ABSTRAK

Keberadaan logam berat khususnya timbal di lingkungan dapat mencemari air dan tanah dan dapat berdampak buruk pada manusia apabila tidak segera dicari solusinya. Tuf zeolitik merupakan batuan piroklastik dengan komposisi mineral zeolit yang memiliki nilai kapasitas pertukaan kation tinggi sehingga dapat dimanfaatkan sebagai adsorben dalam mengatasi pencemaran lingkungan akibat timbal. Keterdapatan tuf zeolitik salah satunya berada di Banteng Wareng, Desa Tancep, Ngawen, Gunungkidul, Yogyakarta. Penelitian ini bertujuan untuk mengetahui karakteristik tuf zeolitik di daerah penelitian yang mencakup karakteristik fisik, mineralogi dan KPK serta pengaruhnya terhadap kemampuan penjerapan timbal dalam larutan tanah tercemar melalui uji batch. Sampel tanah tercemar diambil dari TPA sampah Piyungan, Bantul, Yogyakarta yang memiliki konsentrasi Pb cukup tinggi, yaitu sebesar 36,07 ppm pada zona interface di kedalaman 25 cm. Metode yang digunakan untuk mengetahui karakteristik fisik dan mineralogi tuf zeolitik meliputi deskripsi fisik sampel setangan, analisis petrografi dan XRD (*X-Ray Diffraction*), serta uji Kapasitas Pertukaran Kation (KPK). Lima buah sampel tuf zeolitik dengan karakteristik fisik, kandungan mineralogi, serta nilai KPK berbeda diambil dari daerah penelitian kemudian dipilih dua sampel terbaik untuk dianalisis mineralogi lebih lanjut menggunakan XRD. Kedua sampel terpilih digunakan sebagai adsorben dalam uji *batch* untuk mengontakkan sampel tuf zeolitik dengan larutan tanah tercemar. Selama waktu kontak 15, 30, 45, 60, 120, 180, 240, dan 1440 menit, masing-masing campuran diambil sampel sebanyak 5 ml untuk diukur konsentrasi timbalnya. Pengukuran konsentrasi Pb dilakukan menggunakan instrumen ICP-AES (*Inductively Coupled Plasma- Atomic Emission Spectrometry*). Hasil uji *batch* menunjukkan penjerapan timbal dipengaruhi oleh sifat fisik, mineralogi, serta nilai KPK kedua sampel. Sampel tuf zeolitik berukuran butir halus dan berwarna cerah cenderung memiliki persentase mineral zeolit yang lebih dominan sehingga kemampuan penjerapan Pb dalam uji batch juga tinggi. Jenis mineral zeolit dan keterdapatan mineral pengotor selain zeolit seperti mineral lempung juga mempengaruhi nilai KPK tuf zeolitik serta kemampuannya terhadap penjerapan timbal. Sampel EP-15A yang memiliki kandungan mineral zeolit berupa mordenit (21,97%), klinoptilolit (16,68%), skolesit (5,27%), heulandit (4,76%), serta natrolit (1,3%) dengan nilai KPK 40 meq/100gr memiliki kemampuan lebih baik dalam menjerap timbal daripada sampel EP-13 yang memiliki kandungan mineral ilit dominan sebanyak 18,61% dengan kandungan mineral zeolit berupa klinoptilolit (13,72%), filipsit (8,16%), heulandit (4,35%), mordenit (4,05%), skolesit (3,99%), serta natrolit (0,31%). Kemampuan penjerapan Pb dalam larutan tanah menggunakan sampel EP-13 pada waktu pengadukan maksimum selama 24 jam ditunjukkan oleh presentase sebesar 85,5%, sedangkan uji batch menggunakan sampel EP-15A menghasilkan nilai presentase penjerapan yang lebih tinggi yaitu sebesar 88,2%.

Kata kunci: tuf zeolitik, zeolit, karakterisasi, penjerapan, timbal.

ABSTRACT

The excessive presence of heavy metals, especially lead in the environment can pollute water, soil, and also have a negative impact on humans. Zeolitic tuff is a pyroclastic rock with zeolite mineral composition which has a high cation surface capacity value so that it can be used as an adsorbent in overcoming environmental pollution caused by lead. Zeolitic tuffs can be found in Banteng Wareng, Tancep Village, Ngawen, Gunungkidul, Yogyakarta. This study aims to determine the properties of zeolitic tuff in the study area which includes physical, mineralogy, CEC, and its effect on the adsorption ability of lead in the soil solution through batch tests. Polluted soil samples were taken from the Piyungan landfill, Bantul, Yogyakarta, which has a high Pb concentration of 36.07 ppm in the interface zone with a depth of 25 cm. The methods used to measure the physical and mineralogy of zeolitic tuff include physical description of the hand specimen, petrographic analysis and XRD (X-Ray Diffraction), as well as the Cation Exchange Capacity (CEC) test. Five zeolitic tuff samples with different physical properties, mineralogical content, and CEC values were taken from the study area. Then the two best samples were selected to be analyzed further using XRD. The two selected samples were used as adsorbents and mixed with contaminated soil solution through the batch test. During the contact time of 15, 30, 45, 60, 120, 180, 240, and 1440 minutes, 5 ml of each mixture was sampled to measure its lead concentration. Measurement of Pb concentration was carried out using the ICP-AES (Inductively Coupled Plasma-Atomic Emission Spectrometry) instrument. Batch test results showed that lead adsorption is affected by physical properties, mineralogy, and the CEC value of both samples. The zeolitic tuff samples with fine grain size and bright color tend to have more dominant composition of zeolite minerals so that the adsorption ability of Pb in the batch test was high. The type of zeolite minerals and the presence of impurity minerals other than zeolites such as clay minerals can also affect the value of the zeolitic tuff's CEC and its ability to adsorb Pb. EP-15A sample which contains zeolite minerals in the form of mordenite (21.97%), clinoptilolite (16.68%), scolecite (5,27%), heulandite (4,76%), and natrolite (1,3%) with CEC value of 40 meq / 100gr has a better ability to adsorb lead than EP-13 sample which has a dominant illite mineral content of (18,61%) with less zeolite content of clinoptilolite (13.72%), phillipsite (8,16%), heulandite (4,35%), mordenite (4,05%), scolecite (3,99%), and natrolite (0,31%). The adsorption ability rates of lead in soil solution using EP-13 sample in the maximum stirring time of 24 hours was shown by the adsorption percentage value of 85.5%, while the batch test using EP-15A sample produced a higher adsorption percentage value of 88.2%.

***Keywords**: zeolitic tuff, zeolite, characterization, adsorption, lead.*