Groundwater Pollution By Leachate Using A Case Study Of Waste Treatment Plant At Nashik.

Dr.Pratima Pandit Wagh, Miss. Seema More

Department of Microbiology, K.T.H.M.College,
Gangapur Road, Nashik - 422002, Maharashtra, India.
Email: pratima.p.wagh@gmail.com

Abstract: The Nashik Municipal Corporation has established a compost factory for converting garbage into compost and for land filling. An environmental impact study was carried out mainly to assess the groundwater pollution near Municipal solid waste landfill site to predict potential contamination of groundwater resources by leachate. The water quality parameters were studied. From analysis of the results obtained, it is revealed that the quality around the site up to a distance of 2.5 km. from the Waste Treatment Plant is being impacted due to the infiltration of contaminated leachate.

Keywords: Nashik, Municipal solid waste, Leachate, Groundwater pollution

INTRODUCTION

It is a fact that various activities of humans are exceeding the sustainable capacity of the earth. Increased urbanization and industrialization are adversely affecting the environment; consequently the 'sustenance' of the environment is essential to continue life on earth in a normal way, (3, 8). The main approach towards environmental sustainability in this regard is pollution protection. Domestic solid waste is becoming troublesome day by day to the majority of municipal corporations in different countries. In 2000, the Ministry of Environment and Forest, GoI, (MoEF) notified the Municipal Solid Waste (Management and Handling) Rules (MSW (M&H) Rules) for all Indian cities. The Rules contained directives for all ULBs to establish a proper system of waste management. To improve the MSWM systems in the cities the seven directives were given out of which, one directives is - Treatment of biodegradable waste using composting or waste to energy technologies meeting the standards laid down and secondly, minimize the waste going to

scientifically engineered landfills (SLFs) and dispose of only rejects from the treatment plants and inert material at the landfills as per the standards laid down in the rules.

A case study of waste treatment plant at Nashik- Nashik is the only city in Maharashtra which has taken lead towards scientific management of MSW in abidance of MSW rules 2000. With the upgradation of entire SWM system, this facility could act as a lime-light training and development Centre for the State of Maharashtra.

The Nashik Municipal Corporation for converting garbage into compost and for landfilling has established a compost factory in 2001. Leachate treatment plant with capacity of 0.4mld leachate or 10 TPD organic wastes has been installed for treatment of leachate coming out from the windrows, the solid waste dumps and sanitary landfill site. Proper arrangement for collection and transportation of leachate has been made. As leachate is primarily generated in monsoon season and during other period, same plant is utilized for bio gas generation from organic waste.

An environmental impact study being carried out mainly to assess the groundwater pollution near Municipal solid waste landfill site to predict potential contamination of groundwater resources by leachate, this study investigated groundwater quality close to landfill sites, in post monsoon period. Ten local wells were selected for this purpose. The water quality parameters - Bacteriological examination of well water, Determination of BOD, Isolation and Identification of bacterial pathogens, most probable no of Coliforms were selected for the studies.

Sample Collection

The study area consists of Pathardi and Govalana gaon. The locations were selected by observing maps / development plans prepared by Nashik Municipal Corporation. (**Fig-1**)

Samples were collected from wells located within 2.5 km distance from the landfill site. 10 samples were collected, from the perimeter of the landfill site. Samples were collected directly from the wells by means of sterilized bottle fitted with a weight at the base; care was taken to avoid contamination of samples by any surface scum, (**Table no-1).**

The locations of the wells in the study area are marked on the map. For the control sample the well water was collected from the wells situated far away from the Municipal Waste Treatment Plant. Four control samples were analyzed for the same parameter as for the test sample, (**Table no-2).**

Methods –For bacteriological analysis of water samples, methods carried out are-

1) Isolation & Identification of Microorganisms from Water Sample & TVC.

Culture media used were Nutrient agar and MacConkeys media, and were all prepared according to the manufacturer's specification. Serial dilution of the water were carried out and 1 ml each of the diluents were aseptically introduced into different plates after which sterile prepared medium was introduced using the pour plate technique and incubated at the 37^0C for 24 hrs. Biochemical tests were carried out on pure bacterial cultures using standard methods.

