

Analysis of food waste water from Raipur area by Atomic Absorption Spectrophotometer

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ABSTRACT: Toxic metals may enter foods from various sources: soil, chemicals used for agricultural land, water used in food processing or cooking, bakeries, canteens, hospital equipment, beverages, dairies, containers and utensils used for food processing etc. The presence of cadmium and lead in the environment and foodstuffs represents an important problem in most of the countries. The samples were analyzed for heavy metals (Cd, Cu, Pb, Zn and Ni). Exposure to toxic metals through consumption of contaminated food products is associated with various health risks and has aroused widespread concern in human health. Toxic metals are connected to cardiovascular disease, impaired fertility, nervous and immune system disorders, increased spontaneous abortions etc. Concerns about lead exposure as an important public health problem increased, as witnessed by the adverse health effects at lower levels. Moreover, this problem is complicated by the fact that these two metals show no biological function in humans. The aim of this study was to determine the levels of cadmium and lead in various foodstuffs from south eastern parts of Raipur Chhattisgarh area. The results of the study implies that continuous monitoring has to be carried out to ascertain the long-term impact of anthropogenic inputs to take remedial measures so as to ensure the health of humans and aquatic life.

Key words: AAS, Food wastes, Heavy metals.

INTRODUCTION

The present study was carried out to determine the concentration of heavy metals in the effluents discharged from food wastes located in Raipur area. The food wastes effluents are also the major source of heavy metal pollution. Raipur area is located on the Bilaspur-Durg road. The term heavy metal refers to any metallic chemical element that has a relatively high density and is toxic or poisonous at low concentrations. Heavy metals include mercury (Hg), cadmium (Cd), arsenic (As), chromium (Cr) and lead (Pb). Heavy metals are natural components of the Earth's crust. They cannot be degraded or destroyed. To a small extent they enter our bodies through food, drinking water and air (Lenntech, 2006). Some heavy metals accumulate in plants up to high concentrations by contaminated water and or soil and hence enter into food chain (Spiro & Stigliani, 2004). Heavy metals naturally present in the environment but may also be introduced as a result of human (anthropogenic) or manmade activities.

However, the concentrations of naturally occurring as well as anthropogenically introduced metals in near surface soils, water, through insecticides, pesticides, harmful chemicals which can then migrate to shallow ground water, can vary significantly due to physical and chemical processes operating across geographic regions (Murray *et.al.*, 2006). The metals analyzed were: (Cd, Cu, Pb, Zn and Ni). The metal analysis was performed by Atomic Absorption Spectrometer. The result showed that Ni was absent in all samples while considerable concentrations of other metals were present.

HEAVY METAL POLLUTION

Heavy metals are commonly considered the simulators or inhibiting factors of life processes, due to which they may appear toxic for living organisms. Some of them are dangerous to health or to the environment (e.g., Cd, Pb, Cr), some may cause corrosion (e.g. Zn, Pb), some are harmful in other ways (e.g. As may pollute catalysts). Within the European community the 13 elements of highest concern are As, Cd, Co,Cr, Cu, Hg, Mn, Ni, Pb, Tn, Th, the emissions of which are regulated in waste incinerators'. Some of these elements are actually necessary for humans in minute amounts (Co, Cu, Cr, Mn, and Ni) while others are carcinogenic or toxic affecting.

STUDY AREA

Raipur (21.21°N and 82.30°E) is a business city located on the south eastern part of India. Raipur has a tropical wet and dry climate; temperatures remain moderate throughout the year, except from March to June, which can be extremely hot. The temperature in April–May sometimes rises above 48 °C (118 °F). These summer months also have dry and hot winds. In summers, the temperature can also go up to 50 °C. The city receives about 1,300 millimeters (51 in) of rain, mostly in the monsoon season from late June to early October. Winters last from November to January and are mild, although lows can fall to 5 °C (41 °F).

MATERIALS AND METHODS

Waste water samples were collected from 2 different sites near to hotels in Raipur city. Samples were collected in good quality screw capped high density pre sterilized polypropylene bottles, each of 1lt capacity, labeled properly and analyzed in laboratory for trace metals by Atomic Absorption Spectrometer (AAS). For assessment of the water quality, monitoring was done during Nov, 2013 to Feb, 2014. High pure (Anal R grade) chemicals and double distilled water were used for preparing solutions for analysis. Preservation and analysis of water samples were based on Standard Methods proposed by American Public Health Association (APHA). The selected heavy metals were analyzed. The detection of traced metals in the environment is accomplished by various methods but here the AAS technique was used, which is relatively simple, versatile, accurate and free from interferences. Heavy metals readily form complexes with organic constituents; therefore, it is necessary to destroy them by

digestion with strong acids. Digestion destroys the organic matter, removes interfering ions and brings metallic compounds in suspension to solution.

