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PREPARATION OF MAGNESIUM HYDROXIDE NANOPARTICLES FROM BITTERN

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Abstract

Magnesium hydroxide is an important material with high decomposition temperature. It is the important precursor for magnesium oxide. In the present study, nanoparticles of magnesium hydroxide were prepared from bittern. Bittern is the waste liquid formed during the production of salt. Since it is rich in magnesium, magnesium hydroxide nanoparticles can be prepared. The nanoparticles were characterized by SEM, EDS and TG-DTA.

Keywords: Bittern, magnesium hydroxide, nanoparticles, chemical precipitation process, precipitator.

INTRODUCTION

The production of common salt is one of the most ancient and widely distributed industries in the world[1]. Salt is produced mainly by solar evaporation of sea water, lake and subsoil brines in the salt-pans[2]. The left-out mother liquor after the separation of sodium chloride at 29.5°Be is called 'bittern'. It is the high density residual liquor removed from the crystallizers after harvesting of the salt. It contains most of the dissolved elements in the sea water at a more concentrated level[3]. This bittern is subsequently used up in the manufacture of epsom salt and magnesium carbonate which are predominantly magnesium compounds.[4] The elevated magnesium and potassium levels give the bittern its bitter taste. Since it is rich in magnesium, magnesium hydroxide nanoparticles can be prepared. Magnesium hydroxide nanoparticles with fiber like morphology were prepared by chemical precipitation process, using bittern from the salt-pans of Tuticorin district.

Magnesium hydroxide is an important inorganic material and has been widely used as neutralizing agent,[5] flame retardant, smoke suppressant, desulphurizing agent and decolourizing agent.[6]Magnesium hydroxide is very popular environmental friendly and thermally stable flame-retardant filler in composite materials. It has high decomposition temperature and good effects on depressing smoke. Magnesium hydroxide nanoparticles has favourable high flame retardant efficiency.[7] It is also used to neutralize acidic waste streams and gases rich in sulphuric oxides, as anti-acid excipient in pharmaceutics, in pulp and paper industry, as fertilizer additive, and the important precursor for magnesium oxide.

MATERIALS AND METHODS

In order to eliminate the influence of Ca2+ on the precipitation process, sodium sulphate, was added to bittern solution with continuous agitation at 50°C. Ca2+ ion was precipitated into $Ca(OH)_2$ and was removed from the bittern solution. The precipitation process was carried out in a three-necked bottle in water bath at 20°C. 10 ml of absolute alcohol and 8 ml complex solution of gelatin and lauryl sodium sulphate were added. Then 25% ammonia water was injected into the three-necked bottle at the discharge of 2 ml per minute with vigorous stirring of 1000 r/min. The pH was monitored and maintained at 10 during the precipitation process. The suspension was filtered and washed using dilute ammonia water to remove other impure ions, such as Na+, K+, Cl- and NH4+. The $Mg\ (OH)_2$ nanopowders were obtained after dried at 70°C for 24 hours in vacuum oven and grinded.

RESULTS AND DISCUSSION

The amount of magnesium hydroxide nanoparticles obtained from 100 ml of bittern was found to be 2.18 g.

COMPOSITION OF BITTERN

The composition of the main elements in bittern from the salt-pans such as chloride, sulphate, calcium, magnesium, sodium and potassium were determined by standard procedures[8]. Concentration of copper, manganese, iron and zinc were determined by atomic absorption spectrophotometer. (Table 1)

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Table 1: Composition of bittern

Elements	Percentage
Chloride	29.80
Sulphate	3.33
Calcium	0.05
Magnesium	3.70
Sodium	0.91
Potassium	0.08

Characterization of $Mg(OH)_2$ nanopowder

The sample was characterized by JOEL Model JSM-6390 LB Scanning Electron Microscope and the morphology of the Mg(OH)2 nanopowder was observed. EDS spectrum was recorded. TG-DTA curve of sample was also recorded.

