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Atomic Absorption Spectrophotometric Analysis of Lead in Water

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Abstract: The aim of the present work was to test the application of atomic absorption spectroscopy, to the analysis of lead in various water samples.

Traces of lead found in water can be analysed by atomic absporption spectrophotometer by extraction with dithiocarbamate followed by subjecting to the flame of atomic absorption spectrophotometer. The above mentioned method avoids the inaccuracies of many conventional methods. In the present paper an attempt was made to focus mainly on the determination of lead in water samples. Atomic absorption spectrophotometer entails the determination of the absorption of the metal at its line centre by using a narrow line source emitting the given resonance line whose emission line profile is less than the absorption line profile of the analyte in its flame.

Earlier methods involved direct extraction with a complexing agent or colour development with suitable reagents under controlled conditions of pH. which were time consuming involving other difficulties. Results of investigations were accurate and sensitive and free from interferences by extraneous elements.

Keywords: atomic absorption spectrophotometer, dithiocarbamate

I. INTRODUCTION

In the recent decades pollution from heavy metals has become a matter of serious concern. Arsenic mercury, copper cadmium and lead are some of the trace elements that cause highest risk to human health(1).

High levels of lead contamination in the blood in children may have a significant impact in lowering their IQ and increasing the risk of other diseases .Sources of high levels of lead in the blood are lead based paints, lead contaminated dust, water, air and soil. It is also contracted from the adults who work with batteries , work in home renovations, automobile repair shops and processed foods(2). Development and learning delays are some of the early symptoms of contamination along with slowed growth and mood disorders(3). Apart from atmospheric lead , the use of lead in industries which makes its way through water into the human system was found to be high. Gastrointestinal problems like vomiting, constipation and severe fatigue are seen. Chronic low lead exposure has also been associated with cognitive impairment, cardiovascular disease , anemia , low birth weight and premature mortality. The implications of exposure are extremely detrimental (4,5). Lead enters into the atmosphere through industrial waste, human activities, mining, vehicle emissions, lead acid batteries, fertilizers, paints etc. and thereby enter human tissues through diet .heavy metals are hard to metabolise and bioaccumulate in the bodies which causes many health hazards(6).

II. METHODOLOGY

The metal atoms absorb strongly at characteristic wavelength which coincide with the emission spectral lines of the particular metal. Atomic absorption spectrophotometry entails the determination of the element at its line centre by using a narrow line source emitting the given resonance line whose emission line profile is less than absorption line profile of its analyte in flame. The free atoms generated in the atomiser absorb radiation at a specific frequency (7,8). The flame gases are treated as a medium containing free unexcited atoms capable of absorbing radiation from an external source when the radiation corresponds exactly equal to the energy required for transition of the test element from the ground electronic state to an upper excited electronic state. Unabsorbed radiation passes through a monochromator that isolates the excited spectral line . Absorption is measured by the difference in transmitted signal in presence of absorbance of the test element.

Atomic absorption spectrometer uses the absorption of light to measure the concentration of gas phase atoms. The light that is focussed into the flame is produced by a hollow cathode lamp, inside which is the sample.The samples were vaporised in a flame of graphite furnace. Standards of the heavy metal were prepared and vaporised. Standard solutions were made by dilution containing 100mg per litre of the heavy metal , by dissolving over dried lead nitrate in the minimum quantity of hydrochloric acid . Working standards were made up from these as necessary.

Traces of the absorbed heavy metals in the atomiser and spray chamber were removed before each measurement by spraying nitric acid and water. A fine wire was passed through the atomiser capillary after every 5 measurements to clear the deposited matter. Mercury hollow cathode lamp was used as the light source . The light emitted by the cathode was focussed at the centre of the flame into which the sample was aspirated and focussed into the monochromater set to pass the resonance line. The signal from the photomultiplier behind the monochromater was amplified by an amplifier tuned at 50 cycles per second and the rectified output was read on a microammeter (9,10).

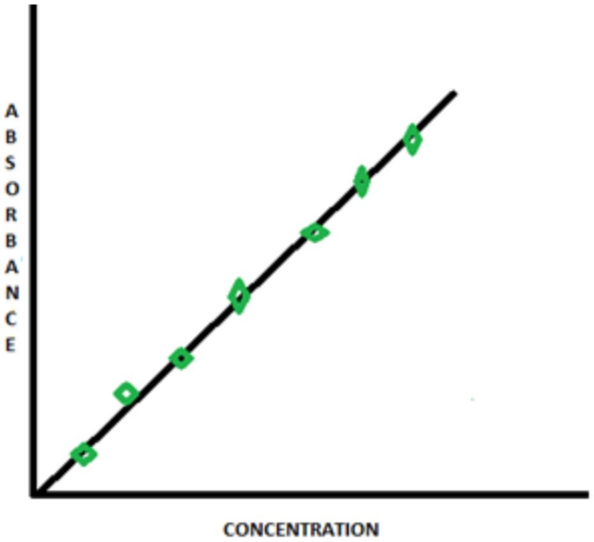
III. RESULTS AND DISCUSSION

A compresser and a cylinder fitted with acetylene gas is used.The pressure is set to 1 psi. Hollow cathode lamp of the sample element is used. A calibration graph is obtained by plotting absorbance Vs. concentration as shown in figure-1 and the data is as shown in table-1.There was ease of sample pre treatment compared to other methods. There was improved sensitivity and an increase in detection power and an increase in reproducibility of the results.

