Spectrometric Determination of Water Soluble Lead in Karachi Dust Samples

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ABSTRACT

Heavy metal contamination can have long lasting effects on human and animal health. High level exposure to pollutants can result from the air, water, and soil etc. The heavy metal lead (Pb) was determined in dust samples of Karachi from different districts with UV-visible spectrophotometer after Liquid-Liquid extraction of the Pb-complex formed with dithizone. Lead was prominently detected in all dust samples. Among all the different dust samples studied, the highest lead contamination was found in dust samples collected from Gulshan-e-Hadeed and Maymar. From the study it was concluded that the heavy metal lead contamination in dust of Karachi can accumulate in body via breathing or drinking water which may cause a cute or chronic diseases.

Keywords: Dithizone, Dust, Lead, Liquid-Liquid Extraction, Pb-Complex, Spectrophotometer, UV-Visible.

INTRODUCTION

Lead belongs to heavy metals and is distributed widely around the world. Lead is used in gasoline refineries, sanitary system, cable coatings. It's main use being lead storage batteries and paint pigments. Besides its uses lead is a highly toxic element that can cause serious health effects in humans and animals. Lead poisoning that is toxicity of lead can be acute or chronic depending upon the level of exposure and can lead to diseases such as anemia, hypertension, renal dysfunction etc. In air, lead contaminated dust is assumed to be the main source. Soil, rocks, dust and vehicular exhausts being source of lead contamination in water becoming a public health problem as Pb can distribute in fruits and vegetables and in soil as well (Jamaluddin, 2001).

Recent researchers have found turmeric as a source of lead poisoning in South Asian countries (Jenna *et al*. 2024) and lead pipes that carry drinking water in the US. Lead's toxicity was recognised and recorded in 2000BC. Research articles as early as 1950s have been recorded for the determination of Pb in zinc ores by polarography (Semerano and Elena. 1950) making it the first instrumental method for chemical determination where as gravimetric analysis of lead in 1823 is termed as a simple classical method. The most common methods used in the present day are Atomic Absorption Spectrometry (AAS), Anodic Stripping Voltammetry (ASV) and Inductively Coupled Plasma Mass Spectrometry (ICP-MS). However the choice of a technique depends upon its accuracy and precision, cost and availability and the sample being tested. Liquid-Liquid extraction method for extraction of Pb after complexing with dithizone has has provided a cost effective and easy method for analysis of metals in water. Dithizone (1,5-Diphenylthiocarbazone) is an important complexing reagent for analysis of Pb by UV-Vis spectrophotometer (Shetahun *et al*. 2024).

The method used must produce rapid results with precision and accuracy and being easily available. The spectrophotometric determination of lead is a cost effective technique that has been compared to different instrumental method's results to give output close to the standard methods.

OBJECTIVE

The study was carried out to determine lead present (and capable to dissolve in water) in dust collected from the different districts of Karachi by means of a cost effective method (Liquid-Liquid extraction followed by UV-visible spectrophotometric determination).

METHODOLOGY

Dust samples were collected from various districts of Karachi by using glass marbles. The dust samples were dissolved in water and filtered to separate water soluble content and insoluble portion. The samples were stored in plastic bottles and sealed. Only to be opened at the time of analysis. The soluble lead content was determined by solvent extraction method. For this 5ml of dithizone 30ppm(in chloroform), 10ml of ammonia-cyanide-sulphite solution(pH 9.8) and 10ml of standard lead solution (different standards) were added in a separating funnel and shaken for 1 minute. A coloured complex formed in the organic phase. The phases were allowed to separate. The upper phase (inorganic liquid phase containing metal) was extracted two more times by introducing a fresh lower phase. Overall three extractions were performed for each standard. The absorbance of the complex formed was measured using double beam spectrophotometer at 510nm. Same procedure was carried out for samples. A standard was analysed along with each sample.

RESULT

The concentrations of the samples were determined by applying single point method with respect to the standard concentrations. Varying concentrations of lead were found in different samples. KD-1, KD-2, KD-3, KD-4, KD-5 and KD-6 had lead concentrations of 5.32ppm, 2.35ppm, 5.21ppm, 0.77ppm, 1.96ppm and 0.81ppm respectively. Effects of pH were also studied in complex formation. Lead exhibits difficulty in forming complex at pH above 10. Therefore, pH must be maintained between 9.5 to10.

KCN in ammonia-cyanide-sulphite solution was replaced with NaCN to observe the effects on complex formation. The replacement of K^+ with Na^+ i.e, use of NaCN resulted in a delayed complex formation. The reagent containing NaCN took longer to form complex as compared to the reagent containing KCN.

CONCLUSION

In the present study lead ions are determined in various samples of Karachi Dust from different districts. From the results we concluded that lead is one of the most prominent contamination of heavy metals in Karachi as it was present in all collected samples in varying concentrations. The areas contaminated with such heavy metals are at a high risk of lead accumulation in body that may result in harmful effects on health. So measures must be against the major sources of the pollutant in order to cease its drastic effects.

ACKNOWLEDGEMENT

The authors thank Dr Najma Rasool; Head of Department of Chemistry for supporting this study and the lab staff for providing with the chemicals and reagents required to make the work possible.

We're grateful to Jinnah University For Women for allowing us to carry out this study of metal estimation in their chemistry laboratory.

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