Heavy metal determination: For the determination of heavy metals in the samples following steps was performed.

1. Sample Preparation: The samples were brought in the laboratory and then digested. The digestion was performed by taking 10ml of sample, 5ml of conc. HNO_3 and 5ml of conc. HCl . This mixture was swirled gently, covered with watch glass and left at room temperature for about an hour. Samples were then heated on hot plate until yellow fumes were released and the solution became clear. After cooling the acid solution was filtered by Millipore filter (0.4μ) and volume was made up to 50ml by deionized water (Fong *et al.*, 2006).

2. Standard Preparation: Various concentrations of standard solutions for each metal were prepared by diluting the prepared standards of 1000ppm (Merck Chemicals, India.). All the chemicals used for the analytical determination were ultra pure compounds. Water for standard preparations was distilled twice, then stored in glass containers.

3. Analysis: The instrument used for analysis of heavy metals was Atomic Absorption Spectrometer (AAS- RIC 111). All lamps used were hollow cathode lamps and the fuel supply was mixture of air and acetylene.

DIGESTION WITH NITRIC ACID

The suitable volume of the water samples in evaporating dishes were taken and acidified to methyl orange with Conc. HNO_3 . Further, 5ml conc. Nitric acid was added and evaporated to 10ml. Then it was transferred to a 125ml conical Flask. 5ml of conc. Nitric acid and 10ml of perchloric acid (70%) were added. Then heated gently, till white dense fumes of HClO_4 appear. The digested samples were cooled at room temperature, filtered through whatmann no41 or sintered glass Crucible and finally the volume were made upto 100ml with distilled water. Then this solution was boiled to expel oxides of Nitrogen and chlorine. This solution contained 0.8N in HClO_4 . The solution was used for the use of determination of heavy metals.

Procedure

- Preparation of samples and standards for total Analysis: 50ml sample or standard was added to a 200ml Berzelius Beaker and then added 1ml , 2.5N H_2SO_4 and 5ml $\text{K}_2\text{S}_2\text{O}_8$. Then the solution was gently boiled on pre heated hot Plate until a final volume of 10ml was reached. After Digestion, it is diluted to 50ml for subsequent as measurement.

Analysis

Analysis of Heavy metals (Cd, Cu, Pb, Zn and Ni) has been done by using Atomic absorption spectroscopy.

Digestion of Water Sample

The EPA vigorous digestion method described by Gregg (1989) was adopted. 100ml of each of representative water Samples were transferred into Pyrex beakers containing 10ml of conc. HNO₃. The samples were boiled slowly and then Evaporated on a hot plate to the lowest possible volume(about 20 ml). The beakers were allowed to cool and another 5ml of conc. Nitric acid was added. Heating was continued with addition of conc. Nitric acid as necessary until digestion was Complete. The samples were evaporated again to dryness (but not baked) and the beakers were cooled, followed by addition of 5ml of HCl solution(1:1 v/v). The solutions were warmed and 5ml of 5M NaOH was added, then filtered. The filtrates were transferred to 100ml volumetric flasks and diluted to the mark with distilled water. This solutions were then Used for the elemental analysis.

SAMPLE PREPARATION

LEAD SOLUTIONS

Lead, Stock Solution equivalent to 1000mg/l of Pb

Weigh to the nearest + 0.0001gm, app. 1.0000gm Pb metal (minimum purity 99.5%) and dilute in a covered 250ml Glass beaker with 10ml HNO₃. Then add 100ml of water. Boil to expel nitrous fumes, cool, transfer to 1000ml volumetric Flask and fill to the mark with water.

Lead, Standard Solution equivalent to 10mg/ l of Pb

Pipette 10.00ml of Pb stock solution into a 1000ml volumetric flask after that add 20ml of nitric acid, fill the mark with Water and mix well.

Lead, Standard Solution equivalent to 0.4mg/ l of Pb

Pipette 20.00ml of Pb standard solution into a 500ml volumetric flask and then add 10ml of nitric acid, fill the mark with Water and mix well. Prepare this solution on the day of use.

