Determining the Amount of the Lead Impact via Light Spectrum in the Solid Phase

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ABSTRACT

This study deals with developing a method to determine the impact of lead via the light spectrum in the solid phase. This method is characterized by selectivity, speed and ease in performing the analysis. It also allows secure detection of low (LOD) and high accuracy analysis (LOQ).

This method is based on the concentration and identification of the elements as a single transaction. The adsorption of lead was studied by the cationic exchanger KY-2-8 form - H + at a pH = 1 in static conditions. The maximum adsorption happened within 30 minutes after the solution was moved.

The cationic exchanger was isolated at the end of the adsorption, and was treated with a solution of sodium sulfur (Na_2S). The severity of the resulting coloration reversal was identified on the Spectrophotometer ФОУ device at a wavelength of 540 nm compared to the cationic exchanger processor in a similar way, but was lead-free. The proposed method allowed the identification 0.05 μg/ml lead with a higher sensitivity compared to other reference methods.

KEY WORDS: Optical spectroscopy on the solid phase, an organic reagent PAR (4- (2-pyridylazo) -resorcinol), lead, cationic exchanger for strong acid KY-2-8.

1. INTRODUCTION

Lead is considered one of the important minerals for the contemporary civilization. Global industry produces millions of tons of metals each year.

Due to its large and important industries and uses, lead is found in many different parts of the environment: water, air, soil. Lead is a poison that builds up the organism and kills cells (Belitz, 1999; Kristic, 2007). Chronic exposure to the high concentration of lead can cause cancer (WHO 1989).

The lowest limit of the allowable concentrations (LOD) in the water in Russia is 0.03 mg / L and 0.1mg / L. in the global standard. To maintain the limits of permissible concentrations (LOD) in industrial conditions and drinking water, they have to be subjected to a rigorous analytical testing.

Determining the amount of lead with such low impact of concentration, requires the processing of prior concentration in order to achieve the required levels of the lowest detection limits (Tarley, 2004). It also requires finding new methods based on other ones, but more recent. One of the vast uses of the modalities of the concentration is perhaps the adsorption method (Macedova, 2004), with continuing the process of isolation of the element using the chemical, physical method for the selection. Therefore it was necessary to adsorb lead from natural water in resins at different pores, then lead was isolated by a spectral detector with the PAN (Malakhova, 1990).

The optical spectroscopic method in the solid phase is considered the most effective method in determining the amount of the elements' effect. This method combines a focus on ion exchangers and a direct reaction to the spectral ion exchangers (Yoshimura, 1976). In sum, and putting aside the process of dilution, this method is characterized by reducing the minimum to determine (LOD) ions and the speed and simplicity of analysis and high selectivity (LOQ), compared with the normal optical spectroscopic, ten times better. This is used when identifying harmful mixtures of heavy elements in the permissible limits content.

The spectral light on the solid phase is widely used for the separation, concentration and determining the effect of the elements as they are characterized by reduced cost and material availability, a metal ion concentration channels from the rank of nanotechnology (Vellaichamy, 2011), Brizenat reciprocity (Lemos, 2007; Ferreira, 2001).

Perhaps one exchanger cationic KY-2-8, a heat exchanger Ktyona strong acid has a sterol structure with functional groups SO3H - which is characterized by the formation of complexes and adsorption on these exchange metal ions instead of ion exchange, and at the expense of the formations of the complexes (Malakhova, 1980).

The adsorption of heavy metal cations on the cation exchanger of a strong acid arises in the midst of an acidic form complexes except for the formation of hydroxylated as in the case of cationic exchanger of weak acids, which arises where the adsorption falls at pH = 4 or more (Sadouh, 2015).

Aim of the Study: This study aims at finding a method of spectral light on the solid phase to determine the effect of the amount of lead in the in aqueous media.

2. METHODS & MATERIALS

Equipment and materials: A cationic exchanger of strong acid KY-2-8 -H+, whose radius particles is 0.25-0.1 mg was used for the adsorption of lead. The standard solution of lead was prepared from high-purity- lead nitrate, (PDH)

by dissolving 2.0 mg/L in order to form the mother liquor for the standard used series. The solution was calibrated with a solution of EDTA, and the solutions with less concentration were prepared by way of dilution, using dual-water distillation. Note that all material data of high purity.

Measuring was done in static conditions on the spectrophotometer КФК. The spectrum of the influential reflection (R) was measured in spectrophotometer ФОУ device. pH degree was measured on the pH device -121.

Methodology: The condition of lead adsorption were studied on cationic exchanger KY-2-8 by looking at the effect of the pH - time - and the wavelength in static conditions.

3. RESULTS

The effect of pH on the degree of adsorption: For this purpose, a 100ml-capacity cup was used, and filled with 25ml of 0.2M NaCl solution to form ionic strength. 0.1mg lead was added with 0.500 g cationic exchanger in order for the pH to become = 1. By adding all of (1N) HNO_3 or (1N) NaOH solution 1N solution, so that the total volume of liquid reaches 50ml. The degree of pH was measured on the pH device - 121 meters.

