



STUDY OF DESORPTION AND SELECTIVITY OF SYNTHETIC ABSORBENT SSA ON ADSORPTION OF HEAVY METALS FROM INDUSTRIAL WASTEWATER

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ABSTRACT

Due to the lack of water, as a serious challenge for the human population in the coming years, and human could jeopardize the future of life on Earth as the most important and largest water consumer in the world by abuse of water and industrialization and the lack of proper management of wastewater and contaminated fluids. In the present study has been used the synthetic absorbent SSA (silica sulfuric acid), as a adsorbent for removal of heavy metals from aqueous media which was used as the catalyst in the pastand survey on the laboratory standard samples and real samples was carried out by the batch method (Batch) and the highest and lowest selectivity of the adsorbent in solution of multi-metal were examined with the presence of nuisance. Finally, desorption of ions was investigated by various acids in order to take the recycling and reuse of the adsorbent by maintain the structure of adsorbent chemical.

KEYWORDS: heavy metals, desorption, adsorption, SSA selectivity

1. INTRODUCTION:

Environmental pollution caused by heavy metals in sewage and runoff and entering them into rivers, groundwater, rivers and lakes is great concern. Surface water contamination with heavy metals mainly due to the mining, metal processing and heavy industry, is a serious problem in third world countries. The elimination of heavy metals, polluted water purifying by industrial units and requires them to refining processes and low cost control systems are the priorities of environmental organizations of these countries (Minceva et al., 2008). Obviously, there are several methods to remove heavy metals from water resources and wastewater, each of which can be used, according to environmental conditions. Solvent extraction, flotation, chemical precipitation, membrane processes, ion exchange LLE and SPE methods, adsorption, etc., are used to remove heavy metals.

2. THE MECHANISM OF ADSORPTION:

It is likely that the process of adsorb material molecules adsorption from liquid volume on the adsorbent surface include the following steps, according to the provided figure 1.

1. Mass transport of adsorb material molecules from external boundary layer into solid particles.
2. Carrying adsorb material molecules through the external boundary layer into solid particles.
3. Adsorption of adsorb material molecules from surface of the particles to active sites by spreading in the pores filled with liquid and migration to the solid surface pores.
4. It is possible once again that adsorb material molecules migrate to the surface of the pores through surface diffusion (Farouk Mohamed, 2011).

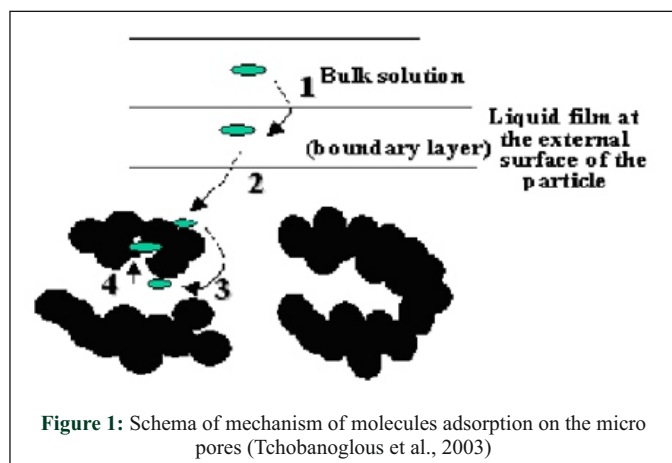


Figure 1: Schema of mechanism of molecules adsorption on the micro pores (Tchobanoglous et al., 2003)

3. RESULTS AND DISCUSSION:

1. Desorption studies:

The desorption capability of silica sulfuric acid, was studied to determine its reuse (consecutive adsorption / desorption) and recovery of metals. In this experiment, the stage of absorption for the concentration of 5mg/L was carried out for each of cations (five tested ions) and the remaining concentration of metal in solution was measured. The adsorbent was washed gently with distilled water to remove any unadsorbed metals and acids of HCl, HNO₃, CH₃COOH and H₂SO₄ at the concentration of 1/0mol/L were used in Desorption stage to determine the appropriate filtering and the effect of acid on desorption rate. The adsorbent was stirred for 60min with acid and then the amount of released metal in acid was measured. The metal detachment percentage was calculated by the following equation (Afkhani et al., 2010; Heidari et al., 2009):

$$\% \text{Detachment} = \frac{\text{Amount of metal desorption}}{\text{Amount of metal adsorbed}} \times 100$$

According to the presented data in the table and above rod-shaped diagram, the best acid for the desorption ions Pb²⁺ and Mn²⁺, is hydrochloric acid, for Cu²⁺, is acetic acid, for Ni²⁺, is acetic acid and sulfuric acid, and for Cd²⁺ + nitric acid and sulfuric acid and acetic acid. The standard deviation of the data, was less than 6/00.

