การเสนอผลงานทางวิชาการระดับนานาชาติ

(นำเสนอแบบปากเปล่า Oral presentation)

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24/06/2008

Dear Pusit Pookmanee,

You are most welcome to attend the ISHA event at Nottingham in September 8-10th 2008.

We are currently working out who will present and at what level, but you are certainly invited to give an oral presentation at this, the first ISHA meeting (formally joint ICSTR-ISHR meetings).

Your abstract entitled " **Adsorption of some Heavy Metals on Natural and Modified Diatomite**" will be well received with the audience we are anticipating from around the world.

I anticipate that you will be visiting the UK covering with dates covering the week of the conference.

Sincerely,

Ed Lester
Conference Organiser
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Adsorption of some Heavy Metals on Natural and Modified Diatomite

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Adsorption of some heavy metal ions from standard solutions by natural and modified diatomite was investigated. Natural diatomite was modified by hydrothermal method with 1M hydrochloric acid at 100 °C for 1h then adjusted to pH 3 and 7. Natural and modified diatomite were investigated by scanning electron microscopy (SEM) and Brunauer-Emmett-Teller (BET) surface area. The particle was generally cylindrical in shape with the average particle size of 10 μm in width and 15 μm in length. The specific BET surface area and average pore size of the natural, modified diatomite at pH 3 and 7 were 54.3, 51.2 and 55.7 m^2/g and 54.3, 52.9 and 54.8 Å, respectively. The adsorption of cadmium, lead, copper and zinc ions from standard solutions were determined by atomic absorption spectroscopy (AAS). The percentage adsorption range of metal ions on modified diatomite at pH 7 was higher than natural and modified diatomite at pH 3, respectively.

Keywords: Natural diatomite, modified diatomite, hydrothermal method, SEM, BET, AAS

การเสนอผลงานทางวิชาการระดับนานาชาติ

(นำเสนอแบบโปสเตอร์ Poster presentation)

The 5th Eco-Energy and Materials Science and Engineering Symposium (5th EMSES)
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Characterization and Adsorption of Heavy Metals on Natural Diatomite

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Abstracts: Natural diatomite was characterized by X-ray fluorescence spectroscopy (XRF), scanning electron microscopy (SEM), energy dispersive spectroscopy (EDS) and specific surface area (BET) analysis. The percentage of chemical compositions of silicon dioxide (SiO_2), aluminium oxide (Al_2O_3), iron oxide (Fe_2O_3) and the other oxides were found to be 71.88, 10.13, 6.83 and 3.65, respectively. The morphology of diatomite was generally cylindrical in shape with the average particle diameter size of 7.72x20.5 μm. The element composition was indicated by energy dispersive values. The characteristic X-ray radiation showed silicon (Si) = 1.739 keV, oxygen (O) = 0.525 keV, aluminium (Al) = 1.486 keV and iron (Fe) = 6.398 keV. The surface area and average pore size were 54.26 $m^2.g^{-1}$ and 54.30 Å. The adsorption of heavy metal ions were determined by atomic absorption spectroscopy (AAS). The percentage adsorptions of Cd(II), Pb(II), Cu(II) and Zn(II) ions were 88.71 %, 90.54%, 88.23 % and 94.56%, respectively.

Keywords: Adsorption, Heavy metals, Natural diatomite

1. INTRODUCTION

Environmental pollution arises from industrial waste streams as a consequence of the industrialization process is one of the major problems that have to be solved or controlled. Many industrial facilities such as metal plating, mining operations, fertilizer industry, tanneries, textile industry discharge heavy metals via their waste effluents. The disposal of these effluents into natural water resources causes damage to the aquatic environment and in humans. Some of these metals, even in small amounts can cause severe physiological and health effects. Therefore, heavy metals are permitted to be discharged only at very low concentrations in wastewaters to prevent public streams and water resources from becoming contaminated [1].

Water is considered an important and scarce commodity in many countries around the world. In particular, the contamination of surface and ground water with heavy metal is a concern. Industries such as plating, ceramics, glass, mining and battery manufacturing are considered the main source of heavy metal, e.g. lead, cadmium, chromium and mercury, in the local water streams is a major concern to public health [2]. The presence of heavy metals in aqueous wastewater has become a problem due to its harmful effects on human health. It is known that legal standards on environment control are becoming strict and, as a result, the discharge of heavy metals into aquatic bodies and sources of potable water is being rigorously controlled [3].

A variety of technologies have been developed and applied for the treatment of wastewater. The commonly used techniques include membrane filtration with the aid of coagulants, ion exchange, chemical oxidation, precipitation, activated carbon adsorption and constructed wetland. Activated carbon adsorption is one of the most commonly used methods for the treatment and disposal of metal containing wastes. Activated carbon adsorption is considered to be a particularly competitive and effective process for the removal of heavy metals at trace quantities. However, the use of activated carbon is not suitable in developing countries due to the less economics and high costs associated with production and regeneration of spent carbon and disposal of regenerate wastes. As a result, over recent years there has been growing interest in using low-cost natural minerals for treating wastewater. The use of alternative low cost materials as potential adsorbents for the removal of heavy metals has been highlighted. These cost-effective materials range from industrial by-products or waste, such as waste rubber tyres, to agricultural products such as wool, rice straw, coconut husks and peat moss. Other known natural materials like clay, zeolite and diatomite have been investigated for their potential use as adsorbents for heavy metals [4,5].

