ISSN No:-2456-2165

# Impact of Municipal Solid Waste Leachate on the Ground Water Quality at Namakkal District, India.

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**Abstract:- Leachate from dynamic municipal solid waste landfills can be a noteworthy wellspring of contamination to groundwater and surface water. In this way, the present investigation was done to evaluate the quality of ground water samples. Seven ground water samples were gathered from various locations, which showed that the quality of centre point samples were within the standards, as the other samples showed higher concentrations than the standard.**

***Keywords:-*** *Groundwater, Leachate, Pollution, Heavy metals, Namakkal.*

## I. INTRODUCTION

One of the significant pollution issue caused by the municipal solid waste (MSW) landfill is leachate, which is created as a consequence of precipitation, surface spillover and infiltration or intrusion of ground water percolating through a landfill. For the most part leachate contain large amounts of organic matter (biodegradable but also refractory to biodegradation), which are awesome risk to the environment soil, groundwater even surface water [Oygard J.K and Gyengadal E (2009)].

The quantity of leachate created from landfills depends chiefly on climatic factors in its vicinity that is the above all on the water balance in the layer covering wastes. The volume of leachate is likewise influenced by beginning moisture content of the waste, solid waste composition, biochemical and physical change occuring in them and causing changes in their humidity and by the inflow of water from outside a landfill [Jedrczak A et al (1994)].

Other than contaminating surface water another devasting impact of dumping site is on groundwater quality by the development of leachate [Khan I.H and Ahsan N (2003)]. Leachate by leakages and invasion break down soil quantity as well as renders the associated aquifer problematic and until for drinking purposes [APHA standard methods (2008)]. In this way the present investigation manages physicochemical analysis of municipal solid waste leachate in Namakkal.

## II. MATERIALS AND METHODS

### *A. Study Area*

Namakkal or Namagiri is a city anda municipality in Namakkal district in the Indian state of Tamil Nadu. It is the headquarters of Namakkal district and the first ISO 14001-2004 certified municipality in Asia for environmental management, specifically the provision and maintenance of water supply, solid waste and sewage management, town planning, lighting and other social services. As of 2011, this municipality had a population of 55,145 with 30 wards of 10.24 sq.km. Further, the municipality has been extended to 39 wards with an area of 50.24 sq.km by adding 9 villages namely Chinnamuthalipatty, Muthalipatty, Kosavampatty, Konduchichetty patti, Periyapatty, Kavateepatti, Nallipalayam, Ayyampalayam and Thumakurichi.

It was a town panchayat since 1943 and in 1970 it was upgraded to a Grade III municipality. Over the years, the town has been upgraded and in 1988, it was upgraded into a Selection Municipality.

### *B. Survey and Sample Collection*

The survey was conducted during rainy season of year 2015. The dumping site is located at Kosavampatty, Namakkal Municipality Compost Yard (E = 78° 10’ 55”, N = 11° 12’ 53”).

All Groundwater samples were collected from MSW dumping sites. The samples were labelled as Sample I – Inside Dump Yard (Bore well), Sample II - Inside Dump Yard (Well Water), Sample III – Front Side of Dump Yard (Bore well), Sample IV – Backside of Dump Yard (Well Water), Sample V – Left side of Dump Yard (Well Water), Sample VI - Right side of Dump Yard (Bore well) and Sample VII – Centre of the dump yard (Bore well). Samples were stored at 40°C for until used for analysis.

### *C. Physicochemical Analysis of Groundwater*

All the Groundwater samples were analysed for following physical as well as chemical parameters included Colour, pH, Electrical Conductivity (EC), Total Dissolved Solid (TDS), Total Alkalinity (TA), Chloride, Total Hardness (TH), Ca hardness, Mg hardness, Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Sulphate, Carbonate and Bicarbonate, Nitrate and Nitrite, Phosphate, Sodium, Potassium and heavy metals like iron, Copper, Zinc, Lead, Nickel, Cadmium and Chromium are carried out in accordance to standard analytical methods [Kumar A. et al (2010b)].

