Mercury Removing from the Contamined Soil Using KI Solution.
The pH Influence

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This paper presents an experimental work regarding the optimal conditions of pH for removing mercury from a contaminated soil sample using 0,1M solution of KI. A test stand with a column packed with contaminated soil has been done. A KI solution with neutral pH passes through the column, then a KI solution with acidic pH passes through another similar column and a KI solution with basic pH through the third column. It was collected periodically 10 mL fraction volume. The extracted mercury concentration from the solution is determined by atomic absorption spetrophotometry The results shows that the optimal conditions for cleaning the soil are using an acidic KI solution with a pH = 1, 5 ÷ 2 and 150 mL of KI solution meaning 15 fractions of 10 mL each.

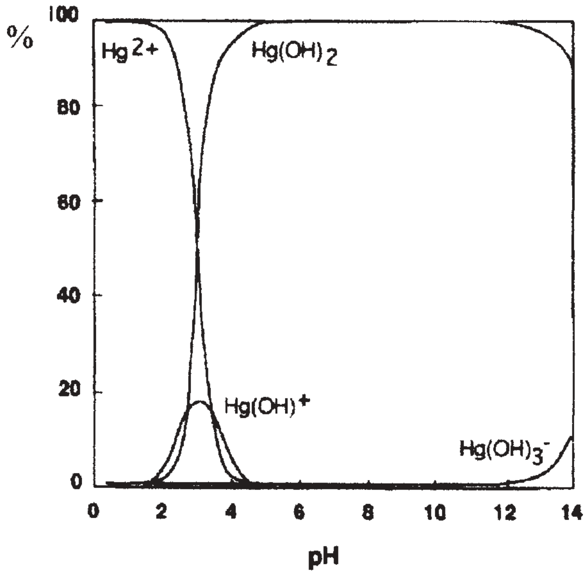
Keywords: *mercury, acidic potassium iodide, atomic absorbtion spectrophotometer*

Mercury is a liquid metal at the atmospheric temperature [1]. It can be found in the environment as: elementary mercury (Hg^0) less soluble in water, mercuric ion (Hg^{2+}) and mercurous ion (Hg_2^{2+}) much more soluble in the water which has an affinity for inorganic and organic ligand, alkilmercury which acumulates in living organisms and very toxic for central nervous system [2-4].

The removing of mercury from soil using $Na_2S_2O_3$, EDTA, KI was presented [5].

This paper presents an experimental work regarding the optimal *p*H conditions for the removing of mercury from the contaminated soil using 0,1M solution of KI.

The mercury speciation is shown in figure 1 [6].



Fi.g.1. Chemical speciation of mercury as a funcion of *p*H

It shows that at *p*H < 2 Hg^{2+} ion is predominant species which accounts for the solubilization of mecury from soil at low pH. Mercury is immobilized as solid $Hg(OH)_2$ in the *p*H range of 5 – 12 which cannot be removed. Formation of ionic species $Hg(OH)_3^-$ accounts for dissolution of mercury at extremely high *p*H.

Experimental Part

It was used a soil sample collected from Timi°oara city site. Main characteristics of the analyzed soil are:

- reaction is low acid or neutral, *p*H = 6.7 - 7.2;
- humus H = 3 – 4 %;
- total nitrogen Nt = 0.173%;
- mobile phosphorus 24 ppm P;
- sum of interchangeable bases SB = 20.6me/100g soil;
- cation exchange capacity T = 21.4me/100g soil;
- exchange acidity SH = 0.8me/100g soil;
- degree of base saturation V = 96.3.

The soil sample was cantaminated with $HgCl_2$

A schematic diagram for cleaning mercury polluted soil by column process is shown in figure 2.

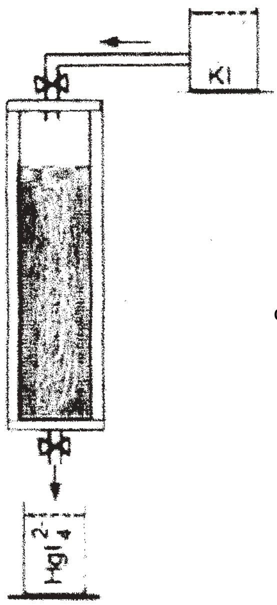


Fig.2 Schematic diagram for cleaning mercury-polluted soil by column process

The column used was 2 cm in internal diameter by 30 cm in height with sintered glass filter at the bottom. The column was packed with 20 g of contaminated soil. The column was attached with 1L reservoir containing KI solution at *p*H = 6 ÷ 7. The flow rate of the carrier solution was controlled. The fraction volume of 10 ml was collected

