Assessment of the Environmental Quality in and around the Municipal Solid Waste Processing and Disposal Facility, HiMSW

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ABSTRACT *Scientific management of waste processing and disposal facilities and compliance with the protocol of the statutory bodies is one of the biggest concerns in the present scenario. Most often it can be exclusively found that either this transport storage and disposal facilities (TSDF) attribute with direct impact on the surroundings or else influences indirect effects on the environment. The idea of investigating the compliance of the existing Hyderabad Integrated Municipal Solid Waste Ltd. (HiMSW) facility to the stringent norms and environmental exercises authenticated from the pollution control board provoked this research work. The study includes physicochemical analysis of the ambient air quality, groundwater quality through piezometricborewells, and inspection of the quality and quantity of leachate generation. Though in some specific pockets a higher concentration of pollution was recorded, still most of the areas especially the zones of anthropogenic movements found to be safe with negligible impact on human health. Ultimately, the investigation revealed that the buffer zone developed by the handling authority is sufficient to nullify the ill effects of the TSDF and proper scientific management of the enormous quantity of municipal waste on regular basis helps to maintain the ambiance of Hyderabad city.*

Keywords: *TSDF, Air quality, Groundwater quality, Leachate*

Introduction

The municipal waste processing facility of Jawahar Nagar is located at the outskirt of the greater Hyderabad city over an area of approx. 351 acres which receives on an average 5000 to 6000 tons of MSW on regular basis. Proficiently handling this humongous quantum of waste is a matter of great concern and attributed to a greater risk of environmental intervention (Gupta et al. 1998, Ghose et al. 2006). The study area has an approximate altitude of 535 m in western part and gradually decreases towards the east. Groundwater in the study area occurs under water table to semi-confined conditions restricted to weathered and fractured formation. The study area contains granite rock formations (Sarala and Ravi 2012). The reconnaissance survey conducted with the localites before the execution of actual field work suggested possible contamination of the groundwater due to the seepage of leachate subjected the health degradation of the local occupants, though the former studies (RoyChoudhuryandGopalakrishnan 2018, Jampala et al. 2016, completely nullified the influence of potential hazard due to the presence of P&D facility in the vicinity. Despite that some of the studies reported possible contamination up to agreeable limit and substantiated the need of the facility to safely handle the enormous amount of waste getting generated on regular basis from the premises of Greater Hyderabad city (Silva et al 2007, Reddy and Reddy 2018, Krishna et al. 2015). The primary objective of the study was to investigate the impact of the facility over the buffer zone and the nearby vicinity in terms of air and water pollution check.

Material and Method

The study was conducted within the premises of municipal waste processing facility, Jawahar Nagar. The research work has undertaken the complete analysis of the air and water quality in and around the facility and the execution procedure is delineated below.

Sampling Locations

In order to minimize the local influence the sampling locations for both air and water was widely distributed throughout the premises of the facility and also around the buffer zone. Based on the concentration of the parameters and instantaneous values the number of sampling points was decided on a particular location.

Sampling Period

Water samples were collected in air tight containers and transferred to the pre-determined location at the earliest for the further analysis and the parameters such as temperature, pH etc. were monitored at the site itself with the help of mobile kit. Some quantity of the sample was refrigerated @ 4^0C for preservation.

Whereas, the air samples were taken on 8h average basis complying all the monitoring norms prescribed from the regulatory authority. Later the concentration values were interpreted with the help of UV-Vis spectro photometer, Gas chromatography, and multi gas analyzer.

Results and Discussion

The facility comprises almost 351 acres of premises and hence multiple locations (i.e. 24) have been pointed out to perform the monitoring. The monitoring locations were majorly attributed from the weighing bridge and then simultaneously extended to Malkaram pond through RDF storage and landfill area. The air quality of the area was analyzed with help of high volume samplers and AAQ machines whereas, water and leachate samples were collected with the help of water samplers and analyzed in HiMSW wet laboratory facility. The analysis reports of ambient air quality enclosed below in table 1.

