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# HEAVY METAL CONTENTS OF MUNICIPAL SOLID WASTES IN CUTTACK (ODISHA)

**Dr. (Mrs) S. PATNAIK**

*S.B. Women's College, Cuttack*

**AND**

**Dr. P.K. MISRA**

*Mayurbhanj Chemical Laboratory, Ravenshaw Univertsity, Cuttack-753003 (Odisha)*

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The heavy metal contents of solid wastes produced by Cuttack city inhabitants during 2014-15 are discussed. Industrial areas contribute the maximum amount of heavy metals to the total metal contents followed by dumping grounds. Various sources of heavy metals have been identified

## INTRODUCTION

A review of literature reveals that the status of heavy metals has been studied extensively in water, air and soil (Dayal and Singh, 1991 and Dayal, 1992) but a few studies on the presence of heavy metals in municipal refuse (Sridhar and Bammeke, 1990). The present investigation was, therefore, undertake to measure the concentrations of heavy metals in solid wastes in Cuttack city. Following points from the basis of this study :

I. Efforts are on to recycle solid wastes with a view to obtain animal feed supplements (Callihan and Dunlap, 1971). In this regard, heavy metals may enter the finished by-product and pose a serious threat to animal health and meat quality.

II. Solid wastes are utilized to prepare compost and soil conditioner and fertilizer in association with chemical fertilizers. If it contains excessive amounts of heavy metals, these can be taken up by plants and ultimately passed on to men and animals causing several physiological disorders. The experience of developed countries who reported large concentrations of heavy metals in compost and sewage sluge demand a look into this aspect (Sommer, 1977 and Mays *et al*., 1973).

III. The combustion of wastes has been recognized as one of several alternatives management options. A concern associated with municipal waste combustion is that heavy metals (lead and cadmium in particular) have found in analytical test of the ash from these facilities.

## MATERIALS AND METHODS

1. **Selection of Sites :** After an initial survey of the municipal area of the city, the different areas were classified occupation-wise as residential, commercial, industrial and dumping grounds. The residential areas were further classified into high income, middle income, low income and slum type groups.

50 sampling points were so selected as to be truly representative of the contributing population scattered all over the city limits. 250 samples (5 samples from each point) were collected during 2014-15.

**2. Frequency of Sampling :** The sampling was carried out on each day for one week. Samples were collected everyday from sampling points belonging to the different occupation groups.

**3. Preparation of Samples :** To 5g each of the samples in a Kjeldahl flash was added 20 ml conc. $HNO_3$ and 10 ml conc. perchloric acid ($HClO_4$). The contents were heated gently first on a sand bath followed by a strong heating until all $HNO_3$ was driven off and the solution began to clear. More $HNO_3$ as added and heated until white fumes of $HClO_4$ were evolved out and the solution became clear pale yellow. The contents were cooled and 10 ml conc. HCl was added. The mixture was heated to dissolve all solids and the volume of solution was made 100 ml volume with conductance water. A residue of sand and other silica materials were removed by centrifugation and discarded.

**4. Analysis :** The concentrations of heavy metals namely Cu, Ni, Cd, Cr, Pb, Fe, Mn and Zn were measured using polarographic methods (Bond, 1980 and Kalvoda, 1987).

## Results and discussion

The average values of heavy metals are given in Table 1. There is a wide variation in heavy metal contents of different sub-groups. No specific trends could be observed in the amounts of heavy metals contributed by various sub-groups. It is apparent from the results that higher amount of heavy metals are given by dumping grounds.

**Residential Areas :** The results reveals that the high income group contributed the highest amount of heavy metals followed by middle, low, slum. This may be attributed to the socio-economic status and socio-cultural factors of these sub-groups. The tendency of using modern equipments and fast foods in the middle income group probably contributed to the high levels of heavy metals. In the high income group Cr, Cd, Ni and Cu showed higher values. Ph, Fe and Zn are in excess in slums.

**Industrial Area :** Solid wastes of industrial areas had higher concentration of Fe (4345.19 mg $kg^{-1}$) followed by Mn, Zn, Cr, Ph, Ni, Cu and Cd. The high concentration of Fe may be attributed to iron foundries. A study conducted by the Environmental Protection Agency (EPA, 1989) in USA reveals that lead-acid batteries contribute 65% of lead in municipal solid wastes and consumer electronics like television set, radio, cassette recorder, etc. contribute 27%, 50% of Cd in solid waste comes from house-hold batteries (rechargeable nickel-cadmium batteries) and 28% from plastic.