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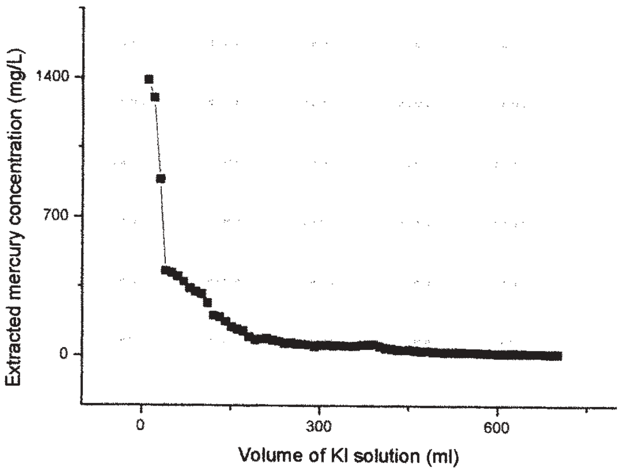


Fig.3. Variation of extracted mercury concentration as a function of the volume of KI solution at *p*H = 6 ÷7

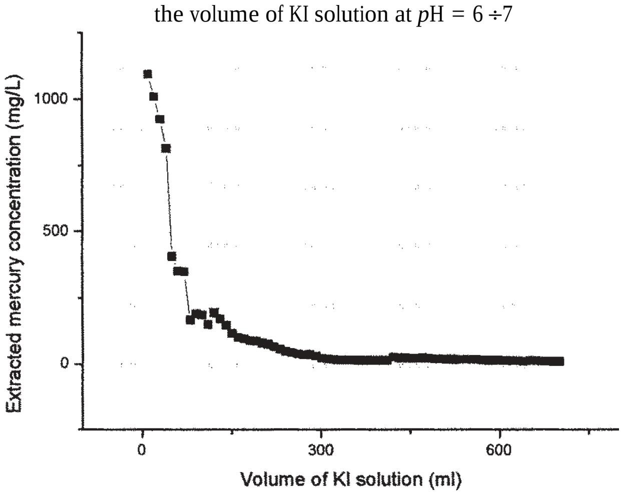


Fig.4. Variation of extracted mercury concentration as a function of the volume of KI solution at *p*H = 11÷11.5

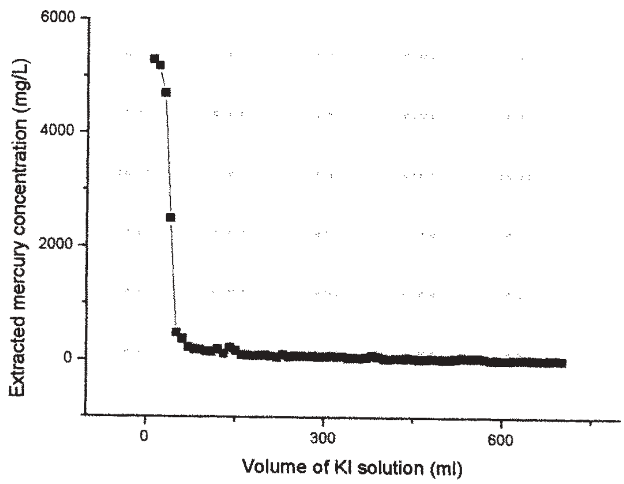


Fig.5. Variation of extracted mercury concentration as a function of the volume of KI solution at *p*H = 1.5÷2

periodically and analysed for mercury. The mercury analysis was made by atomic absorbtion spectrophotometry [7,8] using Varian AA110 spectrophotometer.

The whole operation using KI solution with pH =1.5÷2. and Kisolution with *p*H = 11÷11.5 was repeated. Each time it was used a new soil sample. The acidic *p*H is obtained by adding HCl and the basic *p*H is obtained by adding NaOH

All 10mL sample collected were analysed for mercury. It was also made an secvential analysis for the column soil after the whole KI solution passed through. The column soil was divided in three parts (up, middle and down). The soil sample were digested with aqua regia and then were analysed for the residual mercury.

Results and discussions

The variation of mercury concetration with the nature of KI solution used is shown in figure 3-5.

The experimental results from the figure 3 shows an abrupt decreasing of extracted mercury concetration. From 1390 mg/L after 4 fractions the extracted mercury concentration arrived at 428 mg/L. After that continued to decrease but slowly to 15 mg/L corresponding to 450 mL KI neutral solution meaning 45 fractions. Then extracted mercury concetration remains constant and mercury was not extracted any longer.