CADMIUM SOLUTIONS

Cadmium, Stock Solution equivalent to 1000mg/l of Cd

Weigh to the nearest + 0.0001gm, app. 1.0000gm Cd metal (minimum purity 99.5%) and dilute in a covered 250ml glass beaker with 40ml HNO₃. Then add 100ml of water. Boil to expel nitrous fumes, cool, transfer to 1000ml volumetric Flask and fill to the mark with water.

Cadmium, Standard Solution equivalent to 10mg/l of Cd

Pipette 10.00ml of Cd stock solution into a 1000ml volumetric flask after that add 20ml of nitric acid, fill to the mark with water and mix well.

Cadmium, Standard Solution equivalent to 0.4mg/l of Cd

Pipette 20.00ml of Cd standard solution into a 500ml volumetric flask and then add 10ml of nitric acid, fill to the mark with water and mix well. Prepare this solution on the day of use.

Cadmium, Standard Solution equivalent to 0.02mg/l of Cd

Pipette 5.00ml of Cd standard solution into a 100ml volumetric flask after that add 2ml of nitric acid, fill to the mark with water and mix well. Prepare this solution on the day of use.

COPPER SOLUTIONS

Copper, Stock Solution equivalent to 1000mg/l of Cu

Weigh, to the nearest + 0.0001gm, app. 1.0000gm Cu metal (minimum purity 99.5%) and dilute it in a covered 250ml glass beaker with 10ml HNO₃. Then add 100ml of water. Boil to expel nitrous fumes, cool, transfer to 1000ml a volumetric flask and fill to the mark with water.

Copper, Standard Solution equivalent to 10mg/l of Cu

Pipette 10.00ml of Cu stock solution into a 1000ml volumetric flask and then add 20ml of nitric acid, fill to the mark with water and mix well.

Copper, Standard Solution equivalent to 0.4mg/l of Cu

Pipette 20.00ml of Cu standard solution into a 500ml volumetric flask after that add 10ml of nitric acid, fill to the mark with water and mix well. Prepare this solution on the day of use.

ZINC SOLUTIONS

Zinc, Stock Solution equivalent to 1000mg/l of Zn

Weigh to the nearest + 0.0001gm, app. 1.0000gm Zn metal (minimum purity 99.5%) and dilute in a covered 250ml glass beaker with 40ml HNO₃. Then add 100ml of water. Boil to expel nitrous fumes, cool, transfer to 1000ml volumetric Flask and fill to the mark with water.

Zinc, Standard Solution equivalent to 10mg/l of Zn

Pipette 10.00ml of Zn stock solution into a 1000ml volumetric flask and then add 20ml of nitric acid, fill to the mark with water and mix well.

Zn, Standard Solution equivalent to 0.4mg/l of Zn

Pipette 20.00ml of Zn standard solution into a 500ml volumetric flask after that add 10ml of nitric acid, fill to the mark with water and mix well. Prepare this solution on the day of use.

Zinc, Standard Solution equivalent to 0.02mg/l of Zn

Pipette 5.00ml of Zn standard solution into a 500ml volumetric flask and then add 10ml of nitric acid, fill to the mark with water and mix well. Prepare this solution on the day of use.

NICKEL SOLUTIONS

Nickel, Stock Solution equivalent to 1000mg/l of Ni

Weigh, to the nearest + 0.0001gm, app. 1.0000gm Ni metal (minimum purity 99.5%) and dilute it in a covered 250ml glass beaker with 10ml HNO₃. Then add 100ml of water. Boil to expel nitrous fumes, cool, transfer to 1000ml a volumetric flask and fill to the mark with water.

Nickel, Standard Solution equivalent to 10mg/l of Ni

Pipette 10.00ml of Ni stock solution into a 1000ml volumetric flask and then add 20ml of nitric acid, fill to the mark with water and mix well.

Nickel, Standard Solution equivalent to 0.4mg/l of Ni

Pipette 20.00ml of Ni standard solution into a 500ml volumetric flask and then add 10ml of nitric acid, fill to the mark with water and mix well. Prepare this solution on the day of use.

