WASTEWATER PURIFICATION USING NANOPARTICLE

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Abstract- Clean water that is free of toxic chemicals and pathogens is essential to human health. In countries such as India, 80% of the diseases are due to bacterial contamination of drinking water. The World Health Organization recommended that any water intended for drinking should contain fecal and total coliform counts of 0, in any 100 mL sample. When either of these groups of bacteria is encountered in a sample, immediate investigative action should be taken.The antibacterial potential of Magnesium oxide nanoparticle was detected by well diffusion method. Different concentrations of the nanoparticle were analysed by MIC and antibacterial effect. The MIC result reveals that MgO nanoparticle showed maximum inhibition at a concentration of 0.1 g/ml against *E.coli*. On comparing bactericidal activity it was observed that there was a continuous decrease in the number of colonies with the increase in concentration of MgO nanoparticle. Based on MIC results antibacterial activity of MgO nanoparticle was tested on water sample which was contaminated with *E.coli*culture. The growth of bacteria is completely inhibited when higher concentration (0.1 g /ml) of MgO nanoparticle was added in to 100 ml of water sample with 5ml of *E.coli*culture. Therefore from the above studies conducted, it can be inferred that the MgO nanoparticle has significant bactericidal activity, and overall may be more effective in the purification of water sample.

Keywords: MgOnanoparticle ,E.coli,fecal,coliform, MIC,toxic chemicals,pathogens, Purification,drinking water,bacteria

Introduction

Today most of the countries are facing drinking water problems and conditions are very severe especially in developing countries. The world is facing formidable challenges in meeting rising demands of clean water as the available supplies of freshwater are depleting due to (i) extended droughts, (ii) population growth, (iii) more stringent health based regulations and(iv) competing demands from a variety of users. Research is underway to use advance nanotechnology in water purification for safe drinking. Nanotechnology, the deliberate manipulation of matter at size scales of less than 100 nm, holds the promise of creating new materials and devices which take advantage of unique phenomena realized at those length scales, because of their high reactivity due to the large surface to volume ratio. Nanoparticles are expected to play a crucial role in water purification. The environmental fate and toxicity of a material are critical issues in materials selection and design for water purification. In this study,

magnesium oxide with consistent particle sizes would be obtained from sol-gel method. Commonly, compared to the conventional methods sol-gel technique show much better surface of bulk properties. It is not only easy in term of experimental setup, but also relatively cost effective than others. Different synthesis methods would give different sizes and morphologies of MgO. It is well known that their size and morphology are strongly affect the properties of magnesium oxide such as optical, chemicals, mechanicals and electrical. There two factors could be optimized by controlling the annealing temperature and the concentration of gelling agent.

Various sizes and morphologies of MgO powders-

According to the previous research, different sizes and morphologies of magnesiumoxide nanomaterial were obtained. It is agreed that MgO prepared by different routes has different surface morphologies and properties and thus catalytic activity and selectivity may vary; other factors, such as heating temperature, treatment times, pH, gelling agent, and the atmosphere in which the substance is heated affect greatly the activity of the final products. Many different synthetic routes provide nanoscaleMgO including sol-gel, hydrothermal, flame spray pyrolysis, laser vaporization, chemical gas phase deposition, combustion aerosol synthesis, aqueous wet chemical and surfactant methods (Khairallah and Glisenti, 2007).Different methods of synthesis will give different sizes and morphologies of MgO.Size and morphology of the MgO are "key" for each application.

Preparation o fMgO nanoparticle-Reagents

Magnesium Nitrate Hexahydrade [Mg(NO2)(H2O)6] and Sodium Hydroxide (NaOH) powder of AR grade of high purity (LOBA Chemicals) used in this work. The distilled water and Ethanol (AR grade 99.9% purity) used as a solvent and washing reagent in the chemical reaction respectively

PROCEDURE

1.Initially the Magnesium Nitrate Hexahydrade of wt. 5.21 gm (0.2 M) and dissolved in 200ml of distilled water.

2.The 0.8 gm (0.2 M) of NaOH in 200ml distilled water. Then 200ml of NaOH solution is added in solution of [Mg(NO2)(H2O)6] drop-wise by using glass rod.

3.After that, solution kept under magnetic stirring for 2 h after stirring the solution was kept on table at rest for 2 h so that, the precipitation is formed at the bottom of beaker.

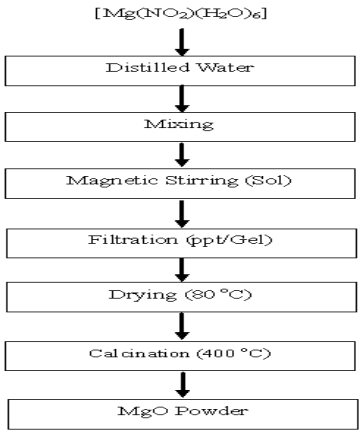
4. This precipitation was filtered and washed several times by using distilled water and Ethanol so as to get the final products.

5.The final product is kept in vacuum oven (Quality Make, India) at 80 °C for 4 h for drying product and removing the moisture.

6.This dried powder is then crush and make it very fine powder by using mortal pestle.

