IJARST

International Journal of Advanced Research in Science and Technology

journal homepage: www.ijarst.com

ISSN 2319 – 1783 (Print)
ISSN 2320 – 1126 (Online)

Assessment of Water Quality around Jawaharnagar Dumpsite, Hyderabad using Water Quality Index (WQI).

B. Soujanya Kamble*[1] and Praveen Raj Saxena[2]

[1] *Department of Environmental Sciences, Osmania University, University College of Sciences, Hyderabad, Telangana, India.*
[2] *Department of Applied Geochemistry, Osmania University, University College of Sciences, Hyderabad, Telangana, India*

**Corresponding Author's E-mail: bsk.029@gmail.com*

ARTICLEINFO

Article history:
Received 20 Nov. 2015
Accepted 22 Dec. 2015
Available online 31 Dec. 2015

Keywords:
Water Quality Index (WQI),
Physico-chemical parameters,
WHO (2006),
Jawaharnagar Dumpsite,
Hyderabad.

ABSTRACT

Hyderabad is a metropolitan city with a population of more than six million and the extent of municipal solid wastes ranges from 2500-5000 Metric tons per day. The present work is aimed to assess the quality of water resources surrounding Jawaharnagar Dumpsite and its suitability for drinking purpose using Water Quality Index (WQI). As a part of study, 2 surface and 12 ground water samples were collected during the pre-monsoon (March-2015) and have been analyzed for various physico-chemical parameters as per standard procedures. Results were compared with the standards as prescribed by World Health Organization (WHO, 2006) for drinking purpose. Results indicate that almost all the 14 water samples are of poor quality and unfit for drinking purpose.

PAPER-QR CODE

IJARST Volume-4, Issue-8

Citation: *Soujanya Kamble. et.al. Assessment of Water Quality around Jawaharnagar Dumpsite, Hyderabad using Water Quality Index (WQI), Int. J. Adv. Res. Sci. Technol. Volume 4, Issue 8, 2015, pp.501-505.*

Introduction:

Management of solid waste and related environmental impacts presents a challenge to both developing and developed countries. Rapid industrialization, growing population and changing lifestyle are the root causes for increasing rate of solid waste generation. The quantum of municipal solid waste generated in India is about 0.15 million tons per day. This is approximately 50 million tons annually. Out of the total municipal waste collected, on an average 94% is dumped on land and 5% is composted. The average rate of MSW generation in India (0.35 to 0.60 kg/ person/day) is very low as compared to developed countries [1].

The most widely used method for disposal of municipal solid waste is landfilling. Landfills or open dumps are tremendously used for disposal of solid waste because they have capacity to accumulate large amounts of wastes offering very low cost as compared to incineration. For a long time, landfilling was the most common waste management option for Municipal Solid Wastes (MSW). Not only is it a waste of resources but landfills as such constitute a health hazard and an environmental burden [5]. Amongst the drawbacks, disposal of solid waste in landfills constitutes a considerable source of water pollution. Landfills have been identified as one of the major threats to ground water resources [10]. Not only ground water resources, it equally affects the surface water bodies. Unconditional dumping of municipal solid wastes results in generation of toxic leachate, which percolates through the soil and finally reaches the water table affecting the ground waters. Further the lateral movement of the leachates through surface run-off as a result of precipitation simultaneously affects the surface bodies as well. According to MSW rules 2010, leachate must be treated before discharging. Leachate may consist of large amounts of organic and inorganic compounds [9]. If leachate is not controlled it can contaminate the surrounding soils, vegetation, livestock, surface waters and ultimately the ground water.

WQI is an important technique for demarcating water quality and its suitability for drinking purposes. It is defined as a technique of rating that provides the

composite influence of individual water quality parameters on the overall quality of water for human consumption [8]. It is one of the aggregate indices that have been accepted as a rating that reflects the composite influence on the overall quality of water quality characteristics. Higher value of WQI indicates better quality of water and lower value shows poor water quality. The physicochemical study was carried out to translate multifaceted water quality data into simple information that is comprehensible and useable by the public.