2) Most Probable Number of Coliforms (Presumptive test)

Lactose Broth is used for detection of the presence of coliform organisms. Ingredients of which are distilled water with Peptic digest of animal tissue (peptone), Beef extract, Lactose, Final pH is 6.9. Growth with the formation of gas is a presumptive test for coliforms.

Each of 5 test tubes with fermentation tubes (Durham) were inoculated, containing 10.0 ml of double strength lactose broth of a 1st set aseptically with 10.0 ml of water sample.

1.0 ml of water samples were inoculated into five small tubes with Durham's tube of 2nd set containing single-strength lactose broth using aseptic conditions.

Similarly 0.1 ml of water samples were inoculated into each of five small tubes with Durham's tube of 3rd set containing single-strength lactose broth using aseptic conditions.

All tubes were incubated at 37^0 C for 2 days and observed for acid and gas production after 24 and 48 hours.

The presence of gas in any tube after 24 hr is a positive presumptive test.

Number of tubes in each set showing gas production were noted and determined MPN counts /100 ml of the water sample by comparing with *McCrady's Table* (Chart)

The formation of gas during a second 24-hr period is a doubtful test. The absence of gas formation after 48 hr incubation shows negative presumptive test.

3) Biochemical Oxygen Demand of Water samples:

Measures how fast organisms use oxygen in water, and indicates amount of organic material in raw wastewater. The Winkler test is used to determine the concentration of dissolved oxygen in water samples.

Materials:

Alkaline-iodide-azide solution. Manganese sulphate. BOD bottles.	Measuring cylinders. BOD Incubator. Burette and burette stand. Standard flask.	Con. Sulphuric acid. Starch solution. 0.025N sodium thiosulphate.	Magnetic stirrer. Water bottle. Pipettes.

1. The water sample is collected. Carefully filled a 300-mL glass Biological Oxygen Demand (BOD) stoppered bottle brim-full with sample water, without making air bubbles.
2. 2ml of manganese sulfate was added to the BOD bottle carefully by inserting the pipette just below the surface of water; avoiding the formation of air bubbles.
3. 2 mL of alkali-iodide-azide reagent was added in the same manner.
4. The bottle was closed and mixed the sample by inverting many times. A brownish cloud was appeared in the solution as an indicator of the presence of oxygen.
5. The brown precipitate was allowed to settle out to the bottom.
6. 2ml of Conc.H_2SO_4 was added carefully. The bottle was closed and mixed the solution well to dissolve the precipitate.
7. 50 ml of sample water was titrated with 0.025N Sodium thiosulphate to a pale yellow color.
8. 2ml of starch solution was added, the sample turns blue in color.
9. The titration was continued till the sample gets clear and noted the readings.
10. DO was calculated. The concentration of dissolved oxygen in the sample is equivalent to the number of milliliters of titrant used.
11. The burette reading was determined for the blank in the same manner.

Determination of dissolved oxygen after 5 days incubation:

The method consists of filling with sample, to overflowing, an airtight bottle of the specified size and incubating it at the specified temperature (at $20^oC \pm 1^oC$) for 5 day. Dissolved oxygen is measured after incubation, and BOD is computed from the difference between initial and final DO.

Incubation of BOD bottles containing desired dilutions of blanks and seed controls is also carried. After 5 day incubation, DO in blanks were determined.

Results & discussion- (Table no-3 & 4)

Isolation & Identification of Microorganisms from Water Sample & TVC.

The test water sample of wells situated in the vicinity of the MSW plant contains more organisms than the control samples. These organisms were mainly from the family *Enterobacteriaceae* that includes the potential pathogens like *Salmonella, Klebsiella, E.Coli,* and *Enterobacter*. If this

water is used for the drinking purpose it may lead to the outbreak of water borne diseases. As the most of the potantial pathogens were found in the well water situated near the MSW treatment plant (when compared with isolates from control well water samples.) the leachate concentration in the vicinity of the landfill site was shown to be maximum.

