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Influence of the Solution's Matrix in Mercury Analysis through HG-AAS

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Abstract: The paper presents the studies regarding the influence of the solution's matrix in mercury analysis through HG-AAS. It has been monitored the influence of acids and salts on mercury analysis. In order to establish the influence of acids, there have been studied well-establish volumes of HCl conc., HNO_3 conc., H_3PO_4 conc. and H_2SO_4 conc. that have been added to 100 mL of mercury synthetic solution with 50 ppm concentration, wich have been subjected to analysis. In order to establish the influence of salts, there have been studied well-defined volumes of NaCl 30%, KCl 10%, $CaCl_2$ 20%, $MgCl_2$ 10% and KI and solutions with well-defined concentrations that have been added to 100 ml synthetic solution of mercury with 50 ppb concentration, wich have been subjected to analysis The method of analysis that has been used has been the atomic absorption spectrometry combined with hydride system. It has been noticed that only HCl influences the analysis of Hg. HNO_3, H_3PO_4 and H_2SO_4 and the salts do not influence within the concentration limit, so they do not lead to interferences.

Keywords: mercury analysis, interferences, HG-AAS.

1. Introduction

Mercury is outstanding the global environmental pollutants of continuing concern. Mercury-rich wastes related to numerous industrial activities have been accumulated on land and, as a consequence, Hg-contaminated sites are abundant world-wide, and many are related to mining activities. In the last decade of the 20th century scientists have become increasingly aware of Hg pollution [1].

From a toxicological point of view, Hg is a potent neurotoxin wich has a tendency to bio-accumulate and to bio-magnify in the food chain [2], and as a consequence, it is a potential threat to human and ecological health. It can be toxic by ingestion or inhalation, but the toxicity is higly dependent upon the chemical species. Mercury can exist in the envorinment in different chemical species with a wide range of chemical and ecotoxicological properties.

The most important chemical apecies known to occure in the environment are: elemental mercury (Hg^0) wich has a high vapour pressure and a relatively low solubility in water, mercuric (Hg^{2+}) and mercurous (Hg_2^{2+}) species, wich can be far more soluble and have a strong affinity for many inorganic and organic ligands, and they are more stable under oxidising conditions, and alkylated species (e.g., methylmercury and athylmercury). Methylmercury (CH_3Hg^+) is strongly accumulated by living organisms. Mercury, once ingested accumulates in the human body and attacks the central nervous system. The toxicity of mercury depends on its chemical species and it is found that organomercurials are more toxic than inorganic mercury compounds. Mercury and its compounds are reported to be mutagenic abd teratogenic in nature [3.]

2. Experimental

Experimental studies have been carried out on a sznthetic solution with 10 ppb mercury content. It has been monitored the influence of acids and salts on mercury analysis. In order to establish the influence of acids, there have been studied well-established volumes of HCl conc., HNO_3 conc., H_3PO_4 conc. and H_2SO_4 conc., that have been added to 100 ml of mercury synthetic solution with 50 ppb concentration, wich have been subjected to analysis [4-5].

In order to establish the influence of salts, there have been studied well-defined volumes of NaCl 30%, KCl 10 %, $CaCl_2$ 20 %, $MgCl_2$ 10% and KI and solution with well-defined concentrations that have been added to 100 ml synthetic solution of mercury with 50 ppb concentration, wich have been subjected to analysis [6-7].

3. Results and discussion

Influence of acids

Experimental data related to the influence of acids on the analysis of mercury are showed in table 1 and figures 1-4.

In accordance to the studies carried out regarding the influence of acods on the matrix of solution, it has been noticed that only HCl influences the analysis of Hg. This may be explained by the fact that HCl is obtained through the Hg cathode process.

HNO_3, H_3PO_4 and H_2SO_4 do not influence within the concentration limit, so they do not lead to interference.

Influence of salts

Experimental data related to the influence of salts are showed in table 2 and figures 5-8.