7.Finally the fine powder of MgO is calcinated at 400 oC for 3 h for the removal of impurities present in the powder.

8.So that we will get synthesized MgO possessed high crystallinity with the particle size in nanosized range.



Antibacterial Effect of Magnesium Oxide Nanoparticle on Water Contaminated

5.1Antibacterial activity studies

Antibacterial activity of MgO nanoparticles was evaluated against the Gram-negative bacteria *Escherichia coli* by well diffusion method . A loopfull of *E. coli* was grown overnight in nutrient Broth (NB) at 37o C for 24 h and after incubation 0.01ml of culture was inoculated in nutrient agar by spread plate technique and wells were made to add different concentrations of MgO nanoparticles (1, 2, 5 10, 20, 50 and 100 mg/ml).

The antibacterial activity of the MgO nanoparticle was evaluated by examining the zone of inhibition of bacterial growth and control was maintained by inoculating only *E.coli*culture without any nanoparticle and kept for incubation. And the antibacterial sensitivity is measured as zone of inhibition in mm in diameter

5.2Minimum inhibitory concentration (MIC)

Various concentrations (40,60,80 and 100 mg/ml) of MgO nanoparticles were prepared and added into series of test tubes containing 5ml of sterilized nutrient broth and 0.1ml of *E.coli*culture and allowed to grow overnight at 37o c for 24h. Pathogen alone with nutrient broth was kept as control and they were examined for inhibition studies. MIC was the lowest concentration of the nanoparticle that did not permit any visible growth of bacteria. CFU was calculated by subculturing the above (MIC) serial dilutions after 24 h in nutrient agar petriplates using 0.01ml loop and incubated at 37o c for 24h

5.3Effect of MgO nanoparticle on water sample

A loopful of *E. coli* was grown overnight in nutrient broth at 37oC with shaking until late log phase. then 5ml of bacteria was transferred into 100 ml of water sample and then maintained as negative control. To determine the antibacterial activity of MgO nanoparticle in water sample, 0.1g/ml of nanoparticle was inoculated in 100 ml of water sample inoculated with 5 ml of *E.coli*culture To assay for the viability of the bacteria with and without MgO nanoparticle 0.1ml of inoculum was spread from test tube before and after adding MgO nanoparticle onto the surface of

nutrient agar plates and incubated at 37oC for 24 h.

MIC Results of MgO nanoparticle against E.coli

Effect of MgO nanoparticle on water sample plate 1 (MgO + E.coli)showsno growth & Plate 2 (without MgO + E.coli)cultivated in NA media shows Mat growth

RESULTS AND DISCUSSION

Antibacterial activity of Magnesium oxide nanoparticle against *E.coli*was tested by well diffusion method[8] In preliminary studies the MgO nanoparticle with concentrations of 1,2,5,and 10 mg/ml didn't show any antibacterial effect. And the plates with the concentration of 20 and 50 mg/ml had shown 2 and 10 mm zone of inhibition and it is represented in table 1. Then the concentration of MgO nanoparticle was increased to 0.1 g/ml which had shown 35 mm zone of inhibition on the growth of bacteria as seen in fig 1. Various concentrations of MgO nanoparticle (40,60,80 and 100 mg/ml) were examined for inhibition studies to determine the minimum inhibitory concentration (MIC). No. of colonies was counted by subculturing the MIC serial dilutions and its effect on bacterial growth is shown in Figure 2 and table 2. In both negative control (only *E.coli*culture with out any nanoparticle) and 40mg/ml, mat growth was observed on agar plates. No. of colonies appeared in 60, 80 and 100mg/ml are 50, 10 and 2 respectively. On comparing it was observed that there was a continuous decrease in the number of colonies with the increase in concentration of MgO nanoparticle. The MIC of MgOnanoparticle from fig.1 appeared to be 100mg/ml against *E.coli*.

MgO NPs have the advantage of being prepared from the readily available and economical precursors and solvents. So they have considerable potential as a solid bactericidal material under simple conditions. They have ability to prevent biofilm formation of common pathogens. MgO nanoparticles show biocidal activity by damaging the cellwall of bacteria or is commonly attributed to the production of reactive oxygen species (ROS). These nanoparticles have already proven their antibacterial effect against different organisms[3]

MgO nanoparticles exhibit bacteriocidal activity which is highly dependent on the particle size and concentration. They are effective against both Gram positive and Gram negative organisms. These nanoparticles are harmless to mammalian cells and the environment. MgO NPs can be used in combination with other antibacterial substances which can be valuable. In the area of water purification, MgO nanoparticles give promising

results by removal of both chemical and biological substances.

Antibacterial activity of MgO nanoparticles in different concentrations Against *E.coli in mg/ml*

Concentration Of MgO nanoparticle (mg/ml)	**Zone of Inhibition (mm) in diameter**
1	-
2	-
5	-
10	-
20	2.2
50	10
100	35

MIC results of MgO nanoparticle against E.coli determined by viable count method

Concentration of MgOnanoparticals (mg/l)	**NO. Of colonies**
Control(*E.coli*) without nanoparticle	Mat growth
40mg/ml	Mat growth
60 mg/ml	50
80 mg/ml	10
100mg/ml	2

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