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A Review of Effect of Textile and Printing Industrial Effluents on Groundwater, Sanganer, Jaipur, Rajasthan

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ABSTRACT: Wastewater and groundwater samples of Sanganer were studied to find out the pollution load of wastewater generated from dyeing and printing units and its impact on the quality of domestic wastewater of the Amanishah Nallah and groundwater. The wastewater of these units was found to have high concentrations of sodium, chloride, and sulfate. It has remarkable concentrations of copper, chromium, and iron with low chemical oxygen demand and nearly 7-fold biochemical oxygen demand. The wastewater of these units, discharged on land without any treatment, comes into the Amanishah Nallah through small watercourses. The quality of the domestic wastewater of Nallah deteriorates with the mixing of wastewater from these units. Maximum concentrations of physicochemical parameters were found at the Sanganer Road bridge sampling point. Eleven groundwater samples, collected from various locations of Sanganer, were found polluted due to percolation of wastewater into the ground. Copper and chromium were recorded from some groundwater sources while iron was recorded from almost all sources. Sodium and chloride are the major cation and anion in the groundwater, which is identical to the wastewater of dyeing and printing units. Source G5, near the small watercourse carrying the wastewater of these units, had maximum impact and maximum values of physicochemical parameters.

KEYWORDS: groundwater, textile, printing, effluents, Sanganer, Jaipur, effect, dyeing

I. INTRODUCTION

Sanganer town, district Jaipur Rajasthan, India , is famous worldwide for its dyeing and printing industries. There are about 400 industries involved in textile printing processes, which discharge effluents into nearby ponds and drains, without any treatment. These effluents contain highly toxic dyes, bleaching agents, salts, acids, and alkalis. Heavy metals like cadmium, copper, zinc, chromium, and iron are also found in the dye effluents. Textile workers are exposed to such waters with no control over the length and frequency of exposure. Further, as the untreated effluents are discharged into the environment they can cause severe contamination of surface and underground water. Dyeing and textile printing industries of Sanganer houses about 400 small scales and one large scale industry 1 . These industries use a variety of chemicals and azo dyes direct, reactive, rapid, mordant and premetalised etc. during processing and finishing of raw materials. The workers in those industries are exposed to such dyes with no control over the length and frequency of exposure. Further, a huge volume of mostly untreated textile dye wastewater 10,000 15,000 Kl day is released into surface waters of Amani Shah drainage or through the drainage systems, seeps into the groundwater and adjoining water bodies flowing through Sanaganer. The untreated waste water is discharged directly into the drains that connect the industry to the main drainage network through the nullas in the town. The effluents disposed in open drains are directly used for crops cultivation which affects the nearby agricultural land also. The study deals with the collection of effluent from one of the large scale printing and dyeing industry in Sanganer town and physicochemical characterization of these samples in order to find out the physio chemical load put in by the effluent on the wastewater stream. Environmental pollution caused by such textile effluents results in adverse effects on flora, fauna, and the general health of not only the textile workers, but also the residents of Sanganer town. Therefore, to assess the possible genotoxic health risk and environmental genotoxicity due to the textile industry effluents, this study was carried out using the Ames Salmonella microsome mutagenicity assay.[1,2,3] The results clearly indicate that the effluents and the surface water of Amani Shah drainage have high mutagenic activity. Further, the drainage water and the dry bed of the drainage during summer months are not fit for agricultural or other recreational purposes. Wastewater and groundwater samples of Sanganer were studied to find out the pollution load of wastewater generated from dyeing and printing units and its impact on the quality of domestic wastewater of the Amanishah Nallah and groundwater. The wastewater of these units was found to have high concentrations of sodium, chloride, and sulfate. It has remarkable concentrations of copper, chromium, and iron with low chemical oxygen demand and nearly 7 fold biochemical oxygen demand. The wastewater of these units, discharged on land without any treatment, comes into the Amanishah Nallah through small