## III. RESULTS AND DISCUSSION

Groundwater samples were characterized for both Physico - chemical parameters and heavy metal analysis. Results are shown in table 1 and 2. The results of different area have also been individually discussed. The values obtained are compared [IS 10500 (1991)] with the desirable

and permissible limit as issue by Government of India i.e. IS 10500.

*A. Sample I:Inside Dump Yard (Bore Well)*

This sample was collected within the dump yard through bore well system. The colour of the sample was found to be having the higher colour of < 40. The pH of the sample was found to be neutral (7.37). Generally pH of water is influenced by geology of catchment area and buffering capacity [Shyamala R. *et al* (2008)]. The electrical conductivity of the sample was found to be 5600 µS/m. It represents the total concentration of soluble salts in water. It is used to measure the salinity hazard to crops as it reflects the TDS in ground water [Ananda Kumar S. *et al* (2007)].

TDS concentration was high (3160 mg/l) due to the presence of bicarbonates (500 mg/l) and chlorides (1518 mg/l). From the clarity of water sample it is clear that the sample contained turbidity (2 NTU) within the standard. The total hardness of the collected sample was very high (1930 mg/l) compared with the standards. Similarly the calcium and magnesium levels were extremely very high (228 mg/l and 340 mg/l respectively) than the standard. The total alkalinity was found to be 500 mg/l Carbonates were not present in the sample.

The concentration of both nitrate (40 mg/l) and nitrite (2 mg/l) was found be within the required limit. The sulphate content in ground water generally occurs as soluble salts of calcium, magnesium and sodium (12450 mg/l). Sulphate (45 mg/l) was found to be within the standard limit. The Bureau of Indian Standards (BIS) has not included potassium in drinking water standards. However, the European Economic Community (EEC) has prescribed guide line level of potassium at 10 mg/l in drinking water. Higher potassium content in ground water is indicative of ground water pollution. The results obtained for the concentration of potassium shows 653 mg/l i.e., exceeding the standard limit.

The most important parameters of ground water are the Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD). The values obtained are 56 mg/l and 240 mg/l.

Heavy metals like Iron, Copper, Zinc, Lead, Nickel, Cadmium, Chromium and Silicates were also estimated and compared with respective standards. Sample collected showed minute concentration of heavy metals i.e., Below Detectable Level (BDL) except for iron (3 mg/l) and lead (0.0087 mg/l).

*B. Sample II: Inside Dump Yard (Well Water)*

This sample was collected within the dump yard through open well system. The colour of the sample was found to be having the higher colour of < 30. The pH of the sample was found to be neutral (7.85). The electrical conductivity of the sample was found to be 4600 µS/m.

TDS concentration was high (2630 mg/l) due to the presence of bicarbonates (502 mg/l) and chlorides (1022 mg/l) [Deepali S. et al (2001)]. Water containing TDS more than 500 mg/l causes gastrointestinal irritation [BIS (1991)]. Chloride in ground water may be due to the contamination from human sources. The high content of chloride in the aquatic systems is responsible for a large amount of organic matter which in turn causes eutrophication [Jayalakshmi V. et al (2007)].

From the clarity of water sample it is clear that the sample contained turbidity (15 NTU) higher than the standard. The total hardness of the collected sample was very high (1100 mg/l) compared with the standards. Similarly the calcium and magnesium levels were extremely very high (196 mg/l and 141 mg/l respectively) than the standard. The total alkalinity was found to be 562 mg/l. Carbonates were not present in the sample.

The concentration of both nitrate (27 mg/l) and nitrite (2 mg/l) was found be within the required limit. The sulphate content in ground water generally occurs as soluble salts of calcium, magnesium and sodium (384 mg/l). Sulphate (93 mg/l) was found to be within the standard limit. The Bureau of Indian Standards (BIS) has not included potassium in drinking water standards. However, the European Economic Community (EEC) has prescribed guide line level of potassium at 10 mg/l in drinking water. Higher potassium content in ground water is indicative of ground water pollution. The results obtained for the concentration of potassium shows 591 mg/l i.e., exceeding the standard limit.