The experimental results from the figure 4 shows that the decreasing of extracted mercury concentration from 1095 mg/L to 116mg/L is after 150mL basic KI solution, meaning 15 fractions. After that extracted mercury concetration remained constant, so that mercury is not extracted any longer.

The experimental results from the figure 5 shows a spectacular decreasing of extracted mercury concentration from 5290 mg/L to191mg/L after 6 fraction of acidic KI solution and after 150mL, meaning 15 fractions the extracted mercury concetration remained constant at10.2 mg/L.

The effect of KI solution was very high especilly at low *p*H according to the mercury speciation showed in figure 1. Iodide ion plays an important role in extracting mercury from soil at *p*H < 2 because it forms a soluble complex with mercury HgI_4^{2-} as shown below:

$$\text{sol-Hg(OH)}_x + 4I^- \xrightarrow{pH<2} HgI_4^{2-}(aq) + xOH^- + \text{sol}$$

In figure 6-8 are showed the secvential analyses of the column soil after the KI solution passed through.

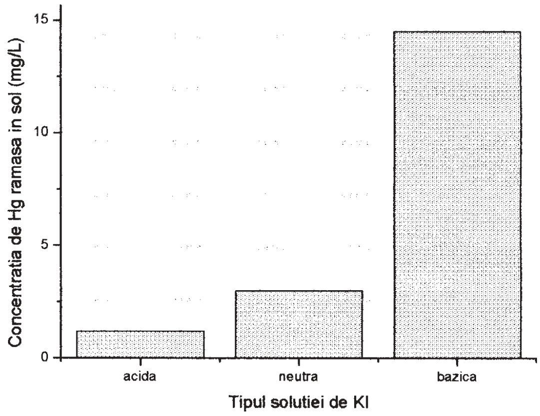
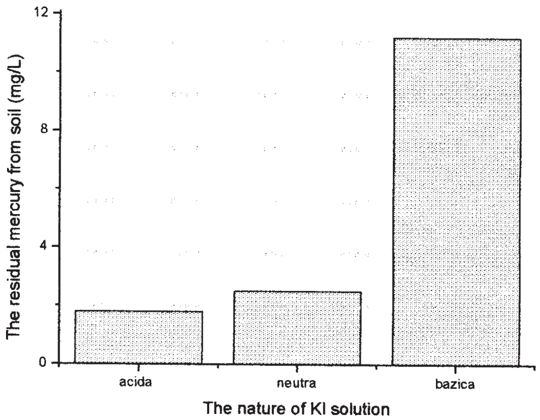
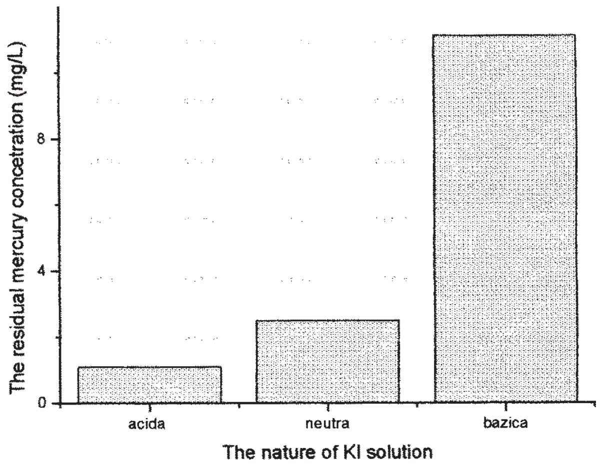


Fig. 6. The residual mercury from soil (upper part) after the KI solution pass through



Fi.g.7. The residual mercury from soil (down part) after the KI solution passes through



Fi.g.8. The residual mercury from soil (middle part) after the KI solution passes through

The experimental results from figure 6-8 show that for the basic KI solution the mercury is very poor extracted. The best extraction is for acidic KI solution a small part of mercury remaining in soil.

Conclusions

From the experimental data showed in this paper it can be concluded that a mercury contaminated soil can be cleaned up using an acidic KI solution with a *p*H = 1,5 to 2. Through a column packed with 20 g contaminated soil it passes 150 ml acidi KI solution for the complete cleaning of the soil. The mercury speciation in acidic medium allows the forming of the solution which passes through the soil and does not remain stocked there. This method represents a promissing mode for cleaning the mercury contaminated soil.

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