2. Selectivity of the SSA adsorbent:

The primary requirement to perform an economic separation process, is to apply the adsorbent, that its selectivity and capacity be high enough. The selection of an adsorbent is indicated adsorbent relative affinity rate to various ions which are determined by the characteristics of the adsorbent and ion. In addition, the solvent plays an important intermediate role. Arrangement selectivity is important evidence around the micro-environment on the properties of ion uptake and absorption behavior in the face of ions adsorb. Also, this process controls the rate of a specific ion loading and the effect of an ion on other ion loading (Bader, 2009). The adsorption of divalent cation across a range of values of pH is defined by the following equation in terms of certain amount of the same cation and catchy:

$$\log D = a + b (\text{pH})$$

Table 1: Evaluation of the effectiveness of desorption in cations desorption of adsorbent surface (3 = n)

Cations Desorption (%)					
Cu ²⁺	Pb ²⁺	Mn ²⁺	Ni ²⁺	Cd ²⁺	Desorption factors
87.6± 0.5	97.6± 0.1	100.4± 4.8	93.3± 2.6	91.2± 4.3	HCl
87.8± 1.5	92.5± 5.1	82.8± 0.2	83.2± 4.7	103.6 ± 81	HNO ₃
81.9± 3.5	76.8 ± 2.3	87.2± 4.3	102.3± 4.2	102.5± 3.2	H ₂ SO ₄
90.8± 1.4	69.5 ± 2.6	95.5 ± 5.2	106.9± 4.1	107.5± 5.4	CH ₃ COOH

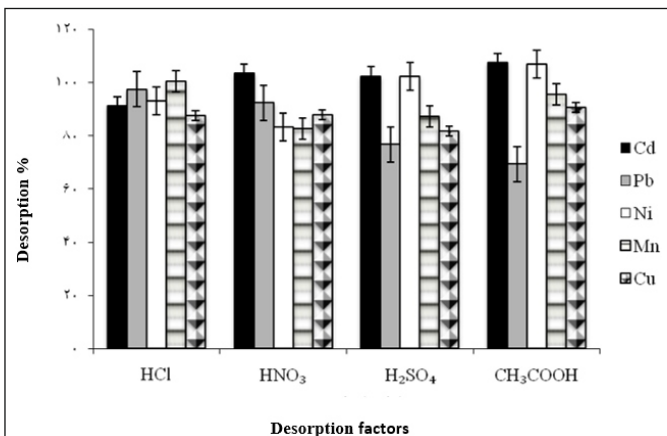


Figure 2: Study the efficacy of different acids, in the desorption cation adsorbent surface

Desorption Policy: pH equal to 8, 25 mL of soluble Mn²⁺, Pb²⁺, Cu²⁺, Ni²⁺ and Cd²⁺, concentration, 5 mg / L, for each of cations, 1 gr adsorbent, stirrer speed, rpm, 200, mixing time min, 60.

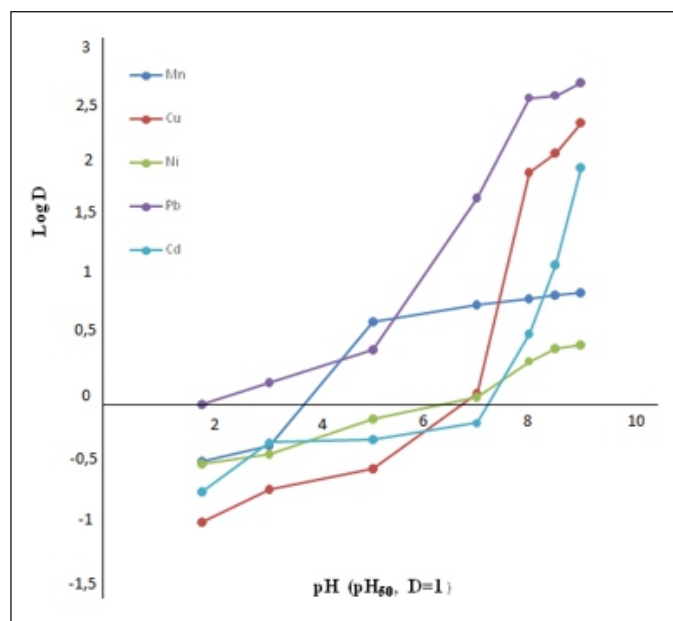
In this regard, a, b and D, are empirical constants and the distribution ratio, respectively, that is defined as a fraction of the absorbed metal to a fraction of the remaining ions in solution by the following equation.

$$D = \frac{\text{adsorbed ions \%}}{(100 -) \% \text{ adsorbed ions}}$$

Diagramming log D in terms of pH curve is called "Kurbatov". pH where D is equal to 1 where, % 50 of added metal is attracted and its 50% remains in solution, and has shown, pH₅₀. The values of pH₅₀ that i, the relative size of the selectivity of an adsorbent relative to a certain set of divalent cations. The cation that has the smaller amount of pH₅₀, adsorbent operates more selectivity than the cation (Bader, 2009). As seen in the figure process of selectivity of the adsorbent relative to metals studied is as follows:

$$\text{Pb} \gg \text{Mn} \gg \text{Ni} \geq \text{Cu} > \text{Cd}$$

And this process shows that silica sulfuric acid has highest selectivity of, than to lead, and less selectivity, with respect to cadmium.



Kurbatov curve to determine the selectivity of the adsorbent

4. CONCLUSIONS:

In the present study, silica solid catalyst acid, sulfuric acid was used as a solid-phase extraction and an adsorbent surface for separation and removal of heavy metals such as nickel, cadmium, manganese, lead and copper from aqueous solutions which is used only as a catalyst numerous organic reactions in the past. In

this study, laboratory standard samples and real samples was carried out by a batch method in which the effect of a number of operational variables were studied. This adsorbent can remove a significant amount of cations with higher selectivity than lead, from multi-element solution in the weak alkaline conditions and on low amount of adsorbent in a five metal system at a appropriate speed. Desorption of ions is carried out completely by different acids to investigate the possibility of recycling and reuse of the adsorbent. Meanwhile, synthesized SSA maintains its chemical structure and does not lose its effectiveness over time. This adsorbent has acceptable results in the implementation of real samples and perhaps it can be used as a simple and cheap for treatment of contaminated wastewater with low to moderate amounts of heavy metals.

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