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II. DISCUSSION

As essential parts of the human diet, fruits and vegetables must be taken into account for their level of heavy metal contamination (Di Salvatore et al., 2009; Nirmal Kumar et al., 2007; Parveen et al., 2003). In urban settings, the plants are frequently utilised as passive biomonitoring equipment. Unquestionably, due to airborne metal particles from vehicle exhaust, green vegetables grown close to busy highways may have a large amount of Pb and Cd (Ayodele and Oluyomi, 2011; Hashmi et al., 2005). Vegetable metal content needs to be understood from the perspectives of agricultural production technology, nutrition, and health implications.High concentrations of Fe^{2+} in plants can cause the production of free radicals, which damage DNA, proteins, and membranes. In variable degrees, other metal ions are toxic to plants, halting enzyme and metabolic pathways and harming the morphology and physiology of plants (Arif et al., 2016). Due to the numerous negative impacts of heavy metals[4,5,6] and their propensity to accumulate in both the biota and non-living ecosystem components, research on these compounds is essential. In order to identify and address specific environmental issues associated to the disruption of the natural ecological equilibrium, it is crucial to look at heavy metals

There is an increasing demand on local and regional water supplies for irrigation, energy production, industrial uses, domestic uses, and environmental reasons as a result of a combination of growing populations, rising resource demands brought on by rising standards of living, and various other external forces of change. These variables are rapidly and often unpredictably shifting, creating new challenges for water management as well as opportunities and risks for all water users (UNESCO, 2012). After being utilized in the household, in agriculture, and in industry, water becomes contaminated. Used water may contain contaminants like trash and even harmful substances. Pollutants are substances created by humans that have an impact on the environment. However, population increase, rapid industrialization, and pollution have harmed the majority of water supplies, whether they are surface water or groundwater (Yousei et al., 2019). Approximately 90% of wastewater in underdeveloped countries is reportedly deposited directly into surface water sources without being cleaned (Yousei et al., 2017). This may be due to low expertise, a lack of resources, and financial constraints. The severity of the issue is highlighted by the claim that over 70% of India's water supplies are contaminated (Murty and Kumar, 2011). The majority of groundwater supplies are contaminated with harmful metals/metalloids like arsenic, cadmium, and manganese, making the water unsafe for human use, claim Sharma et al. (2012) and Selvakumar et al. (2017). Anthropogenic environmental changes may have a profound impact on the ecology and physiology of animals. The physical, chemical, biological, and social components of the natural environment have gotten worse as a result of human activities and advancements, which has a negative impact on people's quality of life (ATSDR, 1999). As industrialization, population growth, and consumer trends all rise, this problem is getting more urgent. Rapid technological improvements, such as an increase in mining and industrial activities, have led to a progressive redistribution of certain hazardous metals from the earth's crust, increasing the likelihood of exposure through ingestion, inhalation, or skin contact.[7,8,9]

It is important from this point of view to observe the suitability of water for safe drinking and irrigation. The different parameters measured are pH, conductivity, TDS, calcium, magnesium, total hardness, COD, alkalinity, Cl^-, F^-, PO_4^{3-}, Na^+, K^+, SO_4^{2-}, NO_3^-, Cd^{2+}, Pb^{2+} and Fe^{2+}. From the observed data it is found that parameters like conductivity, TDS, alkalinity, F^- have high values in this area whereas other parameters are approximately with in the limits or below limit.

Fluoride concentration in all samples is within the permissible limit of BIS, ICMR, and WHO. Fluoride levels were found to be below the acceptable limit (1 mg/l) in 42 samples, causing a number of health issues like enamel fluorosis, bone weaknesses, etc. Fluoride is an important life element for the health of humans and crucial for normal mineralization of bones and for the formation of dental enamel with the presence of lesser quantity. However, higher concentrations, such as more than 1.5 mg/l, can have negative health consequences[12]. Fluorosis is a disease caused by high fluoride levels in the water. Fluoride existence in groundwater can be attributed to geological reasons[13]. Fluoride is present innately in water resources. Generally, the majority of groundwater sources have excessive fluoride concentrations when compared to surface water sources. Weathering of rocks, precipitation, and untreated water,

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mostly from the fertilizer industry, all contribute to fluoride in the soil. Drinking water is a sizeable source of the daily fluoride intake. The enamel fluorosis is spotting of enamel that is forever present once a child's teeth are created[14]. It is explained as a harmful effect caused by interference of fluoride with ameloblasts in the developing tooth, emerging in a disturbance of the process of formation of enamel, making it ever more porous[15][14]. Fluoride weakens bones and increases the risk of fractures. People exposed to around 4 mg/l of fluoride through drinking water over their lifespan are likely to have an increase in bone fractures over those subjected to 1 mg/l. There are multiple endocrine effects of fluoride exposure, which include earlier sexual maturity, reduced thyroid function and Type 2 diabetes[16][12]

