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A REVIEW PAPER ON THE IMPACT OF MUNICIPAL SOLID WASTE ON GROUNDWATER QUALITY

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Abstract - *Water is an important part of human life. Natural water resources are getting contaminated due to human interference and misuse. The quantity of solid waste is increasing day by day and due to lack of management, the waste is getting dumped on grounds unscientifically. These kinds of dumping sites are causing an environmental and health-related problems around the vicinity. The most common problem these kinds of dumping sites can create is groundwater contamination as the toxic and hazardous waste can mix with the rainfall or surface water and then infiltrate into the ground and eventually mix with the groundwater source. In this review paper, a vast study of the groundwater quality parameter assessment is carried out around the dumping sites of Sangli- Miraj- Kupwad metropolitan city. The parameters which are studied in this paper are pH, EC, TDS, total hardness, alkalinity, chloride, COD, BOD, and nitrate. After the analysis, the results were compared with BSI and IS 10500 – 2012.*

Key Words: **Groundwater**, **Contamination**, **MSW**, **Parameters, BSI**...

1. INTRODUCTION

Water is the most important in shaping the land and regulating the climate [5]. It is also important for agricultural production. The water demand is increasing day by day. Most people are dependent on natural resources hence it is very important to check the quality of water as poor-quality water consumption and its use can affect the livelihood and health of the public. Increasing human population levels, booming economy, fast urbanization, and the increase in community living standards have greatly accelerated the generation of municipal solid waste in developing countries [18]. Generally, in developing countries like India, MSW is disposed of in low-lying areas without taking proper precautions or operational controls in the municipality region [18]. The open dumping of waste gives rise to many environmental risks such as water pollution, land pollution, air pollution, and health hazard [11]. The entry of rainwater through the dumped municipal solid waste in landfill area produce liquid waste called leachate [18]. Landfill leachate has contaminated the entire quality of surface and groundwater systems in and around the dumpsite [18]. Groundwater source is used for drinking purpose, irrigation, and also for livelihood. Groundwater source is mainly dependent upon surface and subsurface water runoff and also on climate. This kind of contaminated water poses threats to humankind after its usage. The area near the unscientific dumping site is mostly severally polluted. These unscientific dumping sites create air, water, and soil pollution. After the rainfall, the water which is probably mixed with hazardous pollutants penetrates under the ground and joins the groundwater resource. That is why it's very important to carry out water quality analysis before its consumption. There are different parameters from which one can check the quality of water such as pH, hardness, alkalinity, EC, TDS, COD, BOD, nitrates, heavy metals, etc.

1.1 LITERATURE REVIEW

1.1.) Abhishek Nandan, Bikarama Prasad Yadav, Soumyadeep Baksi, and Debajyoti Bose did research on the status of MSW management in different locations of India. Their study also sums up a collective, systematic effort that improves the implementation of legal frameworks, institutional arrangements, financial provisions, technology, operations management, human resource development, and public participation and awareness of Integrated SWM systems.

1.2) Antara Banerjee did research on municipal solid waste management, its disposal, and its impact at the Ghazipur landfill site. In this paper, they analyzed noise, air, soil, and groundwater pollution they also studied how it's affecting the people who live in the vicinity economically. An analysis of the above factors was done with the Boragaon waste dumping site in Guwahati. From the study, they observed that this MSW on these sites has an adverse effect on the surrounding environment. They also found that both the sites negatively affected the lives of residents of the surrounding area and, with the near future increase in the quantity of MSW, it would further prove to be a serious environmental hazard.

1.3) Aparna Borawake, V. B. Gaikwad, Sucheta Patil, and Anjana Kamra conducted a study on the quality parameters assessment of groundwater for domestic and agricultural usage in the Pathardi region of Nashik, Maharashtra, India. The study covered 10 different locations in the Pathardi region near the composting project of the municipal corporation in Nashik city. They collected samples of water from wells & bore wells during the pre-monsoon period (May month) and analyzed the parameters such as pH,

EC, TDS, TH, HCO3 -, Na+, K^+, Ca^{2+}, Mg^{2+}, Cl^-, SO_4^{2-}, NO_3, Fe, F, Turbidity, Total viable count, Total coliforms, and E. coli presence. They compared the results with IS 10500 standards,2012 (BIS). In this study, they observed the impaired status of groundwater quality at the study site. Which resulted from the excess of TH, HCO3 -, Ca^+, Mg^{2+}, Total coliforms, and E. coli. Excess of these parameters makes the groundwater unsuitable for human consumption in these areas. S

1.4) De. S, Maiti S. K., Hazra T., and Dutta A investigated the impact of landfill leachate on the groundwater in Kolkata, India. They have analyzed groundwater samples for twenty-two Physico-chemical parameters in the pre-monsoon, monsoon, and post-monsoon seasons of 2014. They have assessed the impact of leachate and found that almost all its Physico-chemical parameters changed with time. They found groundwater samples to be contaminated with Hg, Pb, Cd, Cr, Fe, and Mn, showing the minor effect of redox control on the occurrence and transport of heavy metals. In addition, they compared the Physico-Chemical parameters with the World Health Organization (WHO) and Bureau of Indian Standards (BIS) and discovered that most groundwater samples were unfit for drinking.