The most important parameters of ground water are the Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD). The values obtained are 52 mg/l and 232 mg/l.

Heavy metals like Iron, Copper, Zinc, Lead, Nickel, Cadmium, Chromium and Silicates were also estimated and compared with respective standards. Sample collected showed minute concentration of heavy metals i.e., Below Detectable Level (BDL) except for iron (0.72 mg/l) and lead (0.008 mg/l).

*C. Sample III: Front Side of the Dump Yard (Bore Well)*

This sample was collected from the front side of the dump yard through bore well system. The colour of the sample was found to be having the higher colour of < 80. The pH of the sample was found to be slightly acidic (6.91). The electrical conductivity of the sample was found to be 8400 µS/m. TDS concentration was high (4850 mg/l) due to the presence of bicarbonates (1050 mg/l) and chlorides (2630 mg/l).

From the clarity of water sample it is clear that the sample contained turbidity (3 NTU) within the standard. The total hardness of the collected sample was very high (6600 mg/l) compared with the standards. The presence of hardness in water may be due to weathering of limestone, sedimentary rock and calcium bearing minerals or extreme use of lime to the soil in agricultural areas [Priscilla Alexander (2008)].

Similarly the calcium and magnesium levels were extremely very high (1160 mg/l and 888 mg/l respectively) than the standard. The total alkalinity was found to be 1050 mg/l. Carbonates were not present in the sample. The concentration of nitrate (74 mg/l) was found to be exceeding the required limit and nitrite (12 mg/l) was found be within the required limit. The sulphate content in ground water generally occurs as soluble salts of calcium, magnesium and sodium (401 mg/l). Sulphate (95 mg/l) was found to be within the standard limit.

The Bureau of Indian Standards (BIS) has not included potassium in drinking water standards. However, the European Economic Community (EEC) has prescribed guide line level of potassium at 10 mg/l in drinking water. Higher potassium content in ground water is indicative of ground water pollution. The results obtained for the concentration of potassium shows 721 mg/l i.e., exceeding the standard limit.

The most important parameters of ground water are the Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD). The values obtained are 158 mg/l and 640 mg/l.

Heavy metals like Iron, Copper, Zinc, Lead, Nickel, Cadmium, Chromium and Silicates were also estimated and compared with respective standards. Sample collected showed minute concentration of heavy metals i.e., Below Detectable Level (BDL) except for iron (0.52 mg/l), Copper (0.097 mg/l) and lead (0.023 mg/l).

*D. Sample IV: Back Side of the Dump Yard (Well Water)*

This sample was collected from the back side of the dump yard through open well system. The colour of the sample was found to be having the higher colour of < 50. The pH of the sample was found to be neutral (7.25). The electrical conductivity of the sample was found to be 6500 µS/m. TDS concentration was high (3790 mg/l) due to the presence of bicarbonates (487 mg/l) and chlorides (2005 mg/l).

From the clarity of water sample it is clear that the sample contained turbidity (5 NTU) exactly on par with the standard. The total hardness of the collected sample was very high (2150 mg/l) compared with the standards.

Similarly the calcium and magnesium levels were high (300 mg/l and 343 mg/l respectively) than the standard. Calcium in excess will give hardness to water due to passage of ground water over deposits of lime stone, dolomite, gypsum etc and the presence of magnesium in ground water may be due to weathering of rocks. High concentration of magnesium proves to be diuretic a laxative.

The total alkalinity was found to be 487 mg/l. The presence of bicarbonates is the main cause of high concentration of alkalinity in ground water. Carbonates were not present in the sample. Bicarbonates represent the major form since they are formed in considerable amount from the action of carbonates upon the basic materials in soil.

The concentration of nitrate (47 mg/l) was found to be slightly exceeding the required limit and nitrite (11 mg/l) was found be within the required limit. The sulphate content in ground water generally occurs as soluble salts of calcium, magnesium and sodium (9705 mg/l). Sulphate (58 mg/l) was found to be within the standard limit.

