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Characterization of Contaminated Soil and Surface Water/ Ground Water Surrounding Waste Dump Sites in Bangalore

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Abstract

The quality of bore well water around the dumpsite will assessed and compared with the standards prescribed for drinking water. Available literature reveals that the major cations and anions present around any dumpsite were sodium, calcium, chloride and sulphate respectively and were found to be beyond the prescribed limit. The moderately high concentrations of sodium, chloride and potassium in soil and groundwater, likely indicate that groundwater quality is being significantly affected by percolation of leachate. The effect of depth and distance of the well from the pollution source will be established. The pollution potential assessment using DRASTIC methodology guidelines of ministry of Environment/forest ranking system also reveals that some sites are moderately vulnerable to pollution potential.

1. Introduction
It is reported that unscientific dumping of municipal wastes is very common disposal method in many Indian cities which cause adverse impacts to the environment (Mahar et al., 2007). Nearly all human activities generate waste, and the way in which this is handled, stored, collected and disposed of, can pose risks to the environment and to public health (Zhu et al., 2008). Several fluxes of waste and cover materials from different sources end up at these dumpsites and due to the heterogeneity and complexity of wastes, these dumpsites contain a variety of contaminants which can pollute the soil of the area (Sukop et al., 1979). The physico-chemical properties of the degraded soils at these sites are one of the important factor playing roles in vegetation development (Gairola and Soni, 2010). For instance, soil structure and acidity affects the absorption and accumulation of mineral elements by plants (Tresow, 1970) and

thus play a very important role in vegetation establishment and development at such sites. Different Sources such as electronic goods, painting waste, used batteries, etc., when dumped with municipal solid wastes raise the heavy metals in dumpsites and dumping devoid of the separation of hazardous waste can further elevate noxious environmental effects. Environmental impact of land filling of MSW can usually result from the run-off of the toxic compounds into surface water and groundwater (Belevi and Baccini, 1989) which eventually lead to water pollution as a result of percolation of leachate (Beaven and Walker, 1997; Rajkumar et al., 2010). The occurrence of various heavy metals in MSW dumpsites was reported by many workers

2. Research Significance

Generation of waste is an inevitable component of the industrial and community activity. In the present study, a few industrial area dumpsites would be considered for detailed investigation and to evaluate the impact of pollution potential on soil and subsequent ground water resources. There are some biggest and oldest dumpsites with huge quantity of broad spectrum of wastes. Many industries of all nature are located in and around the dump sites. As per the information available, many dumpsites are more than 20 years old and dumpsite spread area is not uniform, with depth of waste materials dumped was about 10-15 feet. It was observed that various kinds of industrial wastes like Oil waste, glass wool, chemical wastes, pharmaceutical wastes, metallic waste, ceramic wastes plastic wastes, stone dust, electronic wastes etc, were dumped in an unscientific manner. Most of the industries discharge solid, liquid and hazardous wastes with or without any pre-treatment. The hazardous waste so generated is presently temporarily stored or stockpiled within industrial premises. The emissions from unscientific disposal of solid/liquid and hazardous waste from industries contain most dangerous heavy metals, acids, oil emissions, toxic wastes or infectious waste which can spread dreaded diseases to man and damage to the environment. The study area has highly undulating topography and predominantly consisting of granites and gneisses which are crisscrossed by pegmatite and are highly jointed. The climate in the study area is generally hot and humid and is characterized with seasonal variations of the year.

3. Materials and Methods

Based on the hydro geological conditions at the dumpsites, a sampling strategy needs to be developed in order to obtain the experimental data needed to arrive at the characterization objective and hence to determine the extent and routes of contamination caused by the illegal dumpsites on the surrounding soils and the subsequent ground waters. APHA method for Ground water analysis and Soil contaminated are used.