1.5) Hassan A. S. S Ghorade I. B. Patil S. S published a paper on the Physico-chemical assessment of groundwater quality of the Waluj industrial area, Aurangabad. The purpose of this study was to assess the physicochemical characteristics of water samples collected from wells in the Waluj MIDC region of Aurangabad. Temperature, pH, EC, alkalinity, nitrate, DO, BOD & COD were analyzed in this study. A study conducted in the Waluj MIDC area found that the water quality of the wells was deteriorating, likely because of an increase in human activities and improper industrial effluent discharges.

1.6) Nitin Kamboj and Mohrana Choudhary have carried out a study to find out domestic waste disposal impact on groundwater quality in Delhi, India. They analyzed various physicochemical parameters of collected groundwater samples, which are EC, TDS, alkalinity, total hardness, calcium magnesium, chloride, sulphate, nitrate, phosphate, fluoride, sodium, and potassium. From the research, they found out that in the collected water samples, chloride and TDS levels were above the desirable limit and below the permissible limit of BIS, and also the other parameters were within the desirable limit

1.7) N. Victor Babu, P. Jagadeeswara Rao, I.V.R.K.V. Prasad carried out research on the Physico-chemical parameter analysis on groundwater in the Greater Visakhapatnam Municipal Corporation (GVMC), Visakhapatnam district, Andhra Pradesh. In this study, they collected about 25 groundwater samples covering the entire area during August 2011. They analyzed physicochemical and heavy metal parameters of collected water samples. They compared the concentration of collected samples with BIS & WHO. From the research they conclude that the water quality parameters were above the desirable limits in the villages of Balacheruvu, Akkireddypalem Sabbavaram, Tarluwada, and Kapulauppada dump yard, they also observed that because of industrial effluent and leachates of urban solid wastes there is a higher content of different elements in groundwater.

1.8) N.C. Tharavathy carried out a study on groundwater quality in Mangalore city, India. In this study, they analyzed parameters such as pH, dissolved oxygen, alkalinity, solids, hardness, chloride, phosphate, sulphate, calcium, magnesium, and iron contents by standard method for nine groundwater samples. They compared the results with WHO and BSI standards. The results show the pH was above the WHO desirable drinking water standards in two locations, Panamboor and Hoige Bazaar. The results also state that DO, alkalinity, solids, hardness, chloride, phosphate, calcium, magnesium, and iron levels are below the desirable BSI and WHO drinking water standards. The quality of sulphate in Konaje and Kavoor locations was more than the standards prescribed by the BSI and WHO

1.9) Priyanka Kumari, N.C. Gupta and A. Kaur published a review paper on landfill sites' threats to groundwater and their impact on human health. They reviewed various studies related to groundwater contamination due to landfill sites, mostly caused by unscientific landfills or open dumps in India and around the world, and its adverse effects on human health. From the study, they found that several studies have established the fact that there is a risk of negative health effects in residents. Pregnant women and children are more endangered by these pollutants, and newborn children are more likely at risk.

1.10) P. Satyanarayana, N. Appala Raju, K. Harikrishna, and K. Viswanath carried out a case study on groundwater quality parameters assessment of Greater Visakhapatnam Municipal Corporation Area (GVMC), Andhra Pradesh, India. They compared the results of collected samples to the water quality standards of WHO, BIS, and CPHEEO. They have collected water samples from bore wells in the GVMC area. In this study, they analyzed various physicochemical parameters such as PH, EC, Total Dissolved Solids, Total Hardness, Ca, Mg, Na, NO3, K, Fe, Cl, SO4, Cr, Cu, HCO3, and Manganese by adapting standard procedures.

1.11) Rajkumar Joshi and Sirajuddin Ahmed published a review paper on municipal solid waste management (MSWM) challenges in urban India. In this study, they assessed the parameters of MSWM, besides a comprehensive review of MSW generation, its characteristics, collection, and treatment options that are carried out in India. In addition, they studied the present status of MSWM in India. Also, they discussed essential conditions for harnessing benefits from public-private partnerships and challenges, and the important role of rag-pickers. The study concludes that the

installation of decentralized solid waste processing units in cities/towns and the development of a recycling industry sector are the need for developing countries like India.

1.12) 1.12) Rakesh Kumar Pandey, Dr. R. P. Tiwari, and Dr. S. G. Kirloskar conducted research on the MSW impact on subsurface water quality around the landfill site. In this study, they collected groundwater samples in and around the Khermai Road landfill to find out the effects of MSW (Municipal Solid Waste) on the groundwater resources in that area. The study aimed to analyze the subsurface water pollution caused by landfills in residential areas nearer to a landfill site; Satna city. They assessed the physical & chemical parameters of samples to check the quality of subsurface water. The study recommends that the concentration of a few parameters like TDS, Total Hardness, Calcium, and Magnesium concentration are over the desired limits of Indian Measures for drinking water (BIS- 10500:1991) and WHO. the study also concluded that at present the MSW doesn't affect the subsurface water quality that much.