The Bureau of Indian Standards (BIS) has not included potassium in drinking water standards. However, the European Economic Community (EEC) has prescribed guide line level of potassium at 10 mg/l in drinking water. Higher potassium content in ground water is indicative of ground water pollution. The results obtained for the concentration of potassium shows 864 mg/l i.e., exceeding the standard limit.

The most important parameters of ground water are the Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD). The values obtained are 60 mg/l and 288 mg/l.

Heavy metals like Iron, Copper, Zinc, Lead, Nickel, Cadmium, Chromium and Silicates were also estimated and compared with respective standards. Sample collected showed minute concentration of heavy metals i.e., Below Detectable Level (BDL) except lead (0.002 mg/l).

*E. Sample V: Left Side of the Dump Yard (Well Water)*

This sample was collected from the left side of the dump yard through open well system. The colour of the sample was found to be having the higher colour of < 100. The pH of the sample was found to be neutral (7.1). The electrical conductivity of the sample was found to be 9100 µS/m. TDS concentration was high (5390 mg/l) due to the presence of bicarbonates (1050 mg/l) and chlorides (3156 mg/l).

From the clarity of water sample it is clear that the sample contained turbidity (8 NTU) within the standard. The total hardness of the collected sample was very high (5450 mg/l) compared with the standards. Similarly the calcium and magnesium levels were extremely very high (1280 mg/l and 540 mg/l respectively) than the standard. The total alkalinity was found to be 1050 mg/l. Carbonates were not present in the sample.

Nitrogen content (both nitrate and nitrite) in drinking water is considered important for its adverse health effects like methaemoglobinaemia (blue babies). The concentration of nitrate (63 mg/l) was found to be little higher than the required limit and nitrite (11 mg/l) was found to be within the required limit. Potential sources of nitrogen include municipal/industrial waste water, septic tanks, landfills, and sewage wastes and feed lot discharges. As organic matter is oxidized, nitrogen is released primarily as nitrate and nitrite.

The sulphate content in ground water generally occurs as soluble salts of calcium, magnesium and sodium (9860 mg/l). Sulphate (57 mg/l) was found to be within the standard limit.

The Bureau of Indian Standards (BIS) has not included potassium in drinking water standards. However, the

European Economic Community (EEC) has prescribed guide line level of potassium at 10 mg/l in drinking water. Higher potassium content in ground water is indicative of ground water pollution. The results obtained for the concentration of potassium shows 868 mg/l i.e., exceeding the standard limit.

The most important parameters of ground water are the Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD). The values obtained are 288 mg/l and 1040 mg/l.

Heavy metals like Iron, Copper, Zinc, Lead, Nickel, Cadmium, Chromium and Silicates were also estimated and compared with respective standards. Sample collected showed minute concentration of heavy metals i.e., Below Detectable Level (BDL).

*F. Sample VI: Right Side of the Dump Yard (Bore Well)*

This sample was collected from the right side of the dump yard through bore well system. The colour of the sample was found to be having the higher colour of < 70. The pH of the sample was found to be neutral (7.07). The electrical conductivity of the sample was found to be 8900 µS/m.

TDS concentration was high (5270 mg/l) due to the presence of bicarbonates (1025 mg/l) and chlorides (2987 mg/l) from the clarity of water sample it is clear that the sample contained turbidity (9 NTU) within the standard. The total hardness of the collected sample was very high (5000 mg/l) compared with the standards.

Similarly the calcium and magnesium levels were extremely very high (1320 mg/l and 408 mg/l respectively) than the standard. The total alkalinity was found to be 1025 mg/l. Carbonates were not present in the sample. The concentration of nitrate (62 mg/l) was found to be exceeding the required limit and nitrite (2 mg/l) was found be within the required limit.

The sulphate content in the ground water generally occurs as solvent salts of calcium, magnesium and sodium (6069 mg/l). Sulphate (56 mg/l) was found to be within the standard limit. Sulphate is a naturally occurring anion in all kinds of natural water. Higher sulphate concentration present in waters of drainage causes laxative effects and diarrhoea [Guru Prasad B. (2003)].

