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Comparison of Alkali Modified Fly Ash and Alkali Activated Fly Ash as Zn(II) Ions Adsorbent from Aqueous Solution

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Abstract

Fly ash which is solid waste can be used as an adsorbent for wastewater treatment. Alkali modification and alkali activation on fly ash can increase the adsorption capacity of fly ash. In this study, alkali modified fly ash and alkali activated fly ash were used as Zn(II) ions adsorbents. The effect of adsorption time and initial concentration of Zn(II) ions was studied, as well as the kinetics and isotherm adsorption. The results showed that the removal efficiency of Zn(II) ions by alkali activated fly ash is higher than that by alkali modified fly ash. The adsorptions of Zn(II) ions by alkali modified fly ash and by alkali activated fly ash have reached equilibrium after two hours. The increase of initial concentration of Zn(II) ions would decrease the removal efficiency with both alkali modified fly ash and alkali activated fly ash. Adsorptions of Zn(II) ions by both alkali modified fly ash and alkali

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Comparison of Alkali Modified Fly Ash and Alkali Activated Fly Ash as Zn(II) Ions Adsorbent from Aqueous Solution

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Abstract:
Fly ash which is solid waste can be used as an adsorbent for wastewater treatment. Alkali modification and alkali activation on fly ash can increase the adsorption capacity of fly ash. In this study, alkali modified fly ash and alkali activated fly ash were used as Zn(II) ions adsorbents. The effect of adsorption time and initial concentration of Zn(II) ions was studied, as well as the kinetics and isotherm adsorption. The results showed that the removal efficiency of Zn(II) ions by alkali activated fly ash is higher than that by alkali modified fly ash. The adsorptions of Zn(II) ions by alkali modified fly ash and by alkali activated fly ash have reached equilibrium after two hours. The increase of initial concentration of Zn(II) ions would decrease the removal efficiency with both alkali modified fly ash and alkali activated fly ash. Adsorptions of Zn(II) ions by both alkali modified fly ash and alkali activated fly ash tend to follow pseudo second order kinetics model and Langmuir isotherm model with maximum adsorption capacity of 62.696 mg/g and 66.667 mg/g, respectively.
Keywords*: Adsorption; Alkali modified fly ash; Alkali activated fly ash; Zn(II) ions.*

1. Introduction

The use of coal as energy source by combustion process produces fly ash as solid waste. Fly ash, generally collected by electrostatic precipitator, can be utilized rather than disposed of. Common utilizations of fly ash are for soil amendment, road and pavement construction, concrete and cement production, zeolite and geopolymer production, adsorbent for wastewater treatment, etc. [1-3]. Adsorption is one of the most widely method used in wastewater treatment. Compared to other methods such as chemical precipitation, electrochemical treatment, ion exchange, ultra filtration, and reverse osmosis, adsorption has advantages namely simple, flexible, efficient, and low cost [4,5].

In its application as adsorbent, the origin (type of coal, combustion condition) and chemical treatment of fly ash affect its adsorption capacity [6,7]. Chemical treatment of fly ash can be done by modification using an alkali solution, lime or magnetite. These modifications can increase surface area resulting in increased adsorption capacity of heavy metals [8-12]. Meanwhile, activation of fly ash with a mixture of alkali solution and alkali silicate solution commonly referred to as geopolymerization process, can transform fly ash into an amorphous three-dimensional structure [13]. Alkali activated fly ash has been widely used as adsorbent for heavy metals and dyes [14,15].

In this study, alkali modification and alkali activation are applied on fly ash before being used as Zn(II) ions adsorbent. The presence of Zn(II) ions at certain level in water can

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Effect of $Y_3Al_5O_{12}$ Addition on the Microstructural Evaluation and Mechanical Properties of Spark Plasma Sintered ZrB_2-SiC Composites