The content of the cups was stirred with a magnetic stirrer and left for 24 hours to equilibrate. In the transparent part of the solution, the lead content was identified via the spectral optical detector with the PAR. Observed the maximum adsorption of lead was observed at a pH = 1. As shown in Table.1, then all the experiments were carried out at pH = 1.

Table.1. The adsorption of lead on KY-2-8 in terms of the pH of the solution

pH	1	2	4	6	8	10
adsorption of lead %	99.68	85.7	71.3	60.5	49.6	46.3

The graph shows the adsorption of lead on KY-2-8 in terms of the pH of the solution in Figure.1.
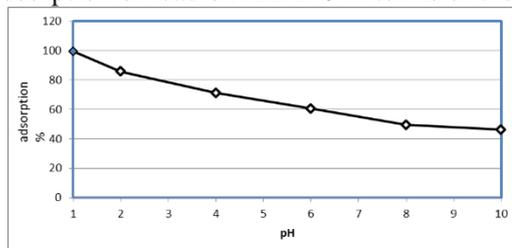

Figure.1. The adsorption of lead on KY-2-8 in terms of the pH of the solution

The Effect of Wave Length: The effect of wavelength was studied from various aspects according to the lead content in the solution, where the cationic exchanger adsorbing the lead was treated, with a solution of sodium sulfur Na2S which gave a black color, the intensity of which differs depending on the content of the solution of lead. The cationic exchanger treatment was conducted in 5ml of Na_2S solution with a concentration of 0.5M after the dismissal of the solution by filtration, then the cationic exchanger was transferred to the filter paper, and then washed with doubly-distilled water, dried up in the air and the spectrum of the influential reflection (R) was measured by Spectrophotometer ФОУ device for the cationic exchanger which is treated in a similar way, and free of lead, as seen in Figure.2, which shows the maximum reflectance at a wavelength $\lambda = 540nm$.

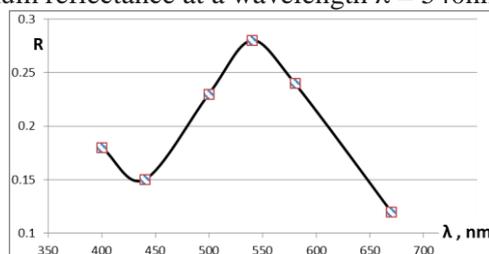**Figure.2. The spectrum influential reflectance sulfur lead in terms of the wavelength**

The Effect of Mixing Time: The effect of mixing time on the adsorption of lead was studied at a pH = 1 by way of measuring the influential reflectance for the adsorbed sulfur lead on the cationic exchanger by setting the mixing time as in Figure.3.
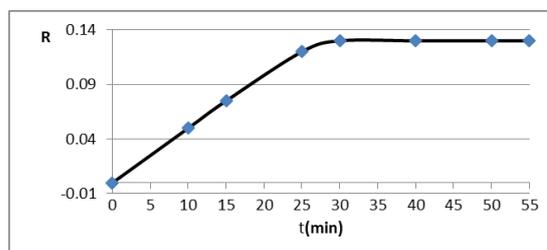

Figure.3. The effect of time mixing on the adsorption of lead, at a pH = 1

From thee Figure, we note that the mixing time lasted 30 minutes, then used as a prerequisite of the experiment.

By drawing a standard curve, which shows the relationship of the influential reflection in terms of the focus when the degree of pH = 1 and l = 540 nm. A linear relationship was observed when domain 0.01 – 0.1 mg, size 50ml and the equation is as follows:

$Y = 1.22 \times 10^{-1} + 2.8 \times 10^{-3} \times X$

To test the accuracy of the method in determining the spectral optical lead on the solid phase in the form of sulfur, the experiment was repeated five times, where the lead of the experiment was 0.05mg, while the lead output was 0.050mg, n = 5, P = 0.95, S r = 0.98.

The experiment was conducted to determine the lead from the solution of the size 1000ml. The ionic strength was (0.1) in the $NaNO_3$ solution, and the degree of pH = 1, the amount of the ion exchanger 0.500g, and the adsorption time of 60 minutes. The amount of lead for the experiment was 0,050 mg, while the lead output was 0.046 mg, where n = 5, p = 0.95, Sr = 0.126.

Comparing this method with a regular optical spectral, it was observed that it reduces the detection of lead significantly. Although the method of adsorption Ky - 2x8 in the middle of an acid treated with sodium sulfur is a valid way to determine the lead content in the field 0.01 – 0.1mg/L, which is equivalent to 10^{-7} - 10^{-8} M.

4. CONCLUSION

- The validity of the proposed method on the optical spectral solid phase in identifying lead in the form of sulfur lead.
- The method allowed even lower concentration of the amount 0.05μg / ml or 2.5 x10^{-7}mole / L.
- The results of this study were compared with other similar studies to determine the amount of lead in a complex shape with the PAR reagent allowing its identification up to 0.2μg/ml (Malakhova, 1980). The resulting method was ten-fold more sensitive.

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