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A Review On Assessment Of Drinking Water Quality Of Various Parts Of India

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Abstract:
Water may be the world's most abundant resource, but the need for hygienic and clean water is exponentially increasing in higher demand. Water is one of the prime necessities of life. Human can hardly live for a few days without water. In a human's body, 70 to 80% is water. Cell, blood, and bones contain 90%, 75%, and 22% water, respectively. In addition to this, the resources of water such as rivers, lakes, tanks, wells and others. In spite of such abundance, there is a shortage of good quality water in the country. Physicochemical parameter of any water body plays a very important role in maintaining the fragile ecosystem that maintains various life forms. Present review deals with assessment of various water quality parameters such as pH, Conductivity, Alkalinity, TDS, TSS, BOD, COD, DO, calcium, magnesium, sodium, potassium, nitrate, phosphate, chloride, sulphate etc.

Key words: Water quality, pH, Conductivity, Alkalinity, TDS, TSS, BOD, COD, DO

I. Introduction

Water plays a significant role in maintaining the human health and welfare. Clean drinking water is now recognized as a fundamental right of human beings. Around 780 million people do not have access to clean and safe water and around 2.5 billion people do not have proper sanitation. As a result, around 6–8 million people die each year due to water related diseases and disasters. Therefore, water quality control is a top-priority policy agenda in many parts of the world. In the today world, the water use in household supplies is commonly defined as domestic water. This water is processed to be safely consumed as drinking water and other purposes. Water quality and suitability for use are determined by its taste, odour, colour, and concentration of organic and inorganic matters. Contaminants in the water can affect the water quality and consequently the human health. The potential sources of water contamination are geological conditions, industrial and agricultural activities, and water treatment plants. These contaminants are further categorized as microorganisms, inorganics, organics, radionuclides, and disinfectants. Having safe drinking water is a human need and right for every man, woman and child. People need clean water to maintain their health and dignity. Having better water is essential in to work, and ability to go to school. However, declining water quality threatens the gains made over the past twenty years to improve access to drinking water. From 1990 to 2011, global efforts have helped 2.1 billion people gain access to improved drinking water, but not all of these new sources are necessarily safe (WHO/UNICEF, 2013).

Water Contamination

The Safe Drinking Water Act defines the term "contaminant" as meaning any physical, chemical, biological, or radiological substance or matter in water. Therefore, the law defines "contaminant" very broadly as being anything other than water molecules. Drinking water may reasonably be expected to contain at least small amounts of some contaminants. Some drinking water contaminants may be harmful if consumed at certain levels in drinking water while others may be harmless. The presence of contaminants does not necessarily indicate that the water poses a health risk. Only a small number of the universe of contaminants as defined above are listed on the Contaminant Candidate List (CCL). The CCL serves as the first level of evaluation for unregulated drinking water contaminants that may need further investigation of potential health effects and the levels at which they are found in drinking water.

The following are general categories of drinking water contaminants and examples of each:

- Physical contaminants primarily impact the physical appearance or other physical properties of water. Examples of physical contaminants are sediment or organic material suspended in the water of lakes, rivers and streams from soil erosion.
- Chemical contaminants are elements or compounds. These contaminants may be naturally occurring or man-made. Examples of chemical contaminants include nitrogen, bleach, salts, pesticides, metals, toxins produced by bacteria, and human or animal drugs.
- Biological contaminants are organisms in water. They are also referred to as microbes or microbiological contaminants. Examples of biological or microbial contaminants include bacteria, viruses, protozoan, and parasites.
- Radiological contaminants are chemical elements with an unbalanced number of protons and neutrons resulting in unstable atoms that can emit ionizing radiation. Examples of radiological contaminants include cesium, plutonium and uranium.

Thus to ensure a good quality of water, physicochemical analysis of drinking water needs to be assessed periodically. Water quality parameters such as pH, Conductivity, Alkalinity, TDS, TSS, BOD, COD, DO.