The presence of sodium may be due to the leachate from soil and rocks. Since the sodium concentration is more than the limit it makes the water unsuitable for both domestic and agriculture use [Jain C. et al (2003)]. The Bureau of Indian Standards (BIS) has not included potassium in drinking water standards.

Notwithstanding, the European Economic Community (EEC) has prescribed guide line level of potassium at 10 mg/l in drinking water. Higher potassium content in ground water is demonstrative of ground water pollution. The results obtained for the concentration of potassium shows 913 mg/l i.e., exceeding the standard limit. The concentrations of potassium in ground water were due to dredged material disposal.

The most important parameters of ground water are the Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD). The values obtained are 192 mg/l and 802 mg/l.

Heavy metals like Iron, Copper, Zinc, Lead, Nickel, Cadmium, Chromium and Silicates were also estimated and compared with respective standards. Sample collected showed minute concentration of heavy metals i.e., Below Detectable Level (BDL).

*G. Sample VII: Centre of the Dump Yard (Bore Well)*

This sample was collected from the centre of the dump yard through bore well system. The colour of the sample was found to be having the similar colour of > 5. The pH of the sample was found to be neutral (7.21). The electrical conductivity of the sample was found to be 645 µS/m. TDS concentration was less (420 mg/l) due to the presence of bicarbonates (126 mg/l) and chlorides (170 mg/l).

From the clarity of water sample it is clear that the sample contained turbidity (1 NTU) within the standard. The total hardness of the collected sample was less (260 mg/l) compared with the standards. Similarly the calcium and magnesium levels were moderate (50 mg/l and 16 mg/l respectively) than the standard.

The total alkalinity was found to be 126 mg/l. Carbonates (0 mg/l) were not present in the sample. The concentration of both nitrate (17 mg/l) and nitrite (0.6 mg/l) was found be very low than the required limit. The sulphate content in ground water for the most part happens as dissolved salts of calcium, magnesium and sodium (120 mg/l). Sulphate (52 mg/l) was found to be inside as far as possible.

The Bureau of Indian Standards (BIS) has excluded potassium in drinking water standards. In any case, the European Economic Community (EEC) has endorsed rule level of potassium at 10 mg/l in drinking water. Higher potassium content in ground water is characteristic of ground water pollution. The results obtained for the concentration of potassium shows 35 mg/l i.e., exceeding the standard limit.

The most important parameters of ground water are the Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD). The values obtained for both BOD and COD are Below Detectable Level (BDL). The study on the quality water in the vicinity indicates that the water quality in all the samples is detorating due to dumping of solid waste.

Heavy metals like Iron, Copper, Zinc, Lead, Nickel, Cadmium, Chromium and Silicates were also estimated and compared with respective standards. Sample collected showed minute concentration of heavy metals i.e., Below Detectable Level (BDL).