The Standard Values as prescribed by BIS

<i>A. Name of Heavy Metal</i>	<i>B. Concentration (Mg/Lit)</i>
<i>C. Pb</i>	<i>D. 0.002</i>
<i>E. Cd</i>	<i>F. 0.001</i>
<i>G. Cu</i>	<i>H. 0.002</i>
<i>I. Zn</i>	<i>J. 0.002</i>
<i>K. Ni</i>	<i>L. 0.001</i>

SAMPLE 1 (TATIBANDH AREA)

<i>M. Name of Heavy Metal</i>	<i>N. Concentration (Mg/Lit)</i>
<i>O. Pb</i>	<i>P. 0.003</i>
<i>Q. Cd</i>	<i>R. 0.000</i>
<i>S. Cu</i>	<i>T. 0.003</i>
<i>U. Zn</i>	<i>V. 0.001</i>
<i>W. Ni</i>	<i>X. 0.000</i>

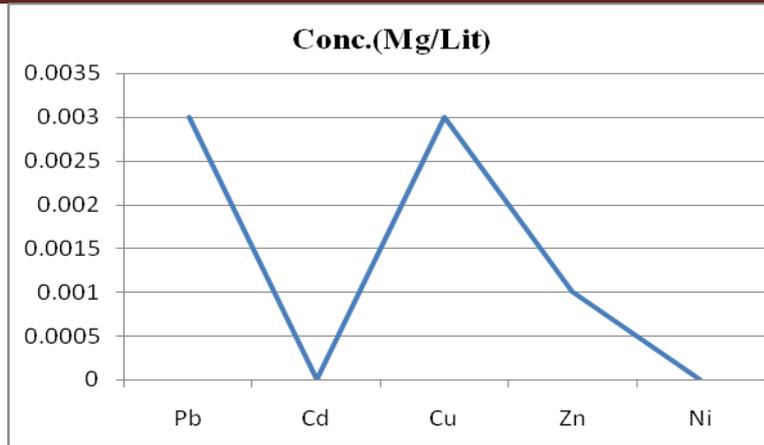


Figure 1 Tatibandh Area

SAMPLE 2 (TELIBANDHA AREA)

<i>Y. Name of Heavy Metal</i>	<i>Z. Concentration (Mg/Lit)</i>
<i>AA. Pb</i>	<i>BB. 0.001</i>
<i>CC. Cd</i>	<i>DD. 0.001</i>
<i>EE. Cu</i>	<i>FF. 0.002</i>
<i>GG. Zn</i>	<i>HH. 0.001</i>
<i>II. Ni</i>	<i>JJ. 0.000</i>

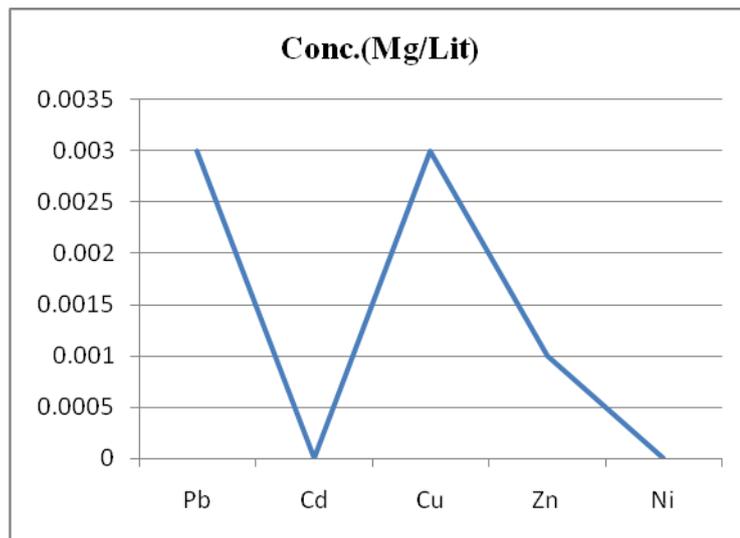


Figure 2 Telibandha Area

CONCLUSIONS

Analysis of Heavy metals in food waste water is carried out by calibrating graph between conc of analyte and absorbance using AAS. The results show that the water from the food stuff area studied had larger content of heavy metals in Tatibandh Area(Pb & Cu) due to rich in Industrial area although high level of heavy metals under study, yet there are some factors effecting their absorption by the soil and of course their availability to the plants. Whereas in Telibandha area the findings are low as compared to Tatibandh area due to lesser in Industries which contaminate soil and water. These findings imply that the consumption of the polluted water by animals from rains and irrigation of crops from this water could be hazardous to the health. The soil contaminated by these effluents will produce unhealthy food as heavy metals can enter the food chain and thus be consumed by human beings.

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