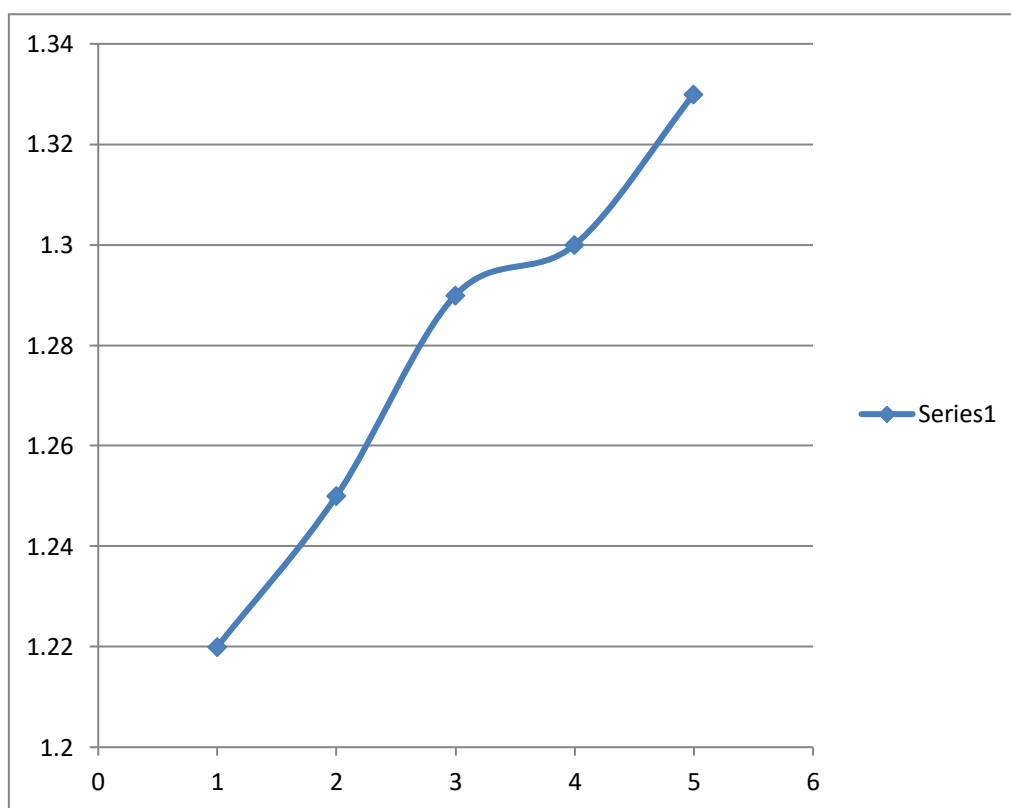


Fig 9:- Graph of density

CHAPTER 5

STUDY OF ANTIMICROBIAL ACTIVITY OF NANO PARTICAL

➤ *PREPARATION OF THE NUTRIENT GROWTH CULTURE*

The nutrient agar is prepared which solidified after cooling is poured in Petri plate with the condition along with these microorganism are poured on the nutrient agar solution then separation are made

By making the small portion of filter paper with the help of machine the small portion of filter are dipped in perception solution which was then placed inside the petriplates in which the agar solution was already poured

After this plate were incubated for 24 hr and result as summarized

➤ *BIOASSYS*

Bioassay is important and crucial in evaluation of bioactivity of compound and helpful .In the present work all derivative have been for their anti microbial activities against different bacteria like as Pseudomonas ,S.aurios& E –coile

>Microbial activity of the nano composites solution

> Microorganism use is

1)Pseudomonas

2) S.aurios

3)E-coile

>labelling of the sample

➤ *Result and Discussion of the Test Microbial Test :*

As microbe use example of E-coile which is found in our body intestine which is pathogen organism cause urinary tract infection

B) All result are positive .that zone of inhibition was absent ,suggestion that above nano composite can inhibited growth of microorganism

The microbial testing was done by making two or four quadrant in petriplatewhich as show in the following figure

