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ASSESSMENT OF HEAVY METAL STUDY ON GROUND WATER IN AND AROUND KAPULUPPADA MSW SITE, VISAKHAPATNAM, AP.

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ABSTRACT
Groundwater samples were collected within 2 km radius in and around Kapuluppada MSW dump Site, Visakhapatnam and its adjacent area to study the possible impact of leachate percolation on groundwater quality (Suman Mor et., al). Collections of sampling locations were divided into 2 residential areas, 4 in the dump site area and 4 in the near rural area of the study area in 10 locations. Concentration of heavy metals such as Al, Cr, Mn, Fe, Ni, Cu, Zn, As, Cd, Hg and Pb were determined in groundwater samples. The average value of each metal concentrations in 10 sampling locations were like Al (0.0449 ppm), Cr (0.096 ppm), Mn (0.144 ppm), Fe (1.569 ppm), Ni (0.203 ppm), Cu (0.508 ppm), Zn (2.814 ppm), As (0.036 ppm), Cd (0.284 ppm), Hg (0.011 ppm) and Pb (1.084 ppm) results respectively. The moderately high concentrations of Al, Cr, Mn, Fe, Ni, Cu, Zn, As, Cd, Hg and Pb in groundwater, likely indicate that groundwater quality is being significantly affected by leachate percolation. The effect of depth and distance of the well from the pollution source was investigated. The presence of heavy metal in groundwater warns for the groundwater quality and thus renders the associated aquifer unreliable for domestic water supply and other uses. Although some remedial measures are suggested to reduce further groundwater contamination via leachate percolation, the present study demand for the proper management of waste in Kapuluppada MSW dump Site.

KEY WORDS: Ground water, heavy metal.

INTRODUCTION

Visakhapatnam, a fast growing metropolitan city, also referred as the city of density at the same time increasing of industrial processes were accelerating urbanization and increasing the population day by day. Increasing population accelerating directly or indirectly resource utilization that leads to solid and liquid waste as well as air emissions. Improper management of solid waste management contributes large quantities of pollutants (soil, water and air) percolated into ground water table that have been continuously introduced into ecosystems. Trace heavy metal contamination in the ground water is a major concern because of their toxicity and threat to human life and the environment. Heavy metals such as Al, Cr, Mn, Fe, Ni, Cu, Zn, As, Cd, Hg and Pb are potential soil and water pollutants. Heavy metal studies are necessary to evaluate both soil/sediment and groundwater contamination. Also most of the municipal water supplies come from boreholes, most of which are shallow wells. The toxic heavy metals entering the ecosystem may lead to geoaccumulation, bioaccumulation and biomagnification. Heavy metals like Fe, Cu, Zn, Ni and other trace elements are important for proper functioning of biological systems and their deficiency or excess could lead to a number of disorders. Food chain contamination by heavy metals has become a burning issue in recent years because of their potential accumulation in biosystems through contaminated water, soil and air. Our present study focused on Kupuluppada Municipal Waste Dumping Site.

MATERIALS AND METHODS

Study Area

The study area Kapuluppada MSW site is lies between latitude 17^0 50’ 45 26’’ N and longitude 83^0 22’ 03 27” E and is a part of Visakhapatnam, Andhra Pradesh shown in Figure 1.

A hilly terrain area in the area is towards Northwest and finally joins flowing NE and the stream is perennial in nature. Errigedda, Gangulugedda, levendor canal are being cleared and periodically through proclaims. The average rainfall of the area is around 2400 mm/year. Unauthorized occupation and Encroachments led to narrowing of major drains, diversion of geddas, indistmate disposal of waste and debris led to inundation of low lying areas during rains sessions.