Nitrate exposure has toxic biological effects. Hence, it is considered to be a contaminant in the drinking water which is mostly sourced from the ground[17]. High concentrations of nitrate can cause methemoglobinemia. It is a blood disease which causes blue-baby syndrome (infant cyanosis). Methemoglobin presumably forms in the intestinal tract of infants when nitrite ion is formed from nitrate ion by bacteria[18]. Methemoglobin is formed when one nitrite molecule interacts with two molecules of hemoglobin. This reaction occurs rapidly in acidic environments. The altered type of blood protein prevents blood cells from taking in oxygen, resulting in the infant's prolonged suffocation, which may be fatal. Also, diseases such as Alzheimer's disease, vascular dementia, multiple sclerosis can happen in human beings due to excess of nitrate consumption [19][20]. Nitrate contamination also promotes eutrophication of water bodies[19]. Mostly, man-made sources cause the concentration of nitrate to increase towards a hazardous level[21]. Human and animal sewage disposal sites; waste from industries related to processing of food, munitions are a few sources of potential nitrate contamination of groundwater. Recently, it has come to attention that vacant manure storage facilities can be more dangerous to groundwater than completely full ones. The concentration of nitrate in groundwater is also related to rainfall. Where there is low rainfall, the concentration happens to be greater because the dilution effect decreases[22]

III. RESULTS

Chlorides of calcium (CaCl2), potassium (KCl), and sodium (NaCl) are widely found in nature and some chlorides are present in industrial effluent. MgCl is widely used in ice and snow control. KCl finds its use in the production of fertilizers [23]. The process of weathering makes chlorides leach from multiple rocks into water and soil. The chloride ion is very mobile and is transported to oceans or closed basins. Chloride reaches groundwater and surface water from both natural and anthropogenic sources, including industrial effluents, landfill leachates, deicing salt run-off, use of chemical fertilizer, septic tanks and animal feeds [24]. Irrigation drainage, and seawater intrusion in coastal places [25]. About 88% of chloride presence in humans is extra-cellular and it promotes the osmotic activity of bodily fluids. A normal adult human contains almost 81.7 grams of chloride. Due to the amount of obligatory loss of about 530 mg/day chloride,[10,11,12] an intake for adults of about 9 mg of chloride per kilogram of body weight is suggested. As far as children up to 18 years of age are concerned, a daily intake of 45 milligrams of chloride is deemed to be enough [26]. An intake of 1 gram of NaCl per kg of body weight was reported to have fatal consequences in a 9-week old child. Chloride noxiousness hasn't been seen in human beings except in the special case of damaged NaCl metabolism, for e.g., in congestive heart failure [27].

Total Dissolved Solids (TDS) are the total amount of active charged ions dissolved in water, including minerals, salts, and metals[28]. TDS is directly related to the consistency and purity of water, as well as water purification systems, and influences everything that consumes it[28]. Any salts, metals, minerals, anions, or cations that may dissolve in water are referred to as dissolved solids. This includes anything present in water other than suspended solids and pure water molecules. The number of the anions and cations in the water is the TDS concentration. Leaves, plankton, silt, sewage, and industrial waste are some of the organic sources of dissolved solids and other sources include urban runoff, fertilizers and pesticides used on lawns and fields, and road salts used on city streets during the winter. A source for dissolved solids may be inorganic materials such as rocks and air that has sulfur, calcium bicarbonate, nitrogen, phosphorous, iron, and other minerals[29]. The majority of the materials mentioned above combine to form salts, which are compounds that contain both a non-metal and a metal. Salts usually dissolve in water forming ions. Ions are charged particles that are either negative or positive[30]. In the study area, the highest TDS of 4510 mg/l was found in Girdharpura (Sample 41, Fig.6) and the lowest TDS of 288.46 mg/l was found in sample no.11. Only two sample concentrations were found to exceed the permissible limit of BIS and twenty-nine samples have exceeded the permissible limit ICMR standard. The presence of high dissolved solids causes an unpleasant taste that can be metallic, salty, or bitter. It may also be a sign of the existence of toxic minerals, which cause scaling in the sanitary system and reduces performance[31].

