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SHORT REPORT

Applications of Alumina Nanoparticles from Coal Fly Ash

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In this research**,** coal fly ash samples collected from Tigypt Power Plant located in Pinlaung Township, Taunggyi District in Shan State, Myanmar were studied. The power plant is the only operating coal-fired power station in Myanmar. Power plant is a complex of structures, machinery, and associated equipment for generating electric energy from another source of energy and is also called generating station, power station. Alumina nanoparticles were obtained at 1000°C for 3 hours. Prepared alumina nanoparticles from coal fly ash were used to treat wastewater samples collected from textile workshop in Inle Lake, Southern Shan State.

Fly ashes (FAs) are the major combustion residues (normally 60-88%) produced during the burning of pulverized coal in thermo-electric power stations (TPSs) and collected by the cleaning equipments of fuel emissions (commonly electrostatic precipitators). Ash which does not rise is termed bottom ash.[1] Fly ash is generally captured by electrostatic precipitators. There is wide range of variation in the principal constituents - silica (25-60%), alumina (10-30%) and ferric oxide (5-25%). When the sum of these three principal constituents is 70% or more and reactive calcium oxide is less than 10%, technically the fly ash is considered as siliceous fly ash or class F fly ash. If the sum of these three constituent is equal to or more than 50% and reactive calcium oxide is not less than 10%, fly ash will be considered as calcareous, also called as class C fly ash.[2] Four classes of nanoscale materials, being evaluated as functional materials for water purification include (i) dendrimers (ii) metal-containing nanoparticles (iii) zeolites, and (iv) carbonaceous nanomaterials. These have a broad range of physicochemical properties that make them particular attractive as separation and reactive media for water purification.[3]

The aim was to present the application of alumina nanoparticles from coal fly ash. Objectives were to prepare alumina nanoparticles from coal fly ash by using alkaline leaching sintering method, to characterize alumina nanoparticles by using XRD (X-ray Diffraction technique), FTIR (Fourier Transform Infrared Spectrometer), SEM (Scanning Electron Microscope) and FE SEM techniques (Field Emission Scanning Electron Microscope) and to carry out some applications (adsorption properties, gas sensor applications and antimicrobial activity) of prepared alumina nanoparticles.

Fifty milliliters of waste water samples were taken out and centrifuged for 15 minutes and alumina nanoparticles from coal fly ash were added and stirred for 1 hour at room temperature. The concentrations of Cu, Zn and Cd in supernatant solutions were measured by atomic absorption spectrophotometer (AAS). Alumina nanoparticles 0.5 g were mixed with 5% polyvinyl acetate binder well and pasted on the interdigitated electrodes (IDEs). Alumina coated electrodes were dried at 150°C for 2 hours.

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Copper, zinc and cadmium contents in waste water samples were found to be 0.12, 0.15 and 0.17, ppm, respectively, before treatment. After treatment with alumina nanoparticles for 2 hours, copper, zinc and cadmium contents were found to be 0.060, 0.009 and 0.0054 ppm, respectively.

It was found that the removal percentages of copper, zinc and cadmium were 95.50%, 94% and 67.70%, respectively. Among these three metal ions, the highest removal percent was found in copper.

In this work, effect of pH and time of coal fly ash on metal removal were carried out. Prepared alumina nanoparticles were used for the removal of Cu (II), Zn (II) and Cd (II) ions from aqueous solutions at different pH values and temperatures. By the increase of pH the removal efficiency of alumina nanoparticles from coal fly ash increased for elimination of Zn (II) ion.

The removal percentages of Zn (II) at pH 3 were found less effective than at pH 5 and 7. Among the three cations, the removal percentage of Cu (II) ion was found to be the highest at pH 7. It was found that the maximum adsorption of Cu (II) were observed, and followed by Zn (II)) and Cd (II) metal cations in aqueous solution are found in their hydrated forms. It was observed that the smaller hydrated diameter of Cu (II), the more adsorption properties pronounced and better than those of Zn (II) and Cd (II). Therefore, it was found that the low adsorption of Zn (II) and Cd (II) ions was observed compared with adsorption of Cu (II).

Gas sensor applications of alumina nano-particles were investigated by using ammonia gas to observe the response of gas in sensing properties. The gas sensor testing system was designed to test sensor by a static environment method and fixed volume (1.18 L). The changes of resistance were measured by using multimeter of type U 1232 A True RMS with Keysight Handheld Meter logger Software. In addition, it was found that Al_2O_3 sensor can detect the much smaller concentration of ammonia gas. According to the results, Al_2O_3 sensor is more suitable for ammonia gas. Gas sensing properties of Al_2O_3 sensor were tested with ammonia gas by using 8.47ppm, 16.94 ppm and 32.45 ppm, respectively. According to experiment, the resistance of alumina sensor decreased when contacted with air ammonia gas mixture. The response and recovery times were about 220 s, 130 s for 8.47 ppm, 455 s and 200 s for 16.94 ppm and 560s and 630s for 32.45 ppm, respectively.

Alumina nanoparticles showed remarkable anti-microbial activity against both gram-positive and gram-negative bacteria.[5] The inhibition zones of alumina nanoparticles against tested microbes show *Bacillus subtilis* (40 mm), *Staphylococcus aureus* (35 mm), *Pseudomonas aeruginosa* (30mm), *B. pumilius* (40 mm), *Candida albicans* (50 mm) and *E. coli* (33 mm), respectively. It was observed that the maximum anti-microbial activity of alumina nanoparticles was found on *Candida albicans* and its maximum inhibition zone diameter was shown to be 50 mm.

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