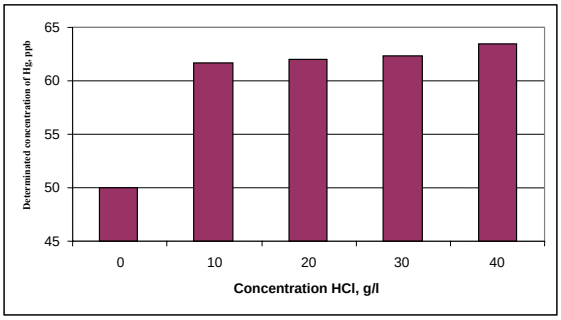

Figure 1. Influence of concentrated HCl on Hg analysis

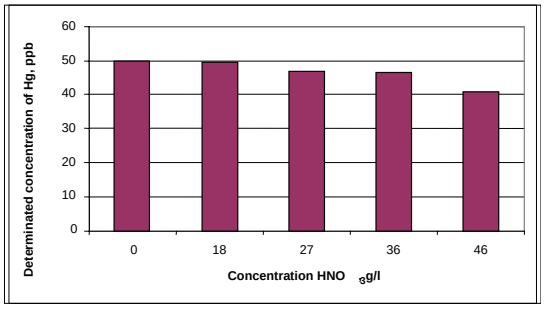

Figure 2. Influence of concentrated HNO_3 on Hg analysis

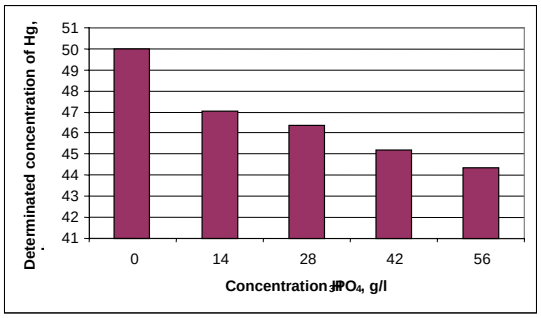

Figure 3. Influence of concentrated H_3PO_4 on Hg analysis

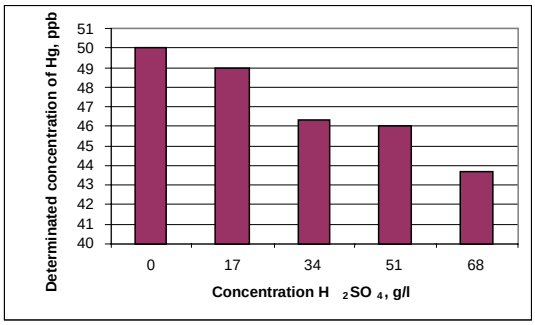

Figure 4. Influence of concentrated H_2SO_4 on Hg analysis

TABLE 1. Experimental data with the influence of acids on Hg analysis

Acid	Nr. Crt.	Volume of acids [mL]	Concentration [g/L]	*Concentration of Hg [ppb]*
	1	0	0	*50*
	2	2.5	10.75	*61.68*
	3	5	21.50	*62.10*
	4	7.5	32.25	*62.39*
	5	10	43	*63.44*
	1	0	0	*50*
	2	2	18.20	*49.58*
	3	3	27.30	*47.12*
	4	4	36.40	*46.59*
	5	5	45.50	*40.97*
	1	0	0	*50*
	2	1	14	*47.03*
H_3PO_4 conc.	3	2	28	*46.37*
	4	3	42	*45.15*
	5	4	56	*44.35*
	1	0	0	*50*
	2	1	17	*48.99*
H_2SO_4 conc.	3	2	34	*46.30*
	4	3	51	*46.04*
	5	*4*	*68*	*43.67*