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Total coliforms (TC) are a group of bacteria that can be found in the environment, such as in plants, water bodies, or soil, as well as in the intestines of mammals, including humans. While TC bacteria are unlikely to cause disease, their presence indicates that the water supply may be vulnerable to pollution by even more toxic microbes. Escherichia coli, which is also called E.coli, is one part of the TC bacteria group bacteria that is discovered only in the intestines of mammals, including human beings[32]. E. coli when found in water shows recent faecal pollution and may show the likely existence of illness-generating microbes, like bacteria, viruses, as well as parasites. Some strains of E.coli such E.coli 0157:H7, may induce diseases, but not all E.coli bacteria are hazardous[33]. Drinking water which contains coliform bacteria ups the possibility of catching a water-borne disease. A confirmed result of faecal coliform or E. coli presence in samples is a severe breach of standards for potable water. Faecal coliform bacteria live chiefly in the guts and faeces of warm-blooded animals. Faecal coliforms are thought of as a better signal of animal waste or human waste pollution than total coliforms. E. coli is a kind of faecal coliform. Its presence is known to be the foremost indication of faecal contamination and that more microbes may be available. Insufficient attention to the treatment of supplied water,[13,14,15] the manure of animals, and septic tanks are great originators of coliforms in groundwater and drinking water. The existence of microbes in groundwater deeply relies upon geological parameters such as flow pathways and mechanisms, sunlight, pH, temperature, and properties of soil[34] . The sort, size, and activity of the microbes' group are also essential components that dictate terms of transport of microbes. The diagnosis of coliform bacteria could be a sign of the existence of a life form that may cause illnesses, including toxic strains of coliforms, parasites such as Cryptosporidium or Giardia, and bacteria which are non-coliform[35]. These beings can cause diseases from intestinal infections, dysentery, and gastroenteritis to hepatitis, typhoid fever, cholera, and many other diseases[36]. Intestinal infections and dysentery are generally considered small health issues in otherwise healthy adults. However, such problems may be deadly to infants, the old and to those who are already sick.[16,17,18]

IV. CONCLUSION

After study of analytical data of groundwater of Sanganer Tehsil, Jaipur, Rajasthan for the chemical parameters such Fluoride, Chloride, Nitrate and TDS and also Bacteriological Examination, it is noted that fluoride concentrations are all under the permissible range of 1.5 mg/l as per BIS and WHO. Nitrate concentrations of almost 50% of the villages exceed the permissible amount. The excess of nitrogen-full fertilizers in the soil in truth kills biota that helps to supply the soil with nitrogen, which can be used by the plants. By using less quantity of fertilizers, these crops could still be as highly yielding as the crops grown under highly fertilized soils, because of much healthier and suitable surroundings for the micro-organisms. If farmers use a huge amount of fertilizer at the start, then they are forced to use increased amounts each following year. Utilizing moderate to low amounts at the beginning gives the farmer a chance to avoid being caught up in this cycle. In addition, several of the mitigation methods listed above can be used to help reduce nitrate leaching from the soil into groundwater. Slurry storage and concrete lagoon pits will significantly reduce nitrate levels. Turfgrass managers and farmers can help to control nitrate leaching into groundwater by avoiding over-irrigation of a field. When it comes to nitrate levels in groundwater, the foremost advice to avert risk of health is to get wells checked frequently and reduce the use of fertilizers on fields. As per BIS, chloride concentration is under the permissible limit for all villages, and only 5% of villages exceed the permissible limits and 5% of villages exceed the permissible limits of TDS. Chloride presence higher than about 250 mg/litre may cause water to attain a taste, but the threshold is up to the associated cations. However, consumers can be used to concentrations in excess of 250 mg/liter. There is no health based standard concentration value for chloride in drinking water. To reduce TDS, RO (reverse osmosis) and other technologies are being used. Reverse Osmosis is the most in-depth technique of large-scale water purification available.[19] Distillation is another method available for water purification. Water vapour is produced by boiling the water. The water vapour condenses back into liquid form after rising to a cooled surface where it is collected. As the dissolved solids do not generally vaporize, they stay in the boiling solution. The bacterial presence was found in 39% of the villages, indicates poor quality of groundwater and it causes waterborne diseases, like fever, stomach cramps, vomiting, headaches, fatigue, jaundice, and diarrhea. Methods to remove bacteria from water can are disinfection and/or filtration. Even though only filtration can not be sufficient to fully oust bacteria, it does increase the output of disinfection by removing sediments that may contain bacteria. Methods of disinfection include iodization, chlorination, ozonation, ultraviolet light and methods such as steam sterilization or boiling, which are physical methods. In the correlation study, only a strong positive correlation was identified between Chloride and TDS. Correlation between other parameters were negative and weak or positive and weak or uncorrelation.[20]

