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Municipal solid waste dumping and impact on ground water

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Abstract: ***Today Raipur is an important regional, commercial and industrial destination of Chhattisgarh. Urbanization and rapid population growth are main cause of degradation in environment, by exploitation of natural resources, generation of municipal solid wastes (MSW) and release of untreated industrial effluents. In present study we try to investigate the impact of Solid Waste in quality of ground water at some of the specific area in Raipur City. Also an attempt is made to review the present solid waste disposal system and existing sewage carrying methods. Outcome of this study will be helpful to give an idea about Water Treatment Plan and safeguard process for solid waste management. This research paper further proposes to suggest the measures through which a more appropriate mechanism can be developed for an effective solid waste management.***

Keywords: - MSW, Water Quality, Solis Waste, Disposal System.

I. INTRODUCTION

Municipal solid waste (MSW) disposal is a big problem in developing countries across the world due to uncontrolled population growth; high urbanization rates and rapid industrialization combine with ineffectual management of wastes [1].

The quantum of MSW generated in India is about 0.15 million tonnes per day (approximately 50 million tonnes annually). Because of unplanned and poor funding conditions, out of the total municipal waste collected, on an average 94% is dumped on land and 5% is composted. In most of the cities and towns the MSW is dumped on low-lying area without following the guidelines for safe disposal of solid waste [2]. Waste generation in Major cities (India)

Population Range (in millions)	Average waste generation (gms/capita/day)
0.1-0.5	210
0.5-1.0	250
1.0-2.0	270
2.0- 5.0	350
5.0 and above	500

Land filling is the simplest, cheapest and most cost effective method of disposing of waste in both developed and developing nations of the world. [2,3]

Wastes placed in landfills are subject to either groundwater underflow or infiltration from precipitation and as water percolates through the waste, it picks up a variety of inorganic and organic compounds, flowing out of the wastes to accumulate at the bottom of the landfill. The resulting contaminated water is termed 'leachate' and can percolate through the soil. Municipal landfill leachate are highly concentrated complex effluents which contain dissolved organic matters; inorganic compounds such as ammonium, calcium, magnesium, sodium, potassium, iron, sulphates, chlorides and heavy metals such as cadmium, chromium, copper, lead, zinc, nickel; and xenobiotic organic substances . [4]

Improper solid waste management (SWM) is a major environmental problem in the Lagos metropolis due to the absence of modern engineered landfills, therefore posing serious contamination risk to both groundwater and surface water. Landfills are considered one of the major threats to groundwater (USEPA, 1984; Fatta et al., 1999). The scale of this threat depends on the concentration and toxicity of contaminants in leachate, type and permeability of geologic strata, depth of water table and the direction of groundwater flow (Al-khaldi, 2006). Modern Sanitary landfills have also been reported to leak leachate and pollute groundwater (Lee and Jones-Lee, 2004). Failure of liners and/or leakage of the leachate collection systems are the primary causes of such leachate seepage and infiltration into groundwater (Lee and Jones-lee, 1994).[5] Chhattisgarh named as "Bowl of Rice" is one of 29th state of central India was formed on 1 November 2000. Raipur is the capital of newly born state with population of 1.2 million and sprawls across 188km^2 with 41 villages. [6]

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The city is administered by Raipur Municipal Corporation (RMC), comprises of 70 wards and 8 zones. In addition to taking the responsibility of constructing basic civic infrastructure, RMC is mainly liable for supply of water, health care, sewage management, solid waste management, educational institutes, and periodic maintenance of the houses.

Raipur has witnessed a high growth rate in population, along with rapid increase in infrastructure and residential colonies. Due to increased population, urbanization, and industrialization the quantum of Municipal Solid Waste generated increased many fold and unmanaged municipal solid waste disposal particularly have lead to the serious socio-environmental problems.

A major problem is the collection and disposal of domestic wastes. Because a large volume of sewage and solid waste are generated in a small area, the waste cannot be adequately disposed off by conventional methods. The intensive use of natural resources and the large production of wastes in modern society often pose a threat to ground and surface water quality and have already resulted in many incidents of water contamination[7,8,9]

The quantity of waste generated in Raipur city is 408 TPD. The household contributes about 55% followed by 16% waste from commercial establishments. Currently there is no segregation at the source.