II. Literature Review

1.1 N K Jain et al have assessed physical parameters of water samples collected from five different lakes of Ahmedabad city. They have checked parameters like Temperature, Odour, Taste, Colour, Turbidity, pH, TDS and DO. They found Turbidity ranging from 0.1 NTU to 0.5 NTU in lakes situated in different areas of Ahmedabad. Naroda is the area where Turbidity observed higher than other areas. The pH range of water samples should lie between 6.5 to 7.5 and municipal water pH observed 7 to 7.5. So it complied with the acceptance criteria of pH range & it was found to be healthy for human use. During the assessment of water collected from different city areas, they found Dissolved carbon dioxide & Dissolved oxygen were in the range of 6.4 and 33. Total Dissolved Solid of collected water samples showed range under 1500 ppm and found within the range of BIS. Important and vital minerals like Calcium, Magnesium, Chloride, Sulphate, Barium, and Copper were also tested from the collected samples and the results complied with the given range of Test for Minerals. Alkalinity & Total Hardness of water samples should be less than or equal to 10 and 300 ppm respectively and said research group's results were found within permissible. Water Temperature may be depending on the season, geographic location and sampling time. As Temperature of water rises, it harms aquatic life to get required oxygen to meet their need. Thus, Thermal pollution can cause shifts in the community structure of aquatic organisms. Turbidity value was recorded from 4 NTU to 11 NTU. Total dissolved solid found from 668 ppm to 942 ppm in water samples. After the physicochemical analyses, they found that the sample of habited water was pollution free as well as ecologically balanced.

1.2 Namita Agrawal et al undertaken a systematic study to calculate the water quality index of River Ganga in Haridwar District. They have collected and analysed samples for two consecutive years 2007 and 2008. Each parameter was compared with the standard desirable limit of that parameter in river water as prescribed by different agencies. They have collected 90 water samples from five sampling stations and investigated for physicochemical analysis. The parameters chosen mainly includes Temp, velocity, pH, dissolved oxygen, free CO2, COD, BOD, Carbonate, Bicarbonate, total alkalinity, hardness, turbidity, calcium, magnesium, sodium, potassium, nitrate, phosphate, chloride, sulphate, EC (electrical conductivity), TDS (total dissolved solids) and total suspended solids(TSS).After the investigation, they found that some parameters like pH, electrical conductivity, TDS, TSS, turbidity and sodium were found to be in excess than the allowed limit. The WQI value suggested that water samples of some sampling stations were really unhealthy due to high value of dissolved solids and sodium. After the precise investigations, they have concluded that the water quality in the year 2007 was of a better quality than in the year 2008. Suitable suggestions were made to improve the quality of river water.

1.3 Neerja kalra and coworkers have checked ground water quality of five blocks i.e. Udwantanagar, Tarari, Charpokhar, Piro and Sahar that all lays in Bhojpur district of Bihar. They have collected sample from each block thus ten ground water samples were under studied for Physicochemical evaluation of ground water. They have checked parameters including pH, turbidity, electrical conductivity (EC), total dissolved solids (TDS), total hardness(TH), content of calcium (Ca2+) magnesium (Mg^{2+}), chloride(Cl^{-}), sulphate ($S0_4^{2-}$), Iron (Fe), DO, BOD, COD, Total alkalinity (TA) and Nitrate (NO_3^{2-}) concentration present in ground water. Studies revealed that the pH of water shows variation in its ranges but fall in water quality parameter permissible limits. EC of water samples and Calcium showed huge variation in all five blocks. Chloride and

fluoride content in water found low. The value of DO, BOD and COD were found within the limits. Turbidity and total hardness were found higher in all the observed parameters of all blocks. Mg^{2+} values were within the limits. Chloride and sulphate data was low in all the blocks of southern Bhojpur. TDS were low in all blocks.