2. ANALYSIS OF WATER QUALITY PARAMETERS

Following are the parameters that are analyzed in this paper: pH, EC, Hardness, Chloride, Alkalinity, TDS, COD, BOD, and Nitrate.

2.1) pH

The pH of the solution is taken as –ive logarithm of H2 ions for many practical practices [5]. The value range of pH from 7 t0 14 is alkaline, from 0 to 7 is acidic and 7 is neutral [5]. Normally for domestic uses, water having a pH between 6 and 10 generally causes no problem [3]. As per IS: 10500-2012 is 500 and 2000 mg/l respectively [5].

2.2) EC

Conductivity is the capacity of water to carry an electrical current and varies both with the number and types of ions the solution contains [5]. In contrast, the conductivity of distilled water is less than 1umhos/cm [5]. This conductivity depends on the presence of ions their total concentration, mobility, valence, and relative concentration, and on the temperature of the liquid [5]. Solutions of most inorganic acids, bases, and salts are relatively good conductors [5]. During the process of municipal waste decompositions, more soluble salts became prone to be leached out and this is reflected in increasing the EC values and the concentrations of soluble ions in leachate [18].

2.3) Hardness

It is a measure of variable complex mixtures of anions and cations [10]. In freshwater, the principal cations which impart hardness are calcium and magnesium [10]. Hard water is objectionable for domestic purposes since it needs a lot of soap for lather formation [10]. As per IS: 10500-2012 Desirable limit and Permissible limit for hardness lie between 200 to 600 mg/l respectively [5]. The Treatment of hard Water is Softener Ion Exchanger and Reverse Osmosis process [5]. The degree of hardness of drinking water has been classified in terms of the equivalent CaCO3 concentration as follows: Soft - 0-60mg/l, Medium - 60-120 mg/l, Hard - 120-180 mg/l, very hard - >180 mg/l [5].

2.4) Chloride

It naturally occurs in all types of water. In natural freshwaters, the concentration of chloride is quite low and is generally less than that of sulphates and bicarbonates [10]. It comes from activities carried out in the agricultural area, Industrial activities, and from chloride stones. Its concentration is high because of human activities [5]. According to BIS standards, the desirable limit of chloride content in water is 250 mg/l [10].

2.5) Alkalinity

Alkalinity in natural water is due to free hydroxyl ions and hydrolysis of salts formed by weak acids and strong bases [10]. It is measured by titration with standardized acid to a pH value of 4.5 and is expressed commonly as milligrams per liter of calcium carbonate (mg/l as CaCo3) [5]. Most of the alkalinity in natural waters is formed due to the dissolution of carbon dioxide in water [10]. Excess alkalinity gives a bitter taste to water [10]. Commonly occurring materials in water that increase alkalinity are carbonate, phosphates, and hydroxides. Limestone bedrock and thick deposits of glacial till are good sources of carbonate buffering [5].

2.6) TDS

The Total dissolved solids refer to matter suspended or dissolved in water with high content that is inferior and may be polluted. The acceptable limit of BIS is 500 mg/L [15]. TDS comprises the leachate mainly of inorganic salts and dissolved organics substances [18]. The acceptable and permissible limits as per IS: 10500-2012 are 500 and 2000 mg/l respectively [5].

2.7) COD

COD is a measure of the oxygen required for the chemical oxidation of organic matter with the help of a strong chemical oxidant [5]. High COD values were obtained in the samples indicating contamination of groundwater by oxidizable organic matter [18]. High COD may cause oxygen depletion on account of the decomposition of microbes to a level detrimental to aquatic life [5]. COD determination has an advantage over BOD determination in that the result can be obtained in about 5 hours as compared to the 5 days required for the BOD test [5].

2.8) BOD

BOD is the amount of oxygen required for the biodegradation of organic content present in the leachate and the value indicates the maturity of the landfill2 [18]. The tolerance limit of BOD for industrial effluents discharged into inland surface waters is 30 ppm [7]. For new landfills, the presence of BOD values was ranged between 2000-30000 mg/l; for mature landfills, it varies between 100-200 mg/l [18].

2.9) Nitrate

Nitrate is present in raw water and mainly it is a form of N2 compound (of its oxidizing state) [5]. Nitrate is produced from chemical and fertilizer factories, matters of animals, declining vegetables, and domestic and industrial discharge [5]. Nitrates are the principal pollutant that leaches into groundwater and causes underground water pollution [18]. The IS:10500-2012 standards for Nitrate are 45 mg/lit.

3. CONCLUSION

A broad review was conducted to understand the impact of municipal solid waste on groundwater quality. Groundwater quality can be checked by analyzing different water quality parameters. Groundwater quality monitoring near the Samdoli & Bedag dumping site is done by collecting groundwater samples and then analyzing its Physico-chemical characteristic. The review paper helps to understand the water quality parameters of the given water samples and their specified ranges according to IS: 10500-2012 standards.

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