The quality of supply water affected due to a large number of hydrological, physical, chemical and biological factors. The drinking water should be free from toxic elements, pathogenic organism and excessive amount of minerals that may be hazardous to health. Some of the heavy metals are essential to humans in small quantity, for example cobalt, copper, etc., but large quantities of them may cause physiological disorders. The present study was aimed to analyze the effect of ground water quality due to rapid unscientific way of dumping of solid waste (municipal solid waste and industrial waste).[10,11]

Currently the waste is dumped openly in dump yards at Sarona, with an area of 18.49 Ha in Raipur approximate 4 Km away from Ring road -2 at low laying location near Kharun River. The collected solid waste, without any segregation dumped directly in Sarona Trenching Ground. It was only a simple land filling method adopted.

II. STUDY AREA AND METHODOLOGY

To analyze the effect of uncontrolled and unscientifically dumped municipal solid waste on the ground and supply water, different kinds of water sources were selected, which are generally used by the surrounding for their routine use. Eight water source locations of the MSW dumps area of Sub-urban area of Raipur near Sarona dumping yard area, Purana Bazar Chowk, Naya Bazar Chowk, Thakur Para, RDA Colony Ring Road 2, were selected for this study. (Fig-1&2).

The water samples were collected from bore well sources at varying distances from RMSW dumps area (Sarona Eeta Bhatti) in four groups, 0 Km to 3 Kms distances according to availability.

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Water samples were collected in the plastic bottles of 250 ml, Bore well. Samples collected were analyzed within 1 day to avoid special preservation required. Standard testing methods are used to evaluate different parameter.[12, 13, 14]

The study area and sampling location are shown in Fig. 1. The sampling points with standard methods are used are shown in Table-1

Fig 1: Sampling Location Raipur City

Fig 2 Sampling Area (Sarona Village)

Table-1 Sampling Points and sources.

Sampling Point	Location	Source	Distance from Dumping Yard (approximate in Km)
WS-1	Sarona Dump Yard	Bore Water	0.0 Km
WS-2	Sarona Dump Yard	River (Kharun Water)	0.2 Km
WS-3	Purana Bazar Chowk-1	Bore Water	0.5 Km
WS-4	Purana Bazar Chowk-2	Bore Water-	0.7 Km
WS-5	Naya Bazar Chowk -1	Bore Water	1.0 Km
WS-6	Naya Bazar Chowk-2		1.5 Km
WS-7	Thakur Para	Bore water	2.0 Km
WS-8	RDA Coloney Ring Road 2	Bore Water	3.0 Km

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Sampling Point – Dumping Yard Area

Sampling Point- Purana Bazar Chowk

Sampling Point – Naya Bazar Chowk

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Table-2 Methods adopted for analysis of Water Samples

A. Physical Parameters

Parameters	Method
Temperature	Thermometer (Scientific)
Appearance	Self
Odour	Self
pH	pH Meter (Digital)
Conductivity	Conductometer
Turbidity	Nephelometer

B. Chemical Parameters

Parameters	Method
Total Alkalinity	HCl-Titration
Total Hardness	EDTA-Titration
TS	Gravimetric
TDS	Gravimetric
COD	Potassium Dichromate method
BOD	BOD incubator
DO	Winklers Method
Chloride	Silver Nitrate
Sulphate	Turbidometer

III. RESULT AND DISCUSSION

The results values of different physical and chemical parameters obtained after analysis of water samples are listed below in Table-3 and Table-4.

Table 3: Physical Characteristics of Water samples (WS-1 to WS-8)

Parameter	WS-1	WS-2	WS-3	WS-4	WS-5	WS-6	WS-7	WS-8
Temperature (^{0}C)	28(1.35)	23 (1.1)	26 (0.6)	27 (1.0)	23 (1.5)	24(0.5)	24 (1.4)	25 (1.1)
Appearance	Hazy	Clear	Hazy	Clear	Dirty	Clear	Dirty	Clear
Odour	Salty/Unacceptable	Bearable	Unacceptable	Bearable	salty	Bearable	Bearable	Bearable
Conductivity µS/cm	1870 (6.55)	546 (2.5)	2360 (10.23)	240 (3.7)	432 (3.9)	560 (3.5)	1430 (12.34)	235 (4.5)
Turbidity NTU	18	6	12	10	7	6	12	5
pH	6.3(0.5)	7.6(1.0)	7.5(1.0)	7.8(1.0)	8.2(0.6)	7.5(1.0)	8.3(0.5)	7.5(1.0)