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Abstract:
In the present study, the addition of $Y_3Al_5O_{12}$ (YAG) into the ZrB_2-SiC composites was investigated. Composites were densified by spark plasma sintering (SPS) at 1850ºC under a uniaxial pressure of 50 MPa for 20 min. Microstructural evaluation and mechanical properties were evaluated with a various content of YAG (1-5 wt%). Obtained results showed that sintering mechanism changed from solid state to liquid phase sintering with incorporation of YAG. The highest density (99.81 % RD) and fracture toughness (6.44 ± 0.23 $MPa.m^{1/2}$) were obtained for the composite containing 5 wt% YAG after the SPS process. Although hardness and elastic modulus of samples were decreased with the increasing of YAG amount, measured values were comparable with the literature.
Keywords*: YAG; ZrB_2-SiC; UHTC; SPS.*

1. Introduction

Belonging to the family of Ultra-High Temperature Ceramics (UHTCs), ZrB_2 and HfB_2 have exclusive physical, mechanical, and chemical properties, like high melting temperature, high strength and hardness, high thermal and electrical conductivity and high chemical stability [1-3]. Due to these unique properties, these materials are potential candidates for high-temperature structural applications like propulsion systems, rocket nozzles, sharp leading edges and nose cones for re-entry and hypersonic vehicles. In order to be maneuverable at hypersonic velocities, sharp leading edges and nose cones are required to control surfaces. If low radius leading edges are designed, maneuverability will be higher. However, the formation of much greater aerothermal heating, leading edges part may reach higher temperatures (> 2000°C) during re-entry [4, 5]. The currently used materials will not resist such extreme temperatures and more stable materials are required for use in this type of high-temperature application. In the earlier studies [6-12], ZrB_2-SiC and HfB_2-SiC composites have come to the forefront under these extreme conditions due to their high strength and high stability. Recently, yttrium and aluminum based additives including Al_2O_3, Y_2O_3 have been successfully used to improve the sinterability of ZrB_2, forming a liquid phase or removal of surface oxides. In addition to sinterability, it has been stated that these additions played an important role in improving mechanical properties and oxidation resistance [13-20]. YAG gel-coated ZrB_2-SiC composites were prepared by pressureless sintering by He et al. [15]. Obtained results showed that 97 % relative density was achieved with coated YAG

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Physico-Chemical and Mechanical Properties of Geopolymer/Zircon Composites

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Abstract:

The effect of zircon ($ZrSiO_4$) on the physico-chemical and mechanical properties of geopolymer/zircon composites was examined in this study. Four geopolymer/zircon composites containing 10, 20, 30 and 40 wt.% zircon were prepared from metakaolin with alkali activators. Characterization of the obtained geopolymers was performed by X-ray diffraction (XRD), Scanning electron microscope (SEM-EDS), Fourier transform infrared spectroscopy (FTIR) and Matrix-assisted laser desorption ionization time-of-flight mass spectrometry (MALDI-TOF). XRD results did not confirmed the formation of interconnected phases between added zircon, starting aluminum silicates and alkali activators. Compressive strength of prepared geopolymer was examined. The maximum obtained compressive strength of 70.15 MPa was measured in sample containing the smallest fraction of zircon, i.e., 10 wt.%. Addition of larger amount of zircon (20 wt.%) hinders the progress of geopolymerization reaction and consequently decreases compressive strength.

***Keywords**: Metakaolin; Zircon; Inorganic polymer; Compressive strength; MALDI-TOF.*

1. Introduction

Zircon ($ZrSiO_4$) is known to be a good refractory material that is widely used in the steel industry. It shows excellent chemical stability and resistance to thermal shock owing to the very low coefficient of thermal expansion (~4.1 x 10^{-6}/K) and low coefficient of thermal conductivity which was found to be 5.1 W/m^{o}C at room temperature and 3.5 W/m^{o}C at 1000^{o}C. In addition, high purity sintered zircon retains its bending strength up to temperature as high as 1400^{o}C [1-3]. These properties make zircon a promising structural ceramics for application where sudden temperature changes are expected. Zircon is tetragonal crystal which contains certain trace elements including mainly hafnium, phosphor, yttrium, uranium, and lanthanides [4,5]. It has been used for improving the mechanical and thermal properties of refractory materials owing to its good chemical stability and other favourable properties [6]. Geopolymers are ecological materials, which belong to a group of inorganic polymers, novel

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