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REFERENCES

[1] Frenkel-Pinter M, Rajaei V, Glass J B, Hud N V. and Williams L D 2021 Water and Life: The Medium is the Message Journal of Molecular Evolution 1–10
[2] Schoeller D 1989 Changes in total body water with age The American journal of clinical 50 1176–81
[3] Hellberg S 2017 Water for survival, water for pleasure - A biopolitical perspective on the social sustainability of the basic water agenda Water Alternatives 10 65–80
[4] Panwar S and Chakrapani G J 2013 Climate change and its influence on groundwater resources Current Science 105 37–46
[5] Richts A, Struckmeier W F and Zaepke M 2011 WHYMAP and the Groundwater Resources Map of the World 1:25,000,000 Sustaining Groundwater Resources (Springer Netherlands) pp 159–73
[6] Singh ,S P., Sunayana. 2017 Study of Physico-Chemical Parameters of Ground Water Quality of Indira Nagar, Gorakhpur Journal of Civil Engineering and Environmental Technology 4 416–22
[7] Panaskar D, Wagh V M and Muley A A 2016 Sustainable Livelihoods and Adaptation to Climate Change (SLACC) View project Working on Ground Water Hydrochemistry. View project Article in Arabian Journal of Geosciences 9
[8] Khatri N and Tyagi S 2015 Influences of natural and anthropogenic factors on surface and groundwater quality in rural and urban areas Frontiers in Life Science 8 23–39
[9] Dadhich A P, Goyal R and Dadhich P N 2018 Assessment of spatio-temporal variations in air quality of Jaipur city, Rajasthan, India Egyptian Journal of Remote Sensing and Space Science 21 173–81
[10] Gupta, R., Das, S., Kapila, V., Gaur, R. C., & Sharma, M. K. 2019 Groundwater quality investigation of Sanganer Tehsil, Jaipur city, Rajasthan Advance and Innovative Research 6 128
[11] Wagh V M, Mukate S V, Dipak ·, Panaskar B, Vasant ·, Wagh M, Stephen ·, Baker J and Mukate S V 2020 Understanding the influence of industrial and agricultural land uses on groundwater quality in semiarid region of Solapur, India Environment, Development and Sustainability 22 3207–38
[12] Kanduti D, Sterbenk P and Artnik A 2016 Fluoride: a Review of Use and Effects on Health Materia Socio Medica 28 133
[13] Das B, Talukdar J, Sarma S, Gohain B, Dutta R K, Das H B and Das S C 2003 Fluoride and other inorganic constituents in groundwater of Guwahati, Assam, India Current Science 85 657–61
[14] Everett E T 2011 Fluoride's Effects on the Formation of Teeth and Bones, and the Influence of Genetics Journal of Dental Research 90 552–60
[15] Bronckers A L J J, Lyaruu D M and DenBesten P K 2009 The Impact of Fluoride on Ameloblasts and the Mechanisms of Enamel Fluorosis Journal of Dental Research 88 877–93
[16] Ayoob S and Gupta A K 2006 Fluoride in Drinking Water: A Review on the Status and Stress Effects Critical Reviews in Environmental Science and Technology 36 433–87
[17] Ritter L, Solomon K, Sibley P, Hall K, Keen P, Mattu G and Linton B 2002 Sources, pathways, and relative risks of contaminants in surface water and groundwater: A perspective prepared for the Walkerton inquiry Journal of Toxicology and Environmental Health - Part A 65 1–142
[18] Marco, A Ortiz-Santaliestra M 2009 Pollution: Impact of Reactive Nitrogen on Amphibians Amphibian Biology, Conservation of Amphibians pp 3145–85
[19] 1Subhash Chand, 2Malik Ashif, 3Zargar M.Y. 4Bhat M. Ayub 2011 Nitrate Pollution: A Menace to Human, Soil, Water and Plant Universal Journal of Environmental Research and Technology 1 22–32
[20] Hanlon J J 1972 Environmental hazards The Science of Life 243–98