Table 1: Ambient air quality report

Sl No.	Parameters	Unit	Method	Results				CPCB standard
				Near weigh Bridge	Near Landfill	Near RDF storage Area	Near Malkaram Pond	
1.	Sulphur Dioxide (SO_2)	µg/m³	IS 5182 (Part- 2): 2001	24.4	19.6	23.4	19.2	80
2.	Particulate matter (PM_{10})	µg/m³	IS 5182 (Part-23): 2006	82	76	78	72	100
3.	Particulate matter ($PM_{2.5}$)	µg/m³	IS 5182 (Part-23): 2006	42.8	34.2	36.8	28.7	60
4.	Ammonia (NH_3)	µg/m³	Indo Phenol Method	9.6	7.2	8.4	8.2	400
5.	Carbon monoxide (CO)	µg/m³	Multi Gas Analyzer	1.4	0.6	1.2	0.8	2
6.	Methane (CH_4)	%	Multi Gas Analyzer	ND	1.4	1.2	2.4	25

ND: Not detected

The above tabulated results explicitly signify a higher concentration of all contaminants near the weigh bridge and RDF storage area on the other hand a lesser level of contamination can be observed near the landfill and Malkaram pond. Though, the foul smell generated from the area germinated a psychological barrier on the localites about this area, but, still the facility manages to bring down the pollution levels and comply with the CPCB limits.

The groundwater quality was assessed through the sample collection and analysis of the piezo metric borewells located at the different points of the site (Rao and Rao, 1991;Pandey and Tiwari 2009). The locations of the borewells are widely distributed across the facility to minimize localization impact and some of the locations are as follows, near leachate treatment plant, near landfill, near second gate, North-East corner of passive dump capping area, near weigh bridge junction, near compost plant, near waste to energy plant etc.

Table 2: Groundwater quality report

Sl No.	Parameters	Unit	Result						
			BW1	BW2	BW3	BW4	BW5	BW6	BW7
1	pH	-	8.09	9.73	8.28	8.34	8.27	8.09	8.40
2	Total Dissolved Solids @ 180^{0}C	mg/L	2126	9698	4278	2332	5962	8356	813
3	Total Alkalinity as $CaCO_3$	mg/L	396	2014	602	676	1426	2246	224
4	Total Hardness as $CaCO_3$	mg/L	1538	3950	1560	740	1458	2770	423
5	Calcium as Ca	mg/L	362	824	370	226	324	628	120
6	Residual Free Chlorine as Cl	mg/L	Nil	Nil	Nil		Nil	Nil	Nil
7	Nitrates as NO_3	mg/L	84	16	36	12	33	15	11
8	Fluorides as F^-	mg/L	1.2	1.2	1.0	1.3	1.2	<1.0	<1.0
9	Chlorides as Cl^-	mg/L	862	3028	1878	738	2354	3024	250
10	Sulphates as SO_4^{2-}	mg/L	186	426	286	234	386	327	112
11	Phenolic compounds as Phenols	mg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
12	Cyanide as CN^-	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

13	Arsenic as As	mg/L	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
14	Cadmium as Cd	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
15	Copper as Cu	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
16	Lead as Pb	mg/L	0.29	0.41	0.34	<0.1	0.22	0.33	0.40
17	Zinc as Zn	mg/L	<0.5	<0.5	<0.5	<0.5	0.76	<0.5	<0.5
18	Nickel as Ni	mg/L	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
19	Manganese as Mn	mg/L	<0.2	2.72	0.80	<0.2	<0.2	<0.2	12.6
20	Iron as Fe	mg/L	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
21	Total Chromium as Cr	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
22	Chromium as Cr^{6+}	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
23	Boron as B	mg/L	<0.5	<0.5	<0.5	<0.5	0.42	<0.5	<0.5
24	Oil & Grease	mg/L	<10	<10	<10	<10	<10	<10	<10

pH level of all the borewell samples lies in alkaline range due to the local influence of the legacy leachate contamination though, the value lies within the prescribed limit of BIS standard of 8.5 except borewell no. 2 located near to the landfill. The same borewell showed a higher concentration of dissolved solids which accounts almost twice the average value. The basic observation revealed that the groundwater quality is far better towards the proposed waste to energy plant only except the manganese concentration which showed an elevated value due to the local aquifer profile and lithospheric characteristics. The experimental values also nullified the theory of heavy metal leaching and contamination.

Apart from the chemical analysis, physical examination of the piezometric water samples were carried out in terms of odor and taste and the same has been reported in table 3.

Table 3: Physical examination report

Sl No.	Parameters	Unit	Result						
			BW1	BW2	BW3	BW4	BW5	BW6	BW7
1	Odor	TON	No odor observed	1	No odor observed	No odor observed	1	1	No odor observed
2	Taste	FTN	No Flavor observed	Not performed	No Flavor observed	No Flavor observed	Not performed	Not performed	No Flavor observed

The major concern of the site is legacy and fresh leachate. The site incorporates 2 nos. of leachate treatment plant with 300 KLD capacity each which comprises chemical and tertiary treatment with an efficiency of 60% recovery. The study included analysis of the leachate at three primary points namely, inlet, outlet-permeate, and outlet- reject and the report presented in table 4.