**Commercial Areas :** The commercial areas include markets dealing mostly with food items. The solid waste produced in these areas comprise of traditional household and commercial (paper, etc.) wastes. The concentration of Fe (3890.14 mg $kg^{-1}$) is higher. Other metals in descending order of their concentration are Mn, Zn, Cr, Ni, Cu, Ph and Cd.

**Dumping Grounds :** Fe follows the same trend as in case of commercial areas. The values of Fe is much higher to those reported for other rest of metals follow the same trend as in other areas.

**Table 1. Heavy metal contents of solid wastes in Cuttack city during 2014-15.**

| | Type of Locality | Cu | Ni | Cd | Cr | Pb | Fe | Mn | Zn |
|---|---|---|---|---|---|---|---|---|---|

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1. | Residential areas | | | | | | | | |
| | i. High Income | 35.15 | 13.80 | 2.98 | 46.14 | 10.70 | 911.70 | 616.43 | 66.81 |
| | ii. Middle Income | 13.15 | 11.15 | 2.76 | 46.15 | 9.76 | 2885.15 | 849.18 | 65.66 |
| | iii. Low Income | 11.35 | 13.75 | 1.35 | 28.76 | 26.15 | 2986.62 | 623.69 | 89.15 |
| | iv. Slum | 5.85 | 4.95 | 0.91 | 40.15 | 4.15 | 2640.03 | 580.19 | 49.85 |
| 2. | Industrial areas | 14.75 | 26.60 | 3.75 | 73.45 | 31.45 | 4345.10 | 815.15 | 65.48 |
| 3. | Commercial areas | 13.85 | 25.15 | 2.95 | 43.25 | 7.15 | 3890.15 | 916.45 | 43.88 |
| 4. | Dumping grounds | 26.10 | 15.87 | 2.65 | 27.80 | 17.95 | 3940.55 | 916.58 | 43.98 |

All values are in mg $kg^{-1}$; DM – Dry matter.

# Conclusion

We contribute a fairly high amount to the total metal contents. The concentration of heavy metals are well below the limits suggested for compost (Brunt *et al*., 1985). We believe that this account of heavy metals may prove useful for the policy makers and planners involved in formulating mitigation strategies for a better management of solid wastes.

# References


1. Bond, A.M., '*Modern Polarographic Methods in Chemical Analaysis*', Marcel Dekker, New York (1980).
2. Brunt, L.P., Dean, R.B. and Patrick, P.K. in '*Solid Waste Management – Selected Topics*', Sues, M.J. (ed.) WHO Regional Office for Europe, Copenhagen, Denmark (1985).
3. Callihan, C.D. and Dunlap, C.E., 'Construction of a Chemical Microbial Pilot Plant for Production of Single Cell Protein from Cellulosic Wastes', *Report SW-24c*, USEPA (1971).
4. Dayal, G., *J. Natcon*. (in Press) (1992).
5. Dayal, G. and Singh, R.P., *Proc. Nat. Acad. Sci.*, India, **60 (A) IV**, 569-572 (1991).
6. EPA, 'Characterization of Products containing Lead and Cadmium in Municipal Solid Waste in the United States, 1970 to 2000', Final Report EPA/530-SW-89-015c, Office of Solid Waste, Washington, D.C. (1989)
7. Kalvoda, R., 'Electroanalytical Methods in Chemical and Environmental Analysis', Plenum Press, New York (1987).
8. Mays, D.A., Terman, G.L. and Duggan, G.L., *J. Environ Quality*, **6,** 225 (1973).
9. Olaniya, M.S. and Bhide, A.D., 'Heavy metal status in some Indian city refuse', *Int. Cog. on heavy metals in Indian Environmental*, Aligarh, Jan. 8-10 (1990).
10. Sommers, J.F., *J. Environ. Quality*, **6,** 225 (1977).
11. Sridhar, M.K.C. and Bammeke, A.O., *Water, Air and Soil Pollution*, **29,** 51-56 (1986).


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