SEM analysis

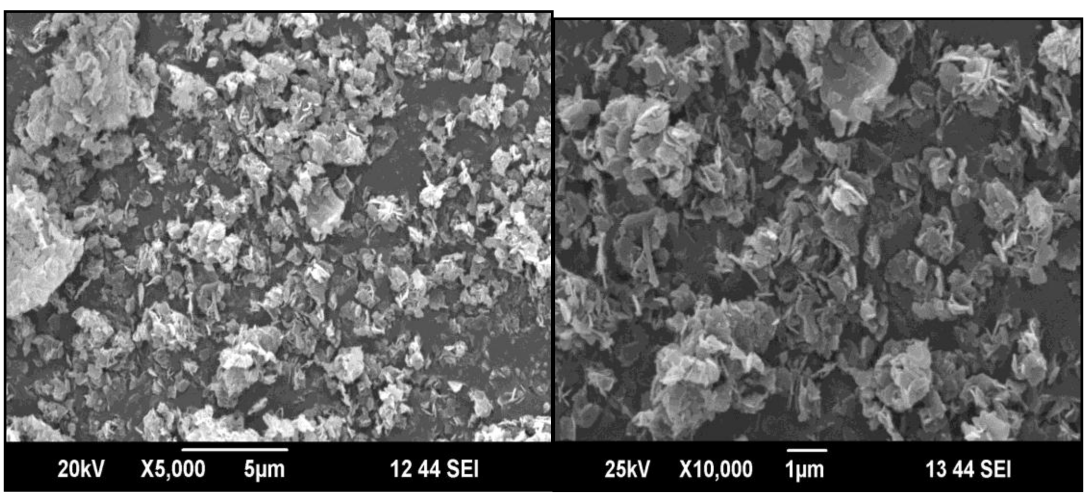
The clear SEM image of magnesium hydroxide nanoparticles was obtained after 15,000 times resolution, from which particles with size of 59 nm was obtained. The shape of the particles is irregular. These particles filled with polymers can improve the flame retardant property and toughness of the compounds. (Fig 1)

EDS spectrum

The EDS spectrum recorded between X-ray energy and number of counts shows the presence of magnesium and oxygen. This confirms the presence of magnesium hydroxide nanoparticles. (Fig 2)

TG-DTA analysis

Magnesium hydroxide has high decomposition temperature and is a non-toxic and smoke suppressing additive as flame retardant polymeric material. About 8.1% of the sample is predicted to be loss of adhesive water and crystal water below 248°C. The decomposition process of magnesium hydroxide to magnesium oxide begins at about 359.6°C and the strongest endothermic peak appears at 396.7°C. The rate of mass loss from 91.9 % at 396.7°C to 63.3 % at 435.4°C indicates that the decomposition process has mostly ended. (Fig 3)



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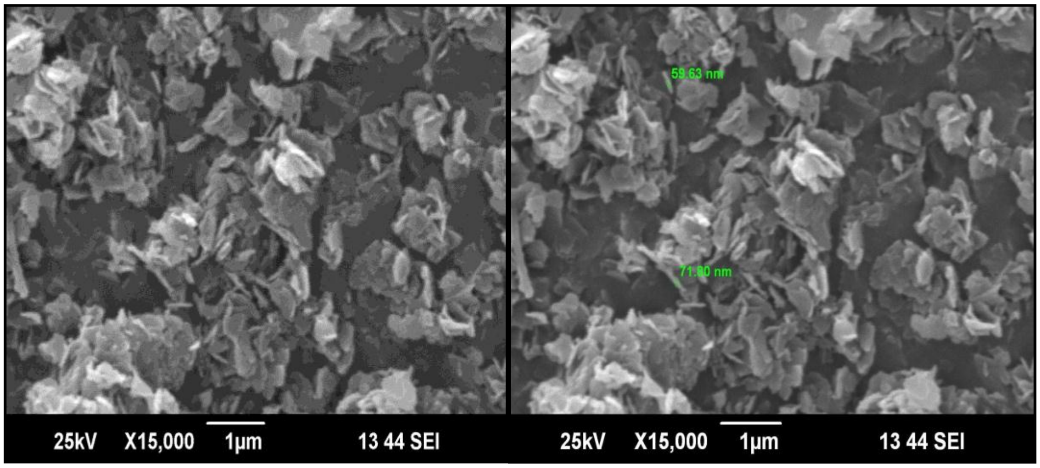

Figure 1: SEM image of Magnesium hydroxide nanoparticles showing the particle size