1.4 Sajitha V et al undertook study to define the quality of water samples with special reference to physicochemical properties to produce WQI of the water samples. For the assessment of pond water quality of the Athiyannoor Panchayath, Thiruvananthapuram District, Kerala. water samples collected from fifteen ponds located in the said area. they have assessed parameters such as Temperature, pH, EC (Electrical Conductivity), TDS (Total Dissolved Solids), TA (Total Alkalinity), DO (Dissolved oxygen), TH (Total Hardness), NaCl (Salinity), Ca (Calcium), Mg (Magnesium), Cl (Chloride), Na (Sodium) and K (Potassium) and obtained results were evaluated and compared with WHO and BIS water quality standards. They have performed calculation of the WQI (water quality index) to quantify overall water quality of said pond of the area. The water quality indices (WQI) were in the range 6.47 to 16.17 indicating the best water quality in the study area. On the basis of WQI results, they stated that, the samples are under the permissible limit and hence suitable for day to day usage. the water quality data of the assessed samples were also compared with the prescribed drinking water standard of BIS 1991 (IS:10500).

1.5 Heena saraswat and coworkers have conducted water analysis by focusing on river The Narmada, also called Rewa. They did the assessment of water samples on monthly basis and as we all know that water is one of the most important of all natural resources known on earth. It is important to all living organisms, ecological systems, humanhealth, food production and economic development. It is a river in central India and the fifth largest river in the Indian Subcontinent. The bank of thousands of tribal people resides on the bank of Narmada river and their daily wastes are discarded into river. Due to this, Physicochemical parameters of the river gets altered. They took one year to enumerate the various Physicochemical parameters of Narmada River. Water samples were taken from sampling stations every month and were analyzed. They found that September and October are the months when Maximum of Phosphate, Nitrate, Calcium and Sulphate were recorded. They also reported that parameters such as Temperature, pH, and Total hardness were observed in maximum number in the season of summer. Water samples were found transparent in Rainy season. pH values ranges from 7.2 to 9.2. Dissolved oxygen in natural and waste water depends on the physical, chemical and biological activities in the water body. DO value fluctuated from 7.0 mg/l to 9.3 mg/l. and they have observed maximum values (9.3 mg/l) in the month of November and minimum values (7.0 mg/l) in the month of June. total hardness reveals that the monthly variation in the water samples ranged between 90 mg/l to 210 mg/l and recorded minimum in the month of September and Maximum in the month of November. Nitrate concentration was observed in the range of 0.19 mg/l to 0.99 mg/l. and minimum value found in the month of May and minimum was found in the month of September. Researchers have also checked sulphate and Calcium concentration into the collected samples. They have revealed that the monthly variation in sulphate ranged between 3.6 mg/l and 9.3 mg/l. and Minimum sulphate was determined in the month of April and maximum was determined in the month of September. while calcium reveals that the monthly variation ranged between 10 mg/l and 33 mg/l. Minimum calcium was recorded in the month of January and the maximum was recorded in the month of July.

1.6 Malaya Ranjan Mahananda and coworkers have studied water quality of Talcher Area of sambalpur district. Sample were collected from Ghats of river Brahmani, tube well and tap water of different colonies in Monsoon and in Post Monsoon seasons. They assessed the water quality between river water, tap water & tube well water. Data were compared with surface water quality standards IS: 2296 & drinking water quality standard IS: 10500 and NSF water quality index in order to classify the quality of water. They have determined important parameters e.g. DO, pH, Conductivity, Temperature, Sodium, Potassium, Dissolve Oxygen, Total Solid, Chloride, Alkalinity, Hardness, Sulphate, Chemical Oxygen Demand, Nitrate, Phosphate and Fluoride. They have also calculated water quality index on the basis of NSF index and the analyzed data were compared with the standard IS: 2296 (Surface Water Quality Standard) and IS: 10500 (Drinking water Quality Standard). During the analysis, the maximum pH found was 7.91 from Jagannath Ghat. Maximum average conductivity found was 559.28 µS/cm in tube well water of Jagannath colony and minimum was 90.66 in Tarini Ghat. Maximum temperature recorded was 28.5 ˚C in tube well water. other parameters like Sodium, Potassium, Chloride, Alkalinity and Nitrate content was recorded as 12.37 ± 1.23, 95.9 ± 7.75, 541.66 ± 2.84 and 24.27 ± 0.61 mg/L respectively in tube well water of Balanda colony. The highest value of parameters namely DO,