Most Probable Number of Coliforms, (Table no 5, Table no 6)

As the total Coliforms count of test sample is very high as compared the control sample. The well water near the landfilling site has been contaminated. The total Coliforms are the indicator of the presence of other pathogenic organisms. The total Coliforms count is very high in the first three well water samples situated within the area of 80 meter and the Coliforms count of the test sample 9 and test sample 10 is similar to that of the control sample.

Biochemical Oxygen Demand of Water samples, (Table no 7, Table no 8)

The BOD concentration of wells near the landfill site was higher than the control water sample. Thus the leachate percolating into the groundwater discharges the organic matter into the water and caused the decrease in the dissolved oxygen of the water. The wells near the landfill site showed the higher concentration of BOD as compared to the furthest well. The BOD values decreased as the distance of the well from the landfill site increased.

References

1) Dr. U.Satyanarayana, 2006, *Biotechnology*, Author-Publisher Interlinks,

2) Ray, A., 2008, *Waste management in developing Asia: Can trade and cooperation help?* The Journal of Environment & Development 17.1 (): 3-25

3) Carlsson Reich, M., 2005, *Economic assessment of municipal waste management systems – case studies using a combination of life cycle assessment (LCA) and life cycle costing (LCC).* Journal of Cleaner Production 13: 253-263

4) Lou, X. F.; Nair, J., 2009, *The impact of landfilling and composting on greenhouse gas emissions – A review*, *Bioresource Technology* 100 (16): 3792.

5) John W Best & James V Kahn, 1999, Research in Education, seventh edition.

6) Bingemer H G and Crutzen P J., 1987, '*The production of methane from solid wastes'* Journal of Geophysical Research 92 (D2): 2181–2187CPCB (Central Pollution Control Board). 2000

7) Chaudry, R. G., 1994, *Biological Degradation and Bioremediation of Toxic Chemicals,* London: Chapman and Hall.

8) Pongrácz E & Pohjola VJ. 2004, 'Re-defining waste, the concept of ownership and the roles of waste management'. Resources Conservation & Recycling.: 141-153.