4. Determination of Moisture Content

Moisture content is measured immediately after the collection of sample, wet weight of the sample is measured, and it is dried in the oven at a temperature of 105°C till the weight is constant. The dried sample is then cooled at room temperature and weighed again. The moisture is then determined using the formulae,

$$W = \left(\frac{W_1 - W_2}{W_1}\right) \times 100$$

Where, W =Moisture content in %

W_1 = Net weight of wet sample in grams

W_2 = Net weight of dried sample in grams

5. Determination of Carbon Content (Walkey and Black Method)

Known weight of dried sample is taken in a conical flask. To this 10 ml of 1N potassium dichromate and 20ml concentrated sulphuric acid are added. Silver sulphate is added as catalyst. The contents are mixed by gentle swirling. The flask is then allowed to stand still for about 30 minutes for the reaction to take place. To this 200ml of distilled water and 10 ml phosphoric acid is added. 1ml diphenylamine indicator is added to mixture. The colour changed to bluish purple. The contents are then titrated against 1N ferrous ammonium sulphate till the colour changed from blue to brilliant green. The percent residual carbon is then calculated using the equation.

$$\%\ \text{organic Carbon} = \left(\frac{(A - B) \times 0.003 \times N\ \text{of FAS}}{W}\right) \times 100$$

Where,

A = Blank volume

B = Volume of 1N FAS rundown in ml to titrate the sample

W = Weight of sample taken

6. Experimental Investigation method

6.1 Soil Sampling and Analysis

Leachate causes the pollution of the soil, surface water and groundwater. The soil which is an important component of landfill site is a media where polluted materials are deposited. Because of continuous transportation to other media (air, ground and surface water) from this media by evaporation, erosion and infiltration, this component is a natural source which is needed to carefully monitor (Banaret al. 2009). In this content, soil characterization (organic matter, moisture content of the soil and pH of the soil, etc.) is very important on the amount and distribution of pollution (Taoeli 2007; El-Fadel et al. 1997; Daskalopoulos et al. 1997; Tchobanoglous et al. 1993). In the present study, the soil samples were collected from four locations (BH 1 to BH 4) with the distance of 200 m from the Bangalore open dump site boundary. Soil samples were collected at every 1.5 m interval (top surface, 1.5 m and 3 m depth from top surface) using auger boring. A total number of 12 samples (three samples at each depth from each location) were collected, properly labeled and brought to the laboratory for analysis. All soil samples were air dried to a constant weight, sieved to < 2 mm through a stainless steel sieve and homogenized preserved in clean plastic containers for subsequent use (Chrastny et al. 2012) An index property such as specific gravity, moisture content and organic matter of the soil was determined according to IS code. Water extracts were prepared based on modified standard test method for shake extraction of soil with water (ASTM 2006). Ten grams of soil was mixed with 100 ml of distilled water (10:1 liquid to solid ratio) and shaked in a mechanical shaker for 18 h. After the completion of the agitation, the surface water was removed by decantation followed by pressure filtration or centrifugation (good water recovery is essential) and preserved at 4 _C for later analysis. The water extracts were analyzed for the parameters such as pH, electrical conductivity, chlorides, total alkalinity, total hardness, and iron.

7. Results

Parameter	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6
Temperature (c)	29.8	29.7	29.8	29.9	29.8	29.8
P^H	8.65	7.63	8.1	8.8	8.5	7.9
Turbidity (NTU)	1	2	0.6	1.6	0.3	1.7
Electrical conductivity	533	652	917	656	687	856
TDS	320	410	641.9	446	515.25	585.56
Total hardness (mg/ltr)	205	258	368	246	302	351
Calcium (mg/ltr)	132	162	223	167	173	207
Magnesium (mg/ltr)	73	96	145	79	129	144
Chloride (mg/ltr)	36.49	56.4	108.46	51.98	69.47	117.96
Sulphate (mg/ltr)	14.39	32.23	79.60	37.98	33.67	52.07
Sodium (mg/ltr)	30.9	35.1	36.9	35.3	27.4	30.6
Phosphate (mg/ltr)	0.16	0.15	0.14	0.14	0.21	0.19
Fluoride (mg/ltr)	0.5	0.6	0.4	0.5	0.5	0.6
Nitrate (mg/ltr)	51.4	37.89	44.28	54.94	24.28	58.3
Total Alkalinity (mg/ltr)	219	231	255	254	205	217
Iron (mg/ltr)	0.023	0.006	0.002	0.02	0.022	0.022
DO (mg/lit)	0.3	1.6	1.4	2.4	2.6	2.3
BOD (mg/lit)	2.25	2.18	3.1	0.9	0.98	0.42

8. Conclusion

Based on the study on ground water analysis, the following conclusions are drawn:

1. Various parameters exceeding drinking water criteria in different bore wells are isolated, indicating that the contamination is only localized.
2. The parameters exceeding limits are found to vary in concentration in the bore wells.
3. Two general parameters exceeding limit, hardness and nitrate can be controlled by adopting proper sewage treatment and disposal mechanism.

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