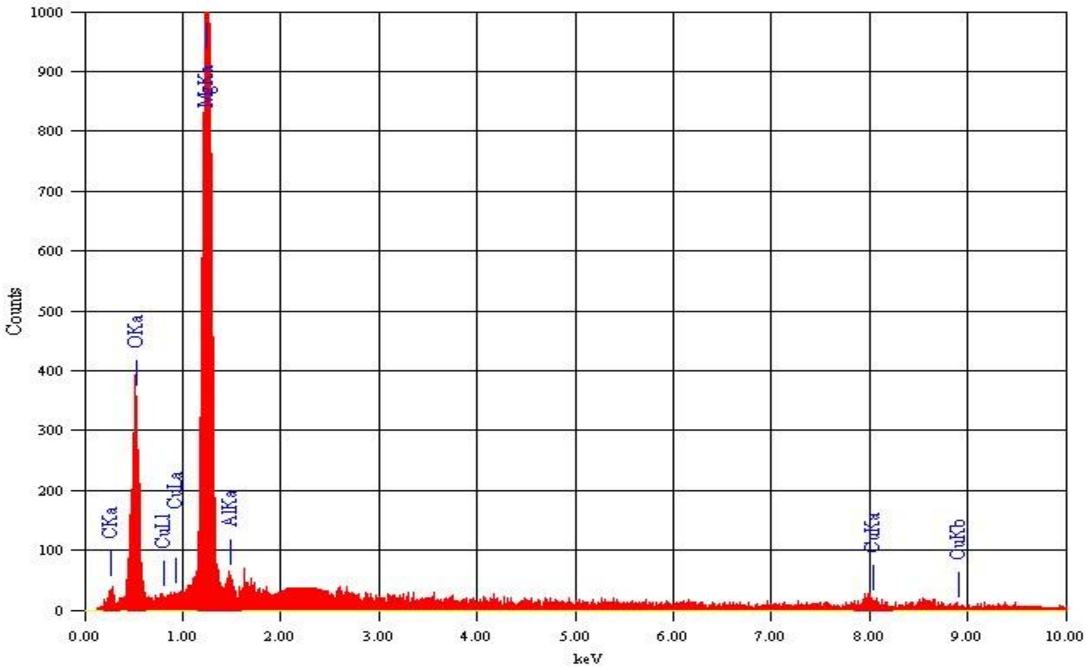

Figure 2: EDS spectrum of Magnesium hydroxide nanoparticles

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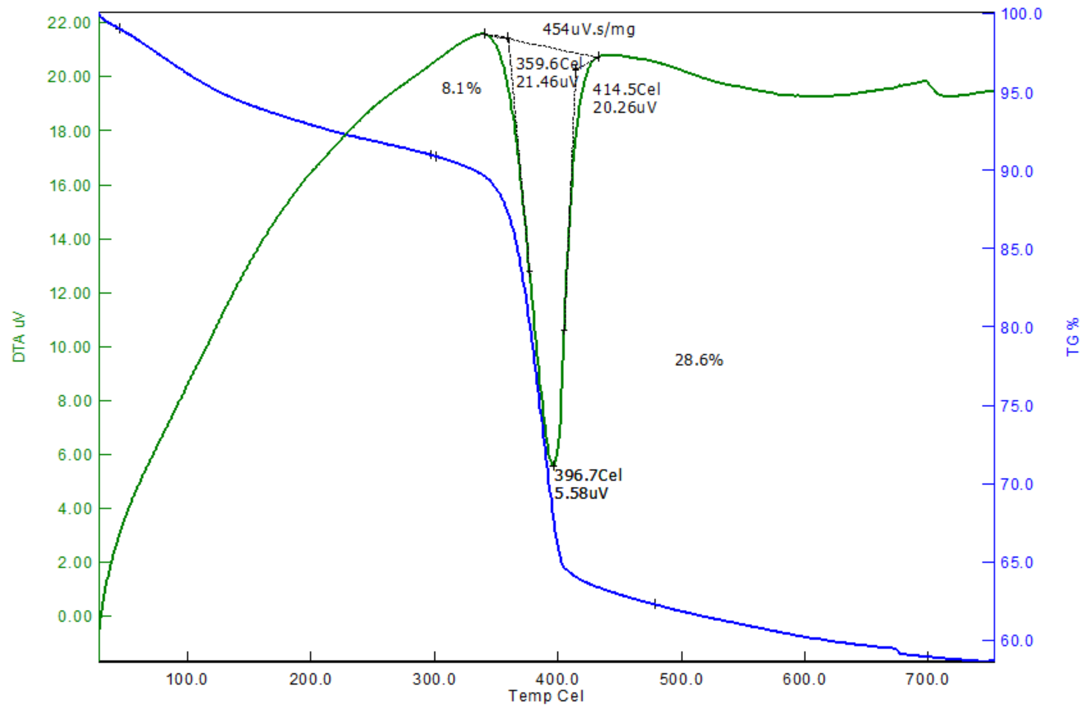

Figure 3: TG-DTA curves of magnesium hydroxide nanoparticles

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