➤ Antimicrobial activtie's photo

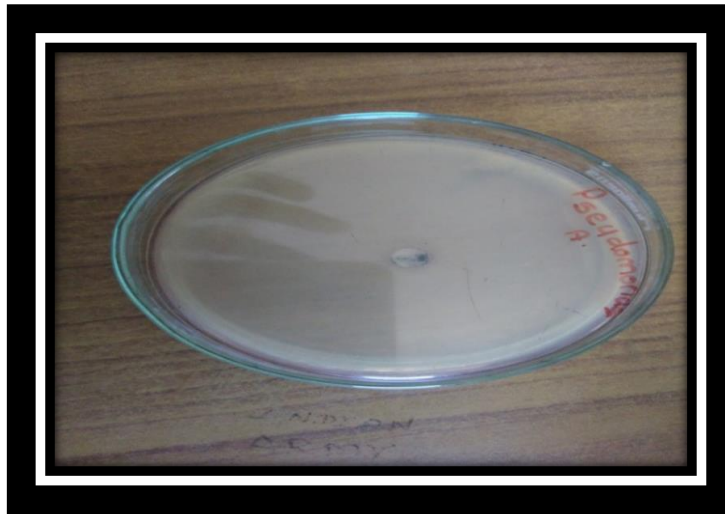


Fig 10:- S.Aurios

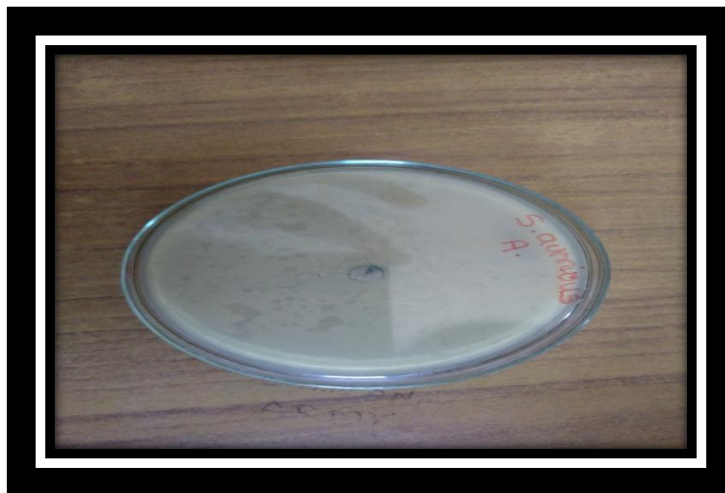


Fig 11:- Pseudomonas

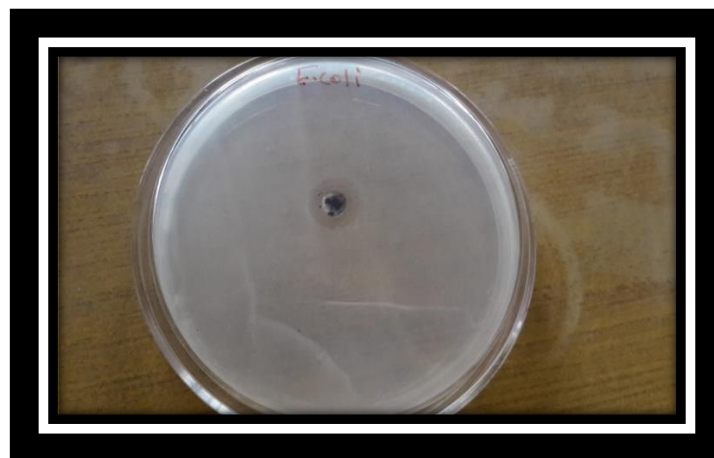


Fig 12:- E-coile

CHAPTER 6

STUDY OF X-RAY DIFFRACTION

The X-Ray diffraction are use study the size of nano particle diffract meter alpha radiation corresponding atom occure electron atom scater center distance wave length 100pm exit from atom occure diffraction wave imping.

X-ray production maximum RD

Produce position an type term crystal intestines provide structure it electron atom structure information .

The scattering radiation with wave length of about 100pm from the crystal give rise to diffraction interprecipation pattern atomic size are finding the x- ray graph

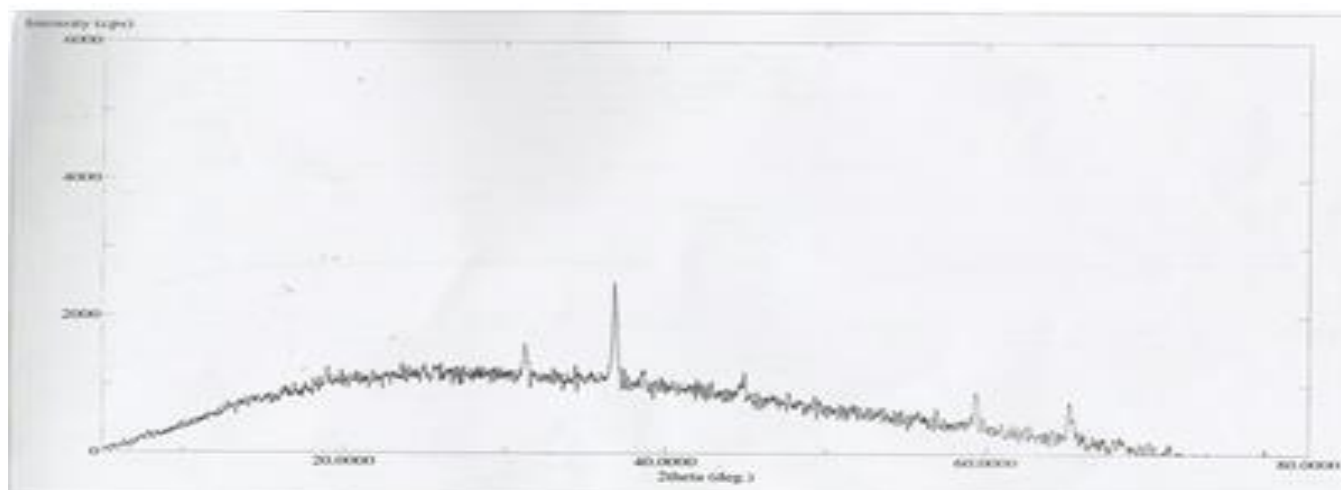


Fig 13

=Radiation of wavelength

=FWHM(full width half wave maxima)

=Bragg angle in degree

=Particle size

Particle size of cobalt oxide (nanopartical)=25.36 nm

These size is determine at 25 C temperature

Calculate the size of nanopatical by using Scherer formula = $D = K\lambda / (\beta \cos\theta)$

➤ *SEM*

Scanning electron microscopy

Scanning electron microscopy unit It exhibit that the growth sample consist of spherical grains having more space as pore . this seen the exact size of particl .