Study Location:

The selected area for research is Jawaharnagar dumpsite Hyderabad, Telangana. Jawaharnagar is just outside the limits of GHMC (Greater Hyderabad Municipal Corporation) and inside the HMDA (New limits of Hyderabad). The site is 35km from Hyderabad city and 105km away from the state highway connecting Hyderabad and Nagpur in west direction from boundary of project site. It is an open dumpsite where unconditionally the solid wastes is dumped on a terraneous site called Irla Gutta.(Gutta=Hill). The total area of Jawaharnagar dumpsite is 350 acres. The site receives Municipal Solid Waste of 2500-3000 metric tonnes per day. The area partly falls under Toposheet (E44 M11 & M12). It is located between 7030'01" N to 17032'03" N latitude and 78034'13" E to 78037'47" E longitude (Fig:1). It has a tropical wet and dry climate bordering on a hot semi-arid climate. The annual mean temperature is 26 °C (78.8 °F). Summers (March–June) are hot and humid. Maximum temperatures often exceed 40 °C (104 °F) between April and June. Winter lasts for only about 2 ½ months, during which the lowest temperature occasionally dips to 10 °C (50 °F) in December and January. May, the hottest has temperatures ranging from 26 to 38.8 °C. January, the coldest, has temperatures varying from 14.7 to 28.6 °C. Heavy rain from the south-west summer monsoon falls between June and September, supplying Hyderabad with most of its annual rainfall of 812.5 mm (32 in). Geology of area comprises of pink and grey granite rock formations.

Materials and Methods:

Sample Collection:

Geographic locations, latitude, longitude of the water points were collected with the help of GARMIN etrex GPS. Ground water samples from 12 bore wells and 2 surface water samples from 2 surface bodies located around Jawaharnagar dumpsite were collected. Sampling was done during dry season in March 2015. All the samples have been collected in Pre cleaned high density polyethylene bottles (HDPE) with dil.HNO_3. The bottles were rinsed with the same water which is to be taken as the sample so as to avoid cross contamination. Each of the water samples was analyzed for 8 parameters viz., pH, TDS, TH, CH, Cl^-, SO_4^{-2}, NO_3^- and F^- using standard procedures recommended by APHA:2005.[2] The analyzed values were further compared with standard values recommended by WHO(2006)[11] and their respective WQI values were calculated.(Table:1).

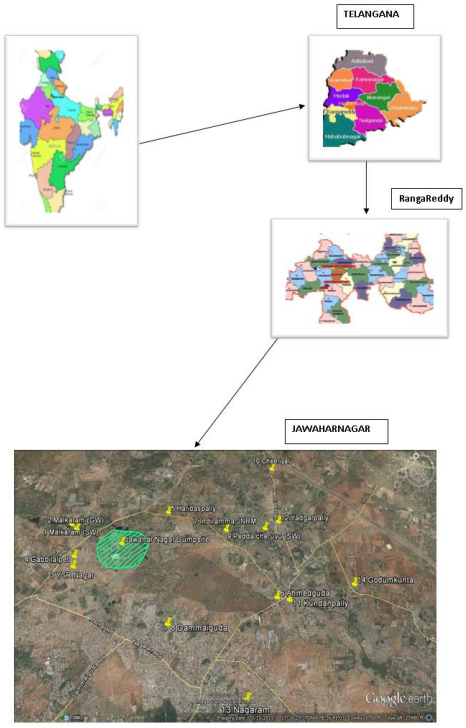

Fig. 1: Location Map of Study Area

Calculation of Water Quality Index:

In this study, for the calculation of WQI, eight important parameters were chosen [3]. The WQI has been calculated by using the standards of drinking water quality recommended by WHO. The WAI (Weighted Arithmetic Index) method has been used for calculation of WQI of the water samples. Further, quality rating or sub index (q_n) was calculated using the following expression.

$$q_n = 100[V_n - V_{io}]/[S - V_{io}] \quad (1)$$

q_n = Quality rating for the n^{th} water quality parameter

V_n = Estimated value of the n^{th} parameter t a given sampling station

S_n = Standards permissible value of the n^{th} parameter

V_{io} = Ideal value of the n^{th} parameter in pure water (i.e.,0 for all other paramaters except the parameter pH, where it is 7.0).

Unit weight was calculated by a value inversely proportional to the recommended standard value S_n of the corresponding parameter,

$$W_n = K/S_n \quad (2)$$

W_n = Unit weight for the n^{th} paramater

S_n = Standard value for n^{th} parameter

Table: 1. Physico-Chemical parameters of water samples around Jawaharnagar Dumpsite, Hyderabad city, in Pre-monsoon, WQI and Water Classification

