J Biochem Tech (2010) 2(5):S62-S63
ISSN: 0974-2328

Adsorption studies of methyl blue and Cu^{2+} ions on lignite pellets

Petra Businova, Miloslav Pekar*

Received: 25 October 2010 / Received in revised form: 13 August 2011, Accepted: 25 August 2011, Published: 25 October 2011

Abstract

In recent years, possibilities of lignite utilization in various non–energy applications, especially in sorption processes, have been investigated. This paper reports on the ability of lignite pellets to adsorb methylene blue or copper ion (Cu^{2+}) from aqueous solution and motor oil from solid surface.

Keywords: Lignite pellets, sorption, motor oil, methylene blue, copper ion

Introduction

Among the various treatment methods, adsorption has been found to be an efficient and economic process to remove various pollutants. The most commonly used sorbent is activated carbon. It has a high adsorption capacity, but its high cost and troubles with regeneration limit its applications. Therefore, many non–conventional natural and locally available materials have been investigated as low–cost adsorbents (Babel and Kurniawan, 2003; Crini, 2006). This paper discusses the possibilities of using lignite pellets as a sorbent for removal of organic or inorganic substances from aqueous environment and oil spills from solid surface.

Materials and methods

Lignite pellets prepared by extrusion using a chopper (see Businova, 2007) were investigated as sorbents. Their composition can be seen in Tab. 1. An aqueous solution of methylene blue with an initial concentration of 1 g/L, aqueous solutions of $CuCl_2.2H_2O$, $CuSO_4.5H_2O$ and $Cu(NO_3)_2.3H_2O$ with an initial concentration of 0.1mol/L and motor oil were used as adsorbates. In the case of the dye and copper (II) compounds, 0.5 g of a sorbent was shaken with 50 mL of a solution and time of adsorption was 24 hours. An adsorbate removal in a solution was determined using UV–VIS spectrophotometer. Residual concentration of particular sorbate in solution was calculated from absorbance at the wavelength of the absorption maximum. These wavelengths for methylene blue and copper were 664 and 810 nm, respectively. Sorption test using motor oil as an adsorbate was conducted in Petri dishes with 2 g of oil and 1 g of pellets. Contact time was 80 minutes. Adsorbed amount of oil was obtained from an increase in weight of the sorbent during the experiment.

Petra Businova, Miloslav Pekar*

Brno University of Technology, Faculty of Chemistry, Institute of Physical and Applied Chemistry, Purkyňova 118, 612 00 Brno, Czech Republic

*Tel: +420 541 149 330, Fax: +420 541 211 697
E-mail: pekar@fch.vutbr.cz

Results and Discussion

Adsorption of three different adsorbates on lignite pellets was investigated. The amount of adsorbate sorbed per gram of pellets in 24 hours in the case of methylene blue and Cu^{2+} and in 80 minutes in the case of motor oil was determined. Furthermore, percentage removal of a dye and Cu^{2+} in 24 hours was calculated. The results can be seen in Fig. 1 and 2. The results show that all tested samples of pellets were able to adsorb both dye and copper ion from aqueous solution as well as oil from solid surface, although with different efficiency. Composition of pellets as well as the kind of adsorbate had effect on the resulting adsorbed amount. The order of affinity of lignite pellets towards adsorbates was found to be motor oil >> methylene blue > Cu^{2+}. The values of adsorbed amount were in the range of 144–230 mg/g for motor oil, 46–99 mg/g for methylene blue and 14–58 mg/g for Cu^{2+}. In addition, effect of anions on copper ion adsorption was observed. Adsorption of Cu^{2+} in the presence of different anions decreased in the order NO_3^- > SO_4^- > Cl^-. The highest adsorbed amount of Cu^{2+} was 58 mg/g in the

Table 1: Composition of used pellets

Pellets	*Binder*	*Composition (wt %)* lignite + binder + water
1	Sokrat	83 + 4 + 13
2	Sokrat + molasses	82 + 6 + 3 +9
3	molasses	83 + 4 + 13
4	molasses	85 + 4 + 11
5	molasses	90 + 4 + 6
6	limestone + molasses + Sokrat	74 + 3 + 4 + 6 + 13
7	water–glass	79 + 6 + 15
8	water–glass + molasses	78 + 3 + 4 + 15
16e	Solvarin AP	55 + 6 + 39

presence of nitrate, 42 mg/g in presence of sulfate and 28 mg/g in presence of chloride.

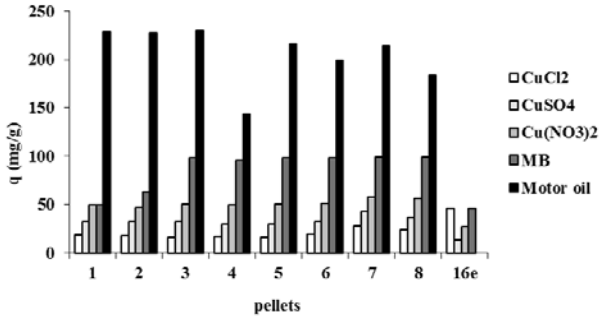

Figure 1: Adsorbate sorbed per gram of pellets

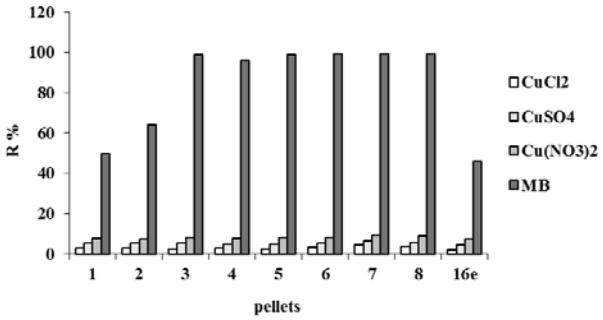

Figure 2: The percentage removal of Cu^{2+} and methylene blue from solution

Conclusion

The ability of lignite pellets to adsorb methylene blue, Cu^{2+} and motor oil was investigated. It was observed that all tested samples of pellets are able to adsorb all studied adsorbates, although with different efficiency. Adsorption efficiency can by influenced by composition of pellets.

.

Acknowledgement

This work was supported by the Czech government funding – Ministry of Education, project Nr. MSM0021630501.

References

Babel S, Kurniawan TA (2003) Low-cost adsorbents for heavy metals uptake from contaminated water: a review. Journal of Hazardous Materials 97(1-3):219-243

Businova P, Pekar M (2007) In 11th Conference on Environment and Mineral Processing, Part I. VŠB–TU Ostrava 319–323

Crini G (2006) Non-conventional low-cost adsorbents for dye removal: A review. Bioresource Technology 97(9):1061-1085