TABLE-1

S.No.	Volume of stock	Concentration (ppm)	Volume of double distilled water	Absorbance
1	0.5	10	49.5	0.2
2	1.0	20	49	0.32
3	1.5	40	48.5	0.68
4	2.0	60	48.0	0.83
5	2.5	80	47.5	0.97

FIGURE-1



IV. CONCLUSION

Earlier methods involved direct extraction with a complexing agent or colour development with suitable reagents under controlled conditions of pH (11,12) . Matrix interferences and high background absorption have been reduced in this method. Those methods were time consuming involving other difficulties. Results of investigations were accurate and sensitive and free from interferences by extraneous elements(13). There was greater reproducibility and was found to be relatively less expensive approach and the sample consumption was also low when compared to other methods (14,15).

V. ACKNOWLEDGMENTS

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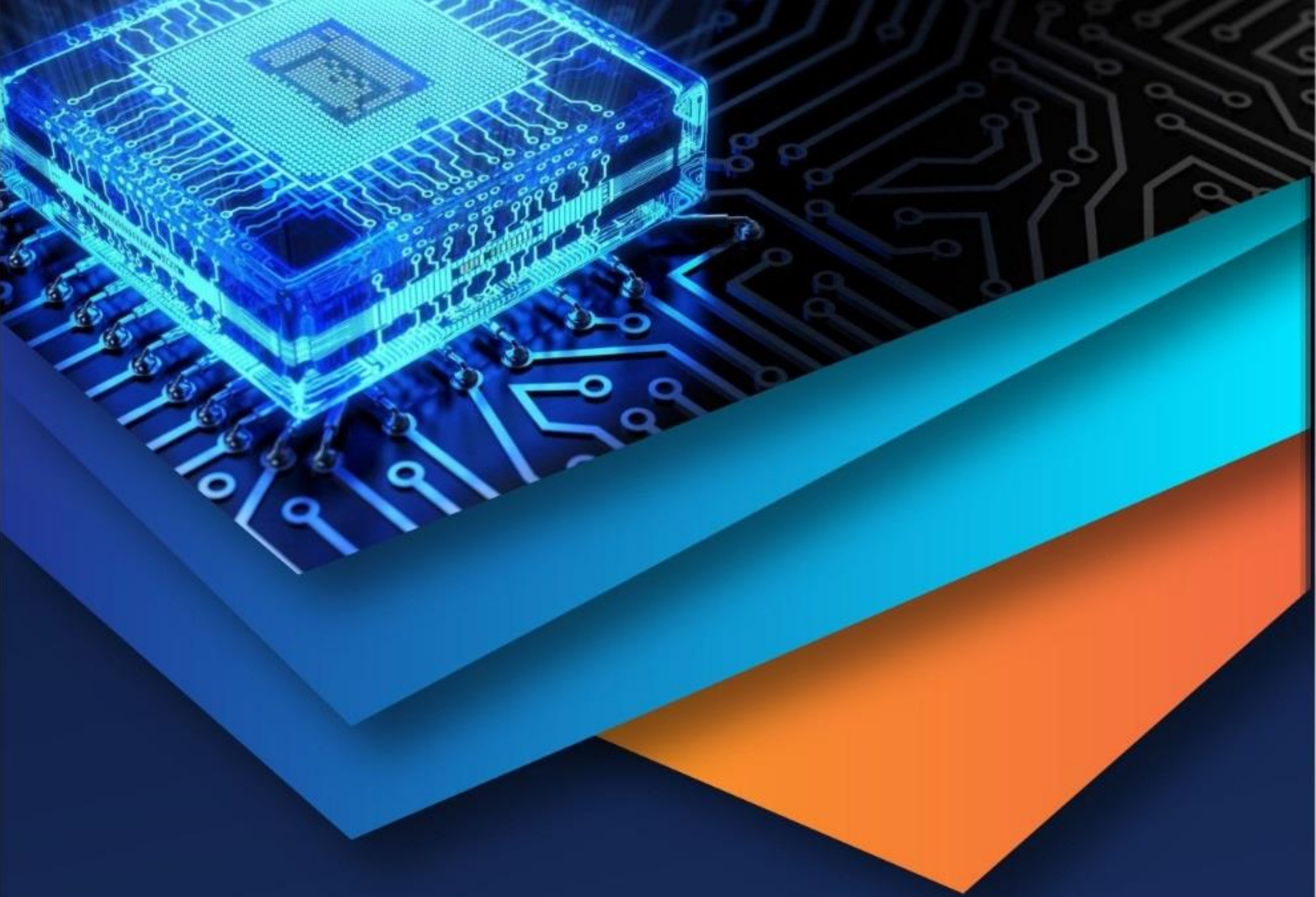

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