S. No	Location	Lat	Long	Dist	pH	TDS	Cl	C H	TH	SO_4^{-2}	NO_3^-	F^-	WQI	Status
1	Malkaram(SW)	17 31 43	78 34 51	1	7.8	640	248	55	90	53	8.4	3.7	133	Unsuitable
2	Malkaram(GW)	17 31 38	78 34 52	1	7.8	384	78	115	205	110	28	1.1	71	Poor
3	Y.S.R nagar	17 31 02	78 34 57	1	7.3	640	128	195	245	187	174	0.9	130	Unsuitable
4	Gabbilalpet	17 31 01	78 34 45	2	7.2	512	135	110	275	106	166	1.6	126	Unsuitable
5	Haridaspally	17 31 39	78 35 49	1	7.1	3904	325	75	145	72	49	0.6	171	Unsuitable
6	Ahmedguda	17 30 04	78 37 13	1	7.1	1408	815	335	590	322	70	0.5	180	Unsuitable
7	Indiramma Jinnaram	17 31 05	78 36 52	2	7.3	768	340	135	250	130	13	1	87	Very Poor
8	Dammaiguda	17 30 12	78 35 27	2	7.1	960	340	250	465	240	196	0.5	166	Unsuitable
9	Pedda Cheruvu(SW)	17 30 59	78 37 26	3	8.4	9600	9585	30	75	29	110	0.3	65	Poor
10	Cheriyal	17 31 52	78 37 49	4	7.1	640	128	175	290	168	162	1.6	136	Unsuitable
11	Kundanpally	17 29 56	78 38 16	4	7.3	832	319	115	295	110	95	1.2	119	Unsuitable
12	Yadgarpally	17 32 56	78 37 49	4	7.5	448	50	115	160	110	41	0.9	67	Poor
13	Nagaram	17 29 21	78 36 00	5	7.2	768	230	135	300	130	73	1.3	109	Unsuitable
14	Godumkunta	17 29 32	78 38 52	5	7.3	960	262	180	306	173	59	1.7	124	Unsuitable

(Note: All parameters are in mg/L except pH in pH units; Dist in km; SW-Surfacewater, GW-Ground Water**)**

Table: 2. Relative weight (Wi) values of each parameter

Chemical Parameters	WHO Standard2006(Sn)	Weight(Wi)	Relative Weight(Wn)
pH	7.0-8.5(8.5)	4	0.125
TDS	500	5	0.156
Total Hardness(mg/L)	200	3	0.093
Calcium Hardness(mg/L)	100	2	0.062
Cl^-(mg/L)	250	4	0.125
SO_4^{2-}(mg/L)	250	4	0.125
NO_3^- (mg/L)	50	5	0.156
F^-(mg/L)	1	1	0.156
Total		32	0.998

Table 3: Calculation of Water Quality Index during Pre Monsoon Season

Parameter	Observed Value	Standard Value(sn)	Unit Weight(Wn)	Quality rating(qn)	Wn*qn
pH	7.4	8.5	0.125	26.1	3.2
TDS(mg/L)	1548.8	500	0.156	309.7	48.3
TH(mg/L)	260.7	200	0.093	135.35	12.12
Calcium Hardness(mg/L)	141.53	100	0.062	141.53	8.77
Cl^- (mg/L)	192.7	250	0.125	77.08	9.63
SO_4^{-2}(mg/L)	137.6	250	0.125	55.04	6.88
NO_3^{-2}(mg/L)	94.3	50	0.156	188.6	29.42
F^-(mg/L)	1.17	1	0.156	117	18.25
			∑Wn = 0.998		∑Wn*qn = 136.57
Water Quality Index (WQI) ∑Wn*qn/∑Wn = 136.84					

Table: 4. Water Quality Classification based on WQI value

WQI	Water Quality	% of Water samples
<50	Excellent	---
26-50	Good	---
51-75	Poor	21%
76-100	Very Poor	7.4%

K = Constant for proportionality

The overall Water Quality Index was calculated by aggregating the quality rating with the unit weight linearly.

$$WQI = \sum q_n W_n / \sum W_n \quad (3)$$

The maximum weight of 5 has assigned to the parameters like NO_3^-, TDS, Cl^-, F^-, and SO_4^{-2}, due to their major importance in water quality assessement [6]. Table (2&3).

Results and Discussion:

Major cations and anions:

The results of physico-chemical analysis of water samples around Jawaharnagar dumpsite are presented in Table The pH values of water samples around dumpsite ranges from 7.1-8.4 with a mean value of 7.3 indicating that waters are alkaline in nature and are within permissible levels of WHO(2006) standards. The ground waters around the dumpsite are alkaline in nature with those collected further away from the dumpsite which may be indicative of influence of leachate from the dumpsite. The TDS values ranges from 384-9600mg/L with a mean value of 1604mg/L indicating that almost all the water samples are highly above the permissible levels as per WHO(2006)standards. The highest concentrations of dissolved minerals owe to the higher amounts of inorganic salts (Ca, Mg, Na, K, SO_4^{-2}) and small amount of organic matter, which looses palatability and causes gastro intestinal irritation. The chloride values ranges from 49.6-15824.8mg/L with a mean value of 2034.5mg/L which are above the permissible levels of WHO (2006). The high chloride concentration may be attributed due to solid waste dumping which in turn is leaching from upper soil layers in dry climates and natural geochemical activities in the area. The calcium hardness ranges from 30-335mg/L with a mean of 144.2mg/L which are above the permissible levels according to WHO(2006) and Total hardness values ranges from 75-590mg/L with a mean value of 263.6mg/L which are also above the permissible levels of WHO(2006). The hardness in water is mainly due to salts and the most common are carbonates and sulphates, calcium and magnesium. This can be indicative of leachate enrichment from dumpsite and may cause encrustation in water supply structure and adversely affect on domestic use.