ISSN No:-2456-2165

| | Kosavampatty Dump Yard | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| S.No | Parameters/Sample | Unit | Standard IS:10500 | I | II | III | IV | V | VI | VII |
| 1 | Colour | Hazen | >5 | <40 | <30 | <80 | <50 | <100 | <70 | >5 |
| 2 | pH | **** | 6.50 to 8.50 | 7.37 | 7.85 | 6.91 | 7.25 | 7.1 | 7.07 | 7.21 |
| 3 | Electrical Conductivity | µS/cm | - | 5600 | 4600 | 8400 | 6500 | 9100 | 8900 | 645 |
| 4 | Total Dissolved Solids | mg/l | 500 | 3160 | 2630 | 4850 | 3790 | 5390 | 5270 | 420 |
| 5 | Turbidity | NTU | 5 | 2 | 15 | 3 | 5 | 8 | 9 | 1 |
| 6 | Total Hardness (as $CaCO_3$) | mg/l | 300 | 1930 | 1100 | 6600 | 2150 | 5450 | 5000 | 260 |
| 7 | Calcium (as Ca) | mg/l | 75 | 228 | 196 | 1160 | 300 | 1280 | 1320 | 50 |
| 8 | Magnesium (as Mg) | mg/l | 30 | 340 | 141 | 888 | 343 | 540 | 408 | 16 |
| 9 | Total Alkalinity (as $HCO_3$) | mg/l | 200 | 500 | 562 | 1050 | 487 | 1050 | 1025 | 126 |
| 10 | Carbonate ($CO_3$) | mg/l | - | - | - | - | - | - | - | 0 |
| 11 | Bicarbonate ($HCO_3$) | mg/l | - | 500 | 502 | 1050 | 487 | 1050 | 1025 | 126 |
| 12 | Nitrate (as $NO_3$) | mg/l | 45 | 40 | 27 | 74 | 47 | 63 | 62 | 17 |
| 13 | Nitrite (as $NO_2$) | mg/l | - | 2 | 2 | 12 | 11 | 11 | 2 | 0.6 |
| 14 | Chlorides (as Cl) | mg/l | 250 | 1518 | 1022 | 2630 | 2005 | 3156 | 2987 | 170 |
| 15 | Phosphate (as PO4) | mg/l | | 3.8 | 4.6 | 6.8 | 6.2 | 7.1 | 6.9 | 1.2 |
| 16 | Sulphate (as $SO_4$) | mg/l | 200 | 45 | 93 | 95 | 58 | 57 | 56 | 52 |
| 17 | Sodium (as Na) | mg/l | 150 | 12450 | 384 | 401 | 9507 | 9860 | 6069 | 120 |
| 18 | Potassium (as K) | mg/l | - | 653 | 591 | 721 | 864 | 868 | 913 | 35 |
| 19 | Chemical Oxygen Demand | mg/l | - | 240 | 232 | 640 | 288 | 1040 | 802 | BDL |
| 20 | Biological Oxygen Demand For 3 Days | mg/l | **** | 56 | 52 | 158 | 60 | 288 | 192 | BDL |

Table 1: Assessment of the Groundwater samples from MSW dumping sites at Coimbatore

BDL: Below Detectable Limit.

| Kosavampatty Dump Yard | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| S.No | Parameters/Sample | Unit | Standard IS:10500 | I | II | III | IV | V | VI | VII |
| 1 | Iron (as Fe) | mg/l | 0.3 | 3 | 0.72 | 9 | 4 | 2 | 4 | 0.05 |
| 2 | Copper (as Cu) | mg/l | 0.05 | BDL | BDL | 0.5 | BDL | BDL | BDL | BDL |
| 3 | Zinc (as Zn) | mg/l | 5 | BDL | BDL | 0.097 | BDL | BDL | BDL | BDL |
| 4 | Lead (as Pb) | mg/l | 0.05 | 0.0087 | 0.008 | 0.023 | 0.002 | BDL | BDL | BDL |
| 5 | Nickel (as Ni) | mg/l | 0.02 | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| 6 | Cadmium (Cd) | mg/l | 0.1 | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| 7 | Chromium (Cr) | mg/l | 0.05 | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| 8 | Silicates (as $SiO_2$ ) | mg/l | 0.4 to 25 | BDL | BDL | BDL | BDL | BDL | BDL | BDL |

Table 2: Heavy Metal Analysis of the Groundwater samples from MSW dumping sites at Namakkal

BDL: Below Detectable Limit

## IV. CONCLUSION

Numerous components impact the leachate composition including the kinds of wastes, moisture content, the particle size, and the degree of compaction, the hydrology of the site, the atmosphere and age of the fill [Kulilowska D. (2002)]. Consequently, from the present investigation we can conclude that MSW leachate containing higher measure of inorganic as well as organic component which may cause defilement of groundwater as well as surface water and furthermore contaminates the agricultural soil near MSW region.

## ACKNOWLEDGEMENT

The authors are thankful to the Municipality of Namakkal and Greenlink Analytical and Research Laboratory for carrying out this work.

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