FIGURE-1

Sample collection and location

The choice of the sampling stations considered location, accessibility, proximity to residential areas and the topography of the study area. 10 sampling locations were within the 2 residential areas (in the 2 km radius), 4 in the dump site area and 4 in the near rural area of the study area. Ground water samples were randomly collected from surrounding areas of MSW dumping site (10 bore holes) with in single season i.e rainy season during the month of September 2010 in 10 different locations. Those are Maridi, Scrap Shop, Beside Scrap Shop, Near Canal, Boravanipalem-1, Boravaniaplem-2, Paradesipalem-1, Paradesipalem-2, Vambay Colony-1 and Vambay Colony-2. The locations of the groundwater points were obtained with a hand held Global Positioning System (GPS, Garmin 72 model) with position accuracy of less than 10 m (Table 1). In all, about 40% of the groundwater sources within 2 km radius of the landfill were sampled. Water samples, in the hand dug wells were obtained using same material that is used to fetch water from each well. The seepage of chemical constituents in the leachate formed as a consequence of continuous disposal of municipal and industrial wastes at the landfill have been shown to constitute serious threat to the environment and human health (Abu-Rukah and AlKofahi, 2001; Lee et al., 2005).

Laboratory methods

The collected samples were filtered (Whatman no.42) and preserved with 6N of HNO3 for further analysis (APHA, 1998). To ensure the removal of organic impurities from the samples and thus prevent interference in analysis, the samples were digested with concentrated nitric acid. 10ml of nitric acid was added to 50ml of water in a 250ml conical flask. The mixture was evaporated to half its volume on a hot plate after which it was allowed to cool and then filtered. Concentrations of heavy metals in water samples were determined with an Inductive coupled Plasma Mass spectrometry (ICP-MS agilent) with a specific lamp for particular metal. The digested water samples were analysis done by for using inductively coupled plasma mass spectrometry (ICP-MS) at Center for Studies on Bay of Bengal, Andhra University. Appropriate drift blank was taken before the analysis of samples.

Heavy metal ICP-MS analysis report:

	Al	Cr	Mn	Co	Cu	Zn	As	Cd	Hg	Pb
SL1	0.725	0.012	0.01	0.007	0.153	0.25	0.003	0.007	0.005	0.433
SL2	0.493	0.073	0.144	0.002	0.663	4.414	0.03	0.006	0.003	0.111
SL3	0.245	0.036	0.145	0.001	0.163	0.905	0.008	0.002	0.008	0.045
SL4	0.251	0.115	0.087	0.001	0.521	0.672	0.01	0.022	0.008	1.39
SL5	0.2	0.06	0.163	0.001	0.374	3.319	0.048	0.171	0.009	0.724
SL6	0.957	0.074	0.176	0.002	0.366	4.827	0.088	0.008	0.009	0.699
SL7	0.277	0.12	0.201	0.001	0.872	3.186	0.038	2.482	0.008	4.287
SL8	0.838	0.385	0.314	0.001	0.767	5.711	0.069	0.006	0.047	0.092
SL9	0.383	0.07	0.186	0.001	0.769	3.982	0.044	0.133	0.007	2.946
SL10	0.12	0.015	0.014	0.001	0.439	0.871	0.021	0.002	0.004	0.111

DISCUSSION

Distribution of trace metals like Al, Cr, Mn, Fe, Ni, Cu, Zn, As, Cd, Hg and Pb at various location results are shown in table: 1. Over all the heavy metal results were observed followed by Zn (5.71 ppm) > Fe (4.51 ppm) > Pb (4.29 ppm) > Cd (2.48 ppm) > Al (0.96 ppm) > Cu (0.87) > Ni (0.80 ppm) > Cr (0.39 ppm) > Mn (0.31 ppm) > As (0.09 ppm) > Hg (0.05 ppm) respectively.

Aluminium is the most abundant element found in the earth's crust (John De Zuane, 1990). The concentration of the Aluminium in our study area ranged from 0.120 – 0.957 ppm. The ground water quality standards of Aluminium desirable limit (WHO) is 0.03 mg/l and maximum permissible limit is 0.2 mg/l. In our study area half of sampling locations i.e. SL6 (0.957) > SL8 (0.838) > SL1 (0.725) > SL2 (0.493) > SL9 (0.383) were observed exceeds the WHO maximum permissible limits. Since toxicity is associated with continuous low level exposure, this can eventually lead to serious health effects (Momodu and Anyakora, 2010).