Sulphates of water samples range from 28-322mg/L with a mean value of 138mg/L. All samples fall within permissible limits of WHO (2006) except for one ground water sample in Ahmedguda which may be due to decomposition of organic matter and fertilizers. Since sulphate is mobile in soil, inputs to soil will impact shallow ground waters [7]. Nitrate values ranges from 8.4-196mg/L with a mean value of 88mg/L. Eight ground water samples and one surface water sample nitrate values exceed the permissible levels of WHO(2006). Highest nitrate value was recorded in Y.S.R nagar which may be due to the nearness of the well to the dumpsite. Nitrates also get into waterways from, leaking septic tanks, leachate from landfills and

manure from farm livestock, animal wastes and discharges from car exhausts. Fluoride values of waters ranges from 0.3-3.7mg/L with a mean value of 1.2mg/L. Five ground water samples are slightly higher than the permissible levels of WHO(2006). The highest value of fluoride (3.7mg/L) has been recorded in Malkaram surface waters. It may be due to atmosphere deposition of particles and weathering of fluoride containing rocks and soils.

Water Quality Index (WQI):

Water quality index developed for the surface water and groundwater samples indicated that there is a wide variation from station to station. during pre-monsoon season. In this study, WQI estimation in water samples surrounding the Jawaharnagar dumpsite for drinking purposes was found ranging from 65.3 to 179.9 which means that 71.2 % of samples fall under unsuitable category, 21% under poor category and 7.4% under very poor category according to water quality index classification. [4] (Table:4)

Conclusion:

The study reveals that the unconditional dumping of the wastes in Jawaharnagar Dumpsite has extremely polluted the surface and ground waters over time. WQI estimation showed that 30% of the groundwater samples were found to be in the good water class and the remaining 70 % were classified under poor water class based on the computed WQI classification scheme. Almost all the water samples are unsuitable for drinking purpose. Further, the results indicated very poor sanitation and damaging effects to health of both man and animals if surrounding waters were used for domestic purposes. Governmental policies on waste disposal and management should be enacted and strictly enforced, citing of dumpsites far away from residential areas to minimize pollution of nearby well waters, waste sorting and treatment before disposal are encouraged. Re-designing of sanitary landfill with clay or plastic liners to prevent leachate from getting to water table, adoption of clean technology for recycling greenhouse gases emanating from the landfill and a sustainable land management programmed for reclamation are recommended.

References:

1. A. B Akolkar, *Asia Pacific Regional Workshop on Sustaianble Waste Management*, 2002, 1-6.
2. American Public Health Association(APHA), 2005, Standard method for the examination of water and waste water(21st edition) Washington D.C.
3. Chaterjee, C and Raziuddin M (2002) Determination od water quality index(WQI) of a degraded river in Asanol, Industrial area, Ranigunj, Burdwan, West Bengal, Nature, Environment and Pollution Technology, 1 (2):181-189
4. Christopher O. Akinbile.,Environmental Impact of Leachate Pollution on Ground Water Supplies in Akure, Nigeria:: International Journal of Science and Development Vol:2, No:1 Feb:2011).
5. Ettler V., Mihaljevic M., Matura M., Skalova M., Sebek O., Bezdicka P. 2008. Temporal variation of trace elements in waters polluted by municipal solid waste landfill leachate. Bulletin of Environmental Contamination and Toxicology, 80, 274-279.
6. Srinivasamoorthy, K., S. Chidambaram, M. Vasantavigar, V.Prasanna and P. John, 2007. Geochemistry of fluorides in groundwater of Salem district, Tamil Nadu, India, Indian J. Geochem., 22(2):(237-246).
7. Sulphate in Minnesota Ground Water:Minnesota Pollution Control Agency(May 1999).
8. Tiwari, T.N. and M.A. Mishra, 2002. A Preliminary assignment of water quality index of major Indian rivers. Indian Journal of Environmental Protection, 5:276-279.
9. V. Bodzek, E. Lobos-Moysa and M.Zamarowska, *Desalination*, 2006, **198**, 16-23
10. V.Ustohalova, T.Ricken and R.Widmann, Waste Management, 2006, 26, 442-450.
11. WHO. (2006). Guidelines for Drinking-Water Quality, Geneva, Switzerland.