Table 4: Chemical Characteristics of Water samples (WS-1 to WS-8)

Parameter	Unit	WS-1	WS-2	WS-3	WS-4	WS-5	WS-6	WS-7	WS-8
Total Alkalinity	mg/L as $CaCO_3$	1770	650	1230	376	560	770	680	340
Total Hardness	mg/L as $CaCO_3$	1480	790	1120	870	960	890	420	270
TS	mg/L	15	06	07	06	09	05	06	04
TDS	mg/L	5470	240	3820	3160	3500	2360	2500	1240
COD	mg/L	56.6	12.2	11.5	10.3	36.2	16.4	28.5	10.2
Chloride	mg/L	657	350	210	205	353	320	440	210

IV. DISCUSSION

1 **Temperature**: - as per the standard the temperature of drinking water must be in range of bearable range. But in analysis report it was found in WS-1 WS-3 and WS-4 were greater than standard range. This parameter is essential for the occurring rate of reaction in water.

2 **pH (Hydrogen Ion Concentration)** :- As per BIS the range for pH is given between 6.5 to 8.5. The investigation report of our analysis shows between 6.3 to 8.3. This indicates the increase of salty nature.

3 **Conductivity: -** The increased conductivity in samples (**235-2360**), clearly shows an alarming condition towards mixing of high concentration of electrolyte from leachates formation due to improper dumping of solid wastes in trenching ground.

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4 **Alkalinity**: - Total Alkalinity of water samples were found well above the standards which may due to dissolution of solid waste in underground sources.

5 Chloride: - The report of analysis regarding to chloride contains are found well above as compare to BIS standards (**657 and 447**) . High concentration of Chloride may affect the taste of drinking water and human health indirectly. The chloride in ground water may results from both natural and anthropogenic sources such as run-off containing salts, the use of inorganic fertilizers, landfill leachates, septic tank effluents, animal feeds, industrial effluents, irrigation drainage and seawater intrusion in coastal areas.

6 COD: - High COD is direct measurement of pollution level in any sample. High value COD is toxic for aquatic organisms and indication of dissolve carbonaceous and suspended particles may be due to solid waste. In the report it was found in very high range in some samples (36.6 and 56.6).

7 Total hardness: - The major criteria for health is hardness in water which was found unacceptable in WS-1,3,4,5 and WS-6 (**1480, 1120, 960 etc.).** It is the most important parameter to show the presence of dissolve ions in ground water sources because of solid waste. The maximum permissible level prescribed by WHO for drinking water is 300-600 mg/l a. According to classifications, water having hardness up to 75 mg/l is classified as soft, 76-150 mg/l is moderately soft, 151-300 mg/l as hard and more than 300 mg/l very hard.

V. CONCLUSION

On the basis of observed results shown in this investigation we can conclude that the quality of ground water is deteriorate in nearby area of land filling yard Sarona with high concentration of undesirable quantity of TDS, Chloride, and COD. Water of almost all sample area is in high Hardness parameter because of ill managed solid waste dumping which may cause skin disease, gastrointestinal disorders, and neurological disorders. Therefore proper solid waste dumping and caring at this area is recommended to surface & ground water. The values of water quality parameters shown in Table 3 and Table 4 depicts that the effect of solid waste on water quality parameters of the water sources in surrounding of RMSW dump is remarkable.

Table 5: Health effect of different parameters

Parameters	BIS Guideline Value	Health Effect
Temperature	-------	-------
pH	6.5-8.5	Affects mucous membrane; bitter taste; corrosion
Total Alkalinity	600 mg/L	Boiled rice turns yellowish
Total Hardness	300-600 mg/L	Poor lathering with soap; deterioration of the quality of clothes; scale forming
COD	2-4 mg/L	High COD level is toxic for aquatic living organisms
TDS	200 mg/L	Undesirable taste; gastro-intestinal irritation; corrosion or incrustation
Chloride	250-100 mg/L	Taste affected; corrosion

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