9) Diaz, L. et al., 2006, 'Solid Waste Management', Volume 2. UNEP/Earth print

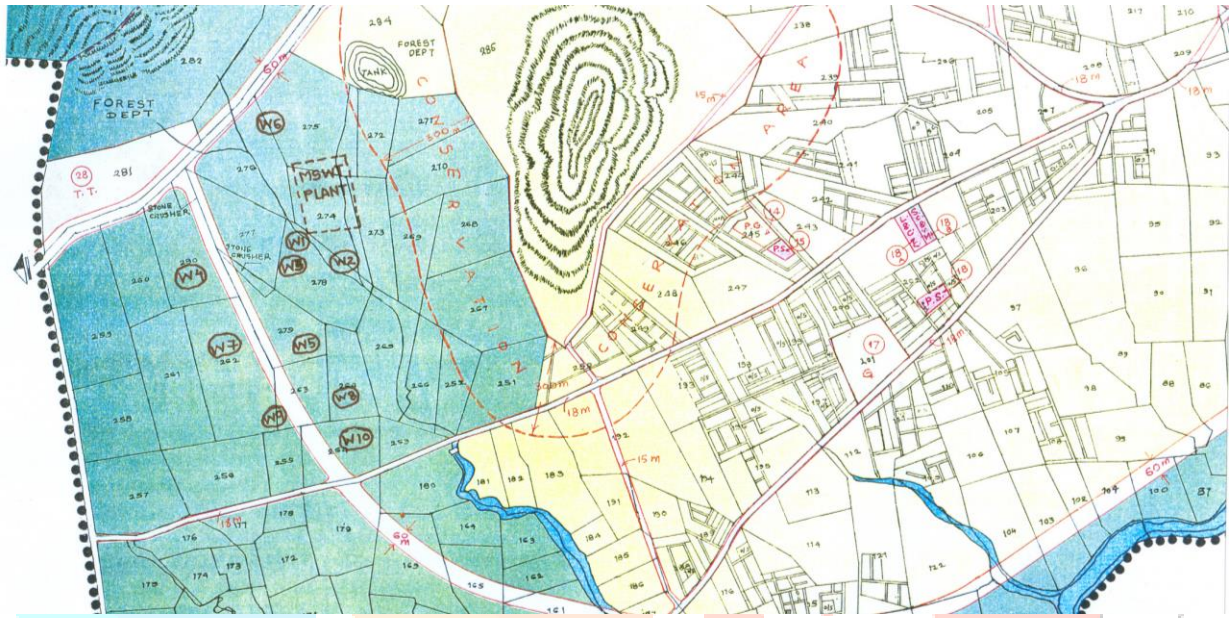

Fig-1 Location of Municipal solid waste treatment plant (MSWT).

Table no-1 – Test sample and distances from landfill site to the well

Sample	Approx. distance of the well from plant (in Meters)	Location
Test Sample 1	20	Govalana road
Test Sample 2	50	Govalana road

Test Sample 3	80	Govalana road
Test Sample 4	500	Pathardi shivar
Test Sample 5	1000	Vadiche ran
Test Sample 6	700	Govalana road
Test Sample 7	1400	Pathardi shivar
Test Sample 8	2000	Govalana shivar
Test Sample 9	2500	Govalana shivar
Test Sample 10	2300	Govalana shivar

Table no 2 – Control Sample number and location of wells.

SAMPLE	LOCATION
Control Sample 1	Mhasarul
Control Sample 2	Nashik road
Control Sample 3	Cidco
Control Sample 4	Panchvati

Table no 3-Total Viable count (TVC) of the Microorganisms /ml of test sample (s)

Test Sample Number	Total Viable Count (CFU)
Sample -1	32 × 10
Sample -2	28 × 10
Sample-3	39 × 10
Sample-4	31 × 10
Sample-5	17 × 10
Sample-6	4 × 10
Sample-7	20 × 10
Sample-8	12 × 10
Sample-9	7 × 10
Sample-10	14 × 10

Table no 4 - Total Viable count (TVC) of the Microorganisms /ml of control sample(c).

Control Sample Number	Total Viable Count (CFU)
Sample -1	3 × 10
Sample -2	8 × 10
Sample-3	9 × 10
Sample-4	13 × 10

Table no 5- Total Coliforms number of Test water sample

Source of water	Number of tubes showing Acid and Gas			Number of Coliforms/100ml
	10 ml	1 ml	0.1 ml	
Test Sample 1-	5	5	5	1800+
Test Sample-2	5	5	5	1800 +
Test Sample-3	5	5	5	1800+
Test Sample-4	5	4	5	1600
Test Sample-5	5	4	4	350
Test Sample-6	4	3	2	40
Test Sample-7	5	3	3	175
Test Sample-8	3	-	1	11
Test Sample-9	2	1	1	9
Test Sample-10	-	2	2	6

Table no 6 - Total Coliforms number of Control water Sample

Source of water	Number of tubes showing Acid and Gas			Number of Coliforms/100ml
	10 ml	1 ml	0.1 ml	
Control Sample-1	–	2	1	6
Control Sample-2	–	1	2	6
Control Sample-3	2	–	–	5
Control Sample-4	–	1	1	4

Table no 7- BOD of Test water samples

Sample	B.O.D. mg/l
Test Sample-1	6.o
Test Sample-2	6.4
Test Sample-3	5.9
Test Sample-4	5.6
Test Sample-5	5.6
Test Sample-6	3.2
Test Sample-7	4.8
Test Sample-8	2.4
Test Sample-9	3.2
Test Samle-10	4.0

Table no 8- BOD of Control water samples

Sample	B.O.D. mg/l
Control Sample-1	0.4
Control Sample-2	1.6
Control Sample-3	0.8
Control Sample-4	0.4