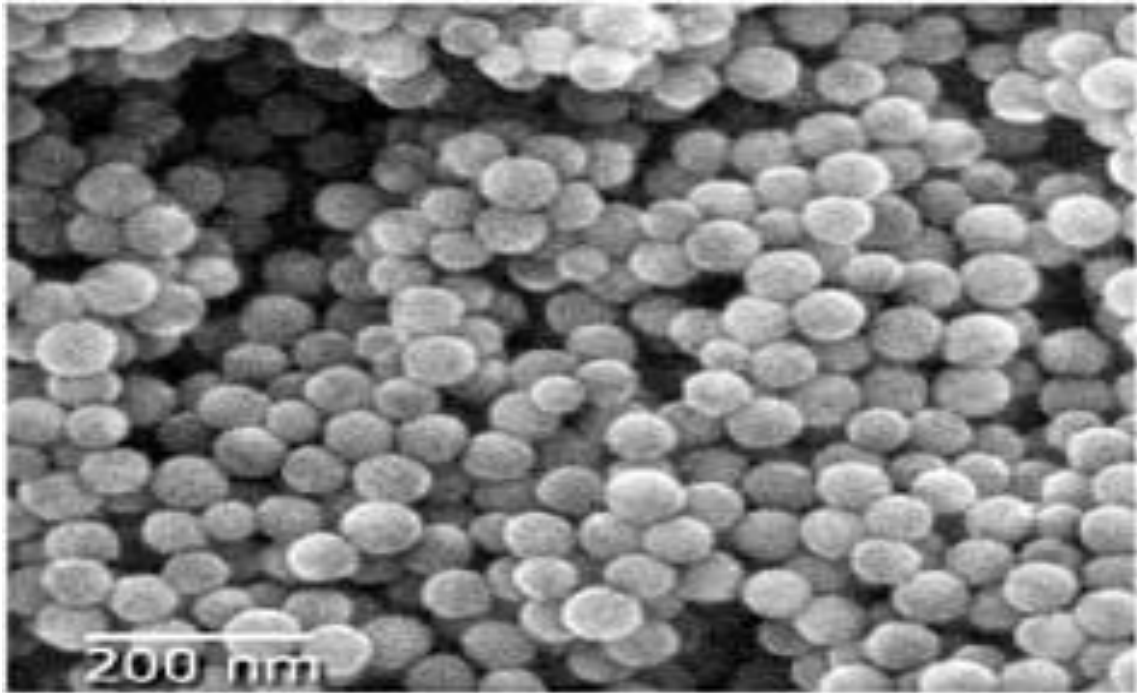


Fig 14

➤ *ELECTRON DISPERSIVE X-RAY SPECTROSCOPY (EDS) Scanning electron microscopy*

Inter action of electron beam with sample target produce a variety of emission .An energy dispersive(EDS) detector is used to separated the characteristics X-ray of element into an energy spectrum and EDS system software is used to analyzed the energy spectrum in order to determine the abundance of specific element .EDS can be used to find out the chemical composition of material down to a spot size of a few micron and to create the chemical composiELECTRON DISPERSIVE X-RAY SPECTROSCOPY (EDS) Scanning electron microscopy.

➤ *ANALYSIS*

tion of material down spot size of a few micron and to create element composition map over a much bordered raster area .Together these capabilities provide fundamental composition information for wide Variety of material .

CHAPTER 7

APPLICATION

- 1) From waste water : This nanoparticle are use as removing of water impurity .
- 2) Other use include: A catalyst in the manufacture of allyl alcohol ceramics colored glass in biosensors, coating plastics nano wire nanofiber and textiles
- 3) As a magnetic nanoparticle for magnetic data storage and magnetic resonance imaging .
- 4) The Co_3O_4 is magnetic nanoparticle uses in micro- batteries and specific alloy and catalyst application
- 5) Also micro electronics ,superconductor, electronics –ceramics ,electro chromic devices .
- 6) Both the technology and economic importance of photo catalyst has increase considerably over the past decade .Improvement in performance have been strongly correlated to advance in

CHAPTER 8

RESULT & CONCLUSION

Colour of the Rosaaniline Hydrochloride dye solution changes after degradation it become intense in colure

Absorbance of the solution with increases with catalyst (Co_3O_4) concentrated .

The antimicrobial activity of (Co_3O_4) nanopartical is all result are positive .

X-RD study that the average size was ...10.....nm in the co-precipitation method of cobalt oxide nanopartical at 25 C temperature the explore eco friendly high efficient nanopartical prepare .

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