Hardness, COD and Sulphate and found was 7.92 mg/L ,326.69 mg/L 188 and 132 mg/L respectively in tube well water of Jagannath colony. Similarly, Phosphate and Fluoride content was determined 423.27 and 664.23 µg/L respectively. Statistical calculation done by them was based on two-way ANOVA and Correlation coefficient.

III. Important water quality parameters

III.1 pH: The effect of pH on the chemical and biological properties of liquids makes its determination very important. It is one of the most important parameters in water chemistry and is defined as -log [H+], and measured as intensity of acidity or alkalinity on a scale ranging from 0-14. If free H+ are more it is expressed acidic (i.e., pH<7), while more OH- ions is expressed as alkaline (i.e., pH> 7). In natural waters pH is governed by the equilibrium between carbon dioxide/bicarbonate/carbonate ions and ranges between 4.5 and 8.5 although mostly basic. It tends to increase during day largely due to the photosynthetic activity (consumption of carbon-di-oxide) and decreases during night due to respiratory activity. Waste water and polluted natural waters have pH values lower or higher than 7 based on the nature of the pollutant.

III.2 Total Dissolved Solids: Dissolved solids are solids that are in dissolved state in solution. Waters with high dissolved solids generally are of inferior palatability and may induce an unfavourable physiological reaction in the transient consumer.
Principle: The difference in the weight of total solids and the total suspended solids expressed in the same units gives the total dissolved solids.
Procedure: The difference in the weights of Total Solids (W1) and Total Suspended Solids (W2) expressed in the same units gives Total Dissolved Solids.

III.3 Dissolved Oxygen: Oxygen dissolved in water is a very important parameter in water analysis as it serves as an indicator of the physical, chemical and biological activities of the water body. The two main sources of dissolved oxygen are diffusion of oxygen from the air and photosynthetic activity. Diffusion of oxygen from the air into water depends on the solubility of oxygen, and is influenced by many other factors like water movement, temperature, salinity, etc. Photosynthesis, a biological phenomenon carried out by the autotrophs, depends on the plankton population, light condition, gases, etc. Oxygen is considered to be the major limiting factor in water bodies with organic materials. Dissolved oxygen is calculated by many methods.

III.4 Alkalinity: Alkalinity is the capacity of water to resist acidification. It should not be confused with basicity which is an absolute measurement on the pH scale. Alkalinity is the strength of a buffer solution composed of weak acids and their conjugate bases. Total alkalinity is measured by collecting a water sample, and measuring the amount of acid needed to bring the sample to a pH of 4.2. At this pH all the alkaline compounds in the sample are "used up." The result is reported as milligrams per litre (mg/l) of calcium carbonate.

III.5 Electrical conductivity (EC): The electrical conductivity (EC) of water is a measure of the ability of a solution to carry or conduct an electrical current. Since the electrical current is carried by ions in solution, the conductivity increases as the concentration of ions increases. Therefore, it is one of the main parameters used to determine the suitability of water for irrigation and firefighting.

III.6 Turbidity: Turbidity in drinking-water is caused by particulate matter that may be present from source water as a consequence of inadequate filtration or from resuspension of sediment in the distribution system. It may also be due to the presence of inorganic particulate matter in some groundwaters or sloughing of biofilm within the distribution system. The appearance of water with a turbidity of less than