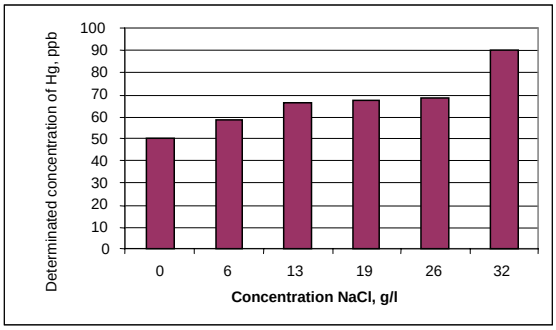

Figure 5. Influence of NaCl on Hg analysis

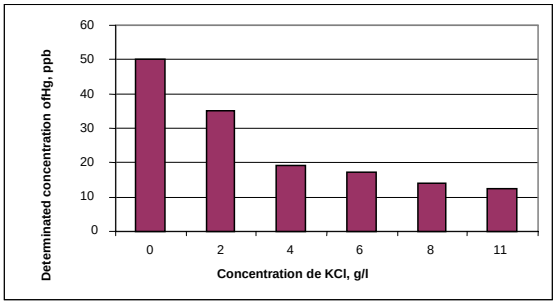

Figure 6. Influence of KCl on Hg analysis

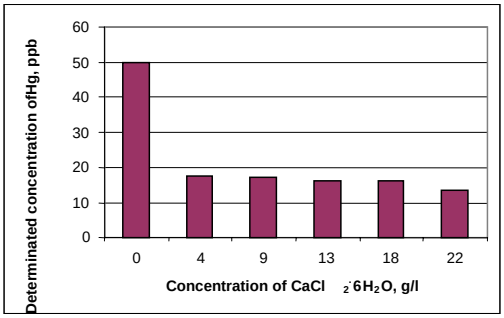

Figure 7. Influence of $CaCl_2.6H_2O$ on Hg analysis

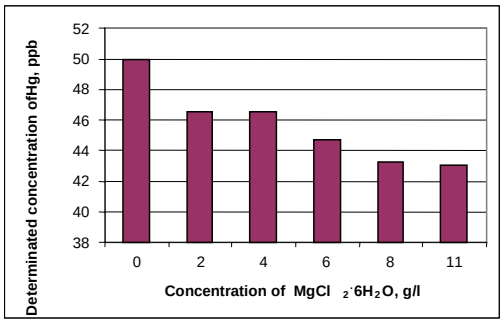

Figure 8. Influence of $MgCl_2.6H_2O$ on Hg analysis

TABLE 2. Experimental data with the influence of salts on Hg analysis

Salts	Nr. Crt.	Volume of chlorides [mL]	Conc. [g/L]	*Conc. of Hg [ppb]*
NaCl 30%	1	0	0	*50*
	2	2	6.4	*58.32*
	3	4	12.8	*66.04*
	4	6	19.2	*67.18*
	5	8	25.6	*68.60*
	6	10	32	*89.96*
KCl 10%	1	0	0	*50*
	2	2	2.12	*34.95*
	3	4	4.24	*19.24*
	4	6	6.36	*17.07*
	5	8	8.48	*14.13*
	6	10	10.6	*12.68*
CaCl2·6H20 20%	1	0	0	*50*
	2	2	4.40	*17.56*
	3	4	8.80	*17.13*
	4	6	13.2	*16.21*
	5	8	17.6	*16.08*
	6	10	22	*13.21*
$MgCl_2 6H_2O$ 10%	1	0	0	*50*
	2	2	2.10	*46.60*
	3	4	4.20	*46.56*
	4	6	6.30	*44.68*
	5	8	8.40	*43.29*
	6	10	10.5	*43.09*
KI	1	0	0	*0*
	2	0.25	2.5	*0*
	3	0.5	5	*0*
	4	1	10	*0*
	5	1.5	15	*0*
	6	*2*	*20*	*0*

TABLE 3. Experimental data with the influence of sulphides on Hg analysis

Salts	Nr. Crt.	Volume of chlorides [mL]	Conc. [g/L]	*Conc. of Hg [ppb]*
Na_2S	1	0	0	*0*
	2	0.25	2.5	*0*
	3	0.5	5	*0*
	4	1	10	*0*
	5	1.5	15	*0*
	6	2	20	*0*
$Na_2S_2O_3$	1	0	0	*0*
	2	0.25	2.5	*0*
	3	0.5	5	*0*
	4	1	10	*0*
	5	1.5	15	*0*
	6	*2*	*20*	*0*

Further to analysis it has been noticed the formation of complexes through reactions of precipitation. Mercury is not made evident through analysis, reason why we shall use further these salts in the separation of mercury from soil.

4. Conclusions

1. Experimental researches aimed to extract mercury from soil.
2. The method of analysis that has been used has been the atomic absorption spectrometry combined with the hydride system. The equipment that has been used was tha Varian Spectr AA 110 apectrophotometer of atomic absoption and the Varian VGA – 77 hydride system.
3. Further to the studies carried out regarding the influence of acids on the matrix of the solution, it has been noticed that only HCl influences the analysis of Hg. This may be explained by tha fact that HCl is obtained through the Hg cathode process.
4. HNO_3, H_3PO_4 and H_2SO_4 do not influence within the concentration limit, so they do not lead to interferences.
5. Further to analysis of the influence of salts, it has been noticed the formation of complexes through reactions of precipitation. Mercury is not made evident through analysis, reason why we shall use further these salts in the separation of mercury from soil.

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References

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