Chromium enters environment from old mining operations runoff and leaching into groundwater, fossil-fuel combustion, cement-plant emissions, mineral leaching, and waste incineration. The concentration of the Chromium in our study area ranged from 0.012 – 0.385 ppm. The ground water quality standard of Chromium desirable and maximum permissible limit (WHO) is 0.05. In our study area higher concentrations were observed when compare to WHO standards i.e., SL2 (0.073) > SL4 (0.115) > SL6 (0.074) > SL7 (0.120) > SL8 (0.385) > SL9 (0.07) respectively. Highest concentrations were observed at SL8 (0.385) Presence of high concentration of Chromium (III) and heavy doses of Chromium salts even though are rapidly eliminated from human body, could corrode the intestinal tract (Akoteyon et. al., 2011)

Manganese is occurs naturally as a mineral from sediment and rocks or from mining and industrial waste. The concentration of the Manganese in our study area ranged from 0.010 – 0.314 ppm. The ground water quality standard of Manganese desirable and maximum permissible limit (WHO) is 0.05. In our study area all sampling locations were Manganese concentrations less then WHO permissible limit. Excess concentrations of manganese make water distasteful to drinking with no specific toxic effects (Longe, E.O. and L.O. Enekwechi, 2007)

Copper enters into water bodies mostly anthropogenic activities like metal plating, industrial and domestic waste, mining, and mineral leaching were main sources for the presences in environment. The concentration of the Copper in our study area ranged from 0.153 – 0.872 ppm. The ground water quality standard of Copper desirable limit (WHO) is 0.05 mg/l and maximum permissible limit is 1.5 mg/l. All the sampling locations SL1 – SL10 were exceeds then WHO desirable limit and less then maximum permissible level of copper.

Zinc is found naturally in water, most frequently in areas where it is mined and from industrial waste, metal plating, and plumbing, and is a major component of sludge. The concentration of the Zinc in our study area ranged from 0.250 – 5.711 ppm. The ground water quality standard of Zinc desirable limit (WHO) is 5.0 mg/l and maximum permissible limit is 10.0 mg/l. Except one sampling location i.e., SL8 (5.711 ppm) exceeds then desirable limit (WHO).

Arsenic enters into environment from natural processes, industrial activities, pesticides, and industrial waste, smelting of copper, lead, and zinc ore. The concentration of the Arsenic in our study area ranged from 0.003 – 0.088 ppm. The ground water quality standard of Arsenic desirable and maximum permissible limit (WHO) is 0.05 mg/l. SL6 (0.088) and SL8 (0.069) sampling points were exceeds then WHO desirable and maximum permissible limit of Arsenic.

Cadmium found in low concentrations in rocks, coal, and petroleum and enters the ground and surface water may enter the environment from industrial discharge, mining waste, metal plating, water pipes, batteries, paints and pigments, plastic stabilizers, and landfill leachate. The concentration of the Cadmium in our study area ranged from 0.002 – 2.482 ppm. The ground water quality standard of Cadmium desirable and maximum permissible limit (WHO) is 0.01 mg/l. Four sampling locations i.e. SL7 (2.482) > SL5 (0.171) > SL9 (0.133) > SL4 (0.022) were recorded more then WHO desirable and maximum permissible limit of Cadmium and most critical level were recorded at SL7 when compare to other.

Mercury is occurs as an inorganic salt and as organic mercury compounds. Enters into the environment from industrial waste, mining, pesticides, coal, electrical equipment (batteries, lamps, and switches), smelting, and fossil-fuel combustion. The concentration of the Mercury in our study area ranged from 0.003 – 0.047 ppm. The ground water quality standard of Mercury desirable and maximum permissible limit (WHO) is 0.001 mg/l. All sampling locations were exceeds then WHO desirable and maximum permissible limit of Mercury. Highest concentration observed at SL9 (0.009).

Lead enters into environment from industry, mining, plumbing, gasoline, coal, and as a water additive. The concentration of the Lead in our study area ranged from 0.045 – 4.287 ppm. The ground water quality standard of Lead desirable and maximum permissible limit (WHO) is 0.01 mg/l. Six sampling locations i.e. SL1, SL4, SL5, SL6, SL7, and SL9 were exceeds then WHO desirable and maximum permissible limit of Lead and while highest concentration observed at SL7 (4.287) in our study location.

CONCLUSION

The ground water samples showed significant higher values of the heavy metal contents than the control. Municipal waste percolation process that result some areas are recorded highest concentrations and this raises a lot of environmental concern and calls for urgent attention. It is therefore recommended that the dumpsite condition be improved to minimize the effects on the environment or that it be relocated to another area, outside the residential area.

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