Table 4: Leachate analysis report

Sl No.	Parameters	Unit	Result		
			Inlet	Outlet-Reject	Outlet-Permeate
1	pH	-	8.32	8.33	8.28
2	Phenolic compounds as C_6H_5OH	mg/L	<1	<1	<1
3	Arsenic as As	mg/L	<0.2	<0.2	<0.2
4	Lead as Pb	mg/L	<0.1	<0.1	<0.1
5	Cadmium as Cd	mg/L	<0.1	<0.1	<0.1
6	Chromium as Cr^{6+}	mg/L	<0.1	<0.1	<0.1
7	Copper as Cu	mg/L	0.186	0.328	<0.1
8	Nickel as Ni	mg/L	0.48	0.76	<0.2
9	Mercury as Hg	mg/L	<0.1	<0.1	<0.1
10	Zinc as Zn	mg/L	2.12	3.02	<0.5
11	Fluoride as F^-	mg/L	1.2	2.8	0.6
12	Ammonical Nitrogen NH_3-N	mg/L	986	1452	38
13	Chloride as Cl^-	mg/L	9862	12968	862
14	Cyanide as CN^-	mg/L	<0.1	<0.1	<0.1
15	Sulphates as SO_4^{-2}	mg/L	5624	8456	96
16	Nitrates as NO_3-N	mg/L	79	115	18
17	Total Suspended Solids @ 105^0C	mg/L	1026	1624	32
18	Total Dissolved Solids @ 180^0C	mg/L	29214	46284	2096

19	Calcium as Ca	mg/L	342	524	16
20	Iron as Fe	mg/L	18.26	28.62	0.16
21	Chemical Oxygen Demand	mg/L	19826	29624	48
22	Biological oxygen demand (BOD_3)	mg/L	8922	13342	14
23	Oil & Grease	mg/L	34	52	<10
24	Total Chromium as Cr	mg/L	0.826	1.024	<0.1
25	Selenium as Se	mg/L	NA	NA	NA
26	Manganese	mg/L	0.724	0.986	<0.2
27	Total hardness as $CaCO_3$	mg/L	1614	2462	76
28	Alkalinity as $CaCO_3$	mg/L	8246	12546	540

The major parameters of concern such as, TDS, COD, and BOD found to be lying within the standard value (BIS-10500, 1994; WHO, 1996) and hence the same has been further utilized for development of the green belt and the reject was sent to the solar evaporation pond (SEP) for further densification.

Due to the complaints of local habitats associated with surrounding air quality the study also incorporated the assessment of the air quality in areas near to the buffer zone. Few predetermined locations such as near Army college of Dental Sciences (ACDS), Rajiv GruhaKalpa, and Karmika Nagar were fixed based on the demand of localites and the air quality was assessed and the results are as follows (Table 5).

Table 1: Ambient air quality report for the buffer zone

Sl No.	Parameters	Unit	Method	Results			CPCB standard
				Near ACDS	Near Rajiv GruhaKalpa	Near Karmika Nagar	
1.	Sulphur Dioxide (SO_2)	µg/m³	IS 5182 (Part-2): 2001	21.8	16.2	17.6	80
2.	Particulate matter (PM_{10})	µg/m³	IS 5182 (Part-23): 2006	78	68	64	100
3.	Particulate matter ($PM_{2.5}$)	µg/m³	IS 5182 (Part-23): 2006	38.6	28.2	24.2	60
4.	Ammonia (NH_3)	µg/m³	Indo Phenol Method	6.2	4.6	2.8	400
5.	Carbon monoxide (CO)	µg/m³	Multi Gas Analyzer	1.2	0.6	0.4	2
6.	Methane (CH_4)	%	Multi Gas Analyzer	0.4	ND	ND	25

ND: Not detected

Concentration of all the parameters found to be decreasing when compared to the values within the premises. Karmika Nagar showed the best air quality among all the locations and it can be easily stated that apart from organic decomposition odor no trace of harmful gases can be detected more than the safe limits in any of the above-mentioned locations.

Conclusion

The TSDF facility namely, HiMSW is a complete path breaking project launched as a joint venture of Ramky group and GHMC which extends 360^0 solution to the solid waste of the greater Hyderabad city generated on regular basis. Production of leachate and contamination of the surrounding environment is an unavoidable issue associated with the successful management. But the analysis revealed that the facility has taken the right way of measures to fight back this environmental interventions and successfully complying with the statutory guidelines in terms of air, water, and soil quality assurance.

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