Diatomite ($SiO_2.nH_2O$) is a pale-colored and lightweight sedimentary rock composed principally of silica microfossils of aquatic unicellular algae. Diatomite consists of a wide variety of shape and sized diatoms in a structure containing up to 80–90% void. Diatomite's high porous structure, low density and high surface area results in a number of industrial applications such as filtration media for various inorganic and organic chemicals, absorbents, catalyst carrier, filler and so on. In aqueous solution diatomite particles are negatively charged, and possesses strong attractability for positively charged species [6]. Diatomite exists in large deposits around the world so it can be applied to various industrial processes. Diatomite usually contains other sediments such as clay and fine sand but its deposits sometimes consists of diatom shells only. In Thailand, the Thai Department of Mineral Resources has found 500,000,000 tons of natural raw diatomite mainly in Lampang Province. Thus, diatomite is naturally available in large quantities at an extremely low cost [7].

2. EXPERIMENTAL

Diatomite was obtained through the natural resources in China. The chemical composition on natural diatomite was characterized using X-ray fluorescence spectrometer (Bruker, Germany). Moreover, the surface area was determined by specific surface area analyzer (Quantachrome, England). The morphology, particle size distribution and element composition of natural diatomite was measured by scanning electron microscope (Jeol-JSM5410LV, Japan), laser particle size analyzer (Malvern, England) and energy dispersive X-ray spectrometer (Oxford-ISIS300, England). The sample was washed with deionized water to remove fines and other adhered impurities, (adjusted to pH 7 with dionized water), dried at 100 °C, desiccated and stored in tightly stoppered glass bottles [6]. Standard Cd(II), Pb(II), Cu(II) and Zn(II) (1000 $mg.dm^{-3}$) solutions were prepared by dissolving $3CdSO_4.8H_2O$, $Pb(NO_3)_2$, $Cu(NO_3)_2$ and $Zn(NO_3)_2$ powders, respectively, in deionized water. Diluted solutions were prepared from the stock solutions (1000 $mg.dm^{-3}$). All chemicals used in this research were of analytical reagent grades. The adsorption percentage for natural diatomite was

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determined by adding 1.000 g of natural diatomite to 20 dm^3 of the standard solutions with concentration of 150 $mg.dm^{-3}$ for Cd(II), 20 $mg.dm^{-3}$ for Pb(II), 200 $mg.dm^{-3}$ for Cu(II) and 300 $mg.dm^{-3}$ for Zn(II) then shaking and standing for 1h at room temperature. The decanted solutions were filtered, diluted with deionized water. Metal ions were determined using atomic absorption spectrometer (PerkinElmer, U.S.A.).

3. RESULTS AND DISCUSSION

Chemical composition of natural diatomite was obtained by the X-ray fluorescence spectrometer. The analysis shows that silicone dioxide (SiO_2) is the main component (71.88%) and the metal oxides: aluminium oxide (Al_2O_3) and iron oxide (Fe_2O_3) are the main minor constituents, respectively as shown in Table 1.

Table 1 Chemical composition of natural diatomite

Oxide	Composition (%)
SiO_2	71.88
Al_2O_3	10.13
Fe_2O_3	6.83
Other oxide	3.65
LOI	7.51

LOI = lost on ignition

Figure 1 shows the morphology of natural diatomite. It was generally cylindrical in shape with the average particle size of 7.72x20.5 μm and corresponding with the data from the particle size distribution as shown in Figure 2.

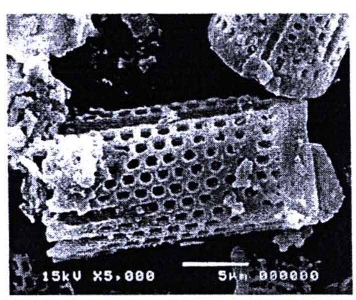

Fig. 1 SEM micrograph of natural diatomite

Table 2 Element composition of natural diatomite

Element	Energy dispersive values (keV)
Si	1.739
O	0.525
Al	1.486
Fe	6.398

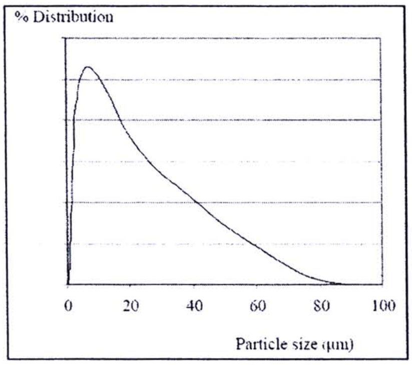

Fig. 2 Particle size distribution of natural diatomite

Fig. 3 shows the energy dispersive spectra of natural diatomite. The characteristic X-ray radiation showed silicon (Si) = 1.739 keV, oxygen (O) = 0.525 keV, aluminium (Al) = 1.486 keV and iron (Fe) = 6.398 keV and according to the energy dispersive values detailed in Table 2.

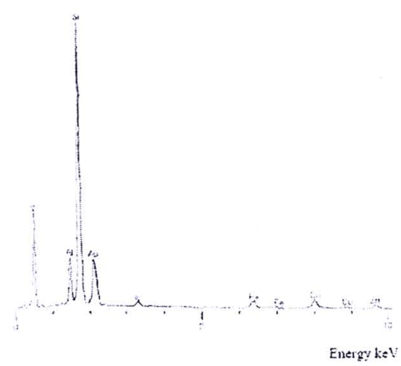

Fig. 3 EDS spectra of natural diatomite

The adsorption percentage of Cd(II), Pb(II), Cu(II) and Zn(II) solutions onto natural diatomite were 88.71 %, 90.54%, 88.23 % and 94.56%, respectively as shown in Table 3 and Figure 4.

Table 3 The adsorption percentage of standard solutions onto natural diatomite

Metal ions	Adsorption (%)
Cd(II)	88.71
Pb(II)	90.54
Cu(II)	88.23
Zn(II)	94.56

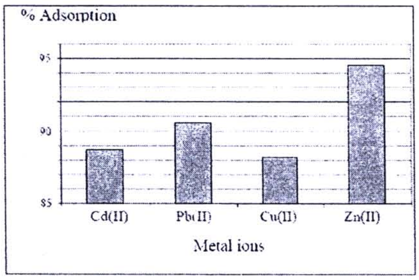

Fig. 4 The adsorption percentage of standard solutions onto natural diatomite

The surface area and average pore size of natural diatomite were 54.26 $m^2.g^{-1}$ and 54.30 Å, respectively, corresponding with the SEM micrograph as shown in Figure 1. The high surface area of natural diatomite was the main reasons for choosing it as a potential adsorbent for heavy metal ions because of negatively charged of hydroxyl groups (–OH) present on the surface structure [8]. The batch isotherm studies were conducted under slightly natural conditions (pH 7) for two main reasons. Firstly, heavy metals normally start to precipitate (by forming metal oxides and hydroxides) under alkaline conditions. In the concentration study, heavy metals are expected to precipitate at pH ≥ 8, therefore, a slightly acidic solution ensures that adsorption on diatomite is restricted to divalent ions rather than to highly adsorbable metal hydroxide species. In addition, heavy metals are usually found in a cationic form in wastewater. Secondly, diatomite powder is slightly unstable in higher pH conditions. It is known that silica containing materials precipitate (dissolve) when exposed to alkaline solution [2].

4. CONCLUSIONS

The main component of natural diatomite is silicon dioxide (SiO_2). The particle is the generally cylindrical in shape with the average particle size of 7.72x20.5 μm. The surface area and average pore size of natural diatomite were 54.26 $m^2.g^{-1}$ and 54.30 Å. The adsorption percentage of Zn(II) standard solution onto natural diatomite is highest.

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Adsorption of Copper Ions onto Natural and Modified Diatomite from Aqueous Solutions

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Keywords Adsorption, diatomite, hydrothermal method, modified diatomite

Abstract

Natural diatomite was modified by manganese chloride via the hydrothermal method. The adsorption of Cu(II) onto natural and modified diatomite has been studied in batch mode using atomic absorption spectroscopy (AAS). The chemical compositions of both diatomites were determined by X-ray fluorescence spectroscopy (XRF) and energy dispersive X-ray spectroscopy (EDS). Langmuir isotherm was employed to describe adsorption equilibrium. The saturation capacity of Cu(II) was 8.0 and 11.4 $mg.g^{-1}$ for natural and modified diatomite, respectively. Modified diatomite has a good adsorption efficiency than natural diatomite to remove Cu(II) from aqueous solution.

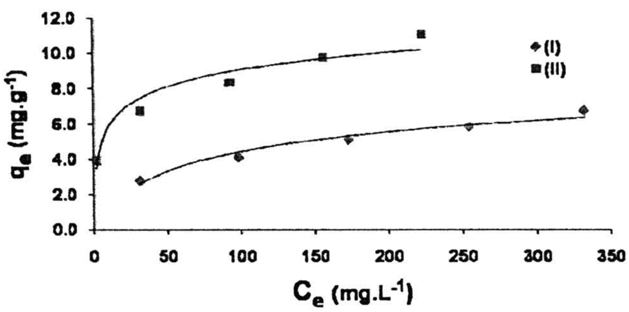

Fig. 1 Adsorption isotherm of Cu(II) onto natural and modified diatomite; (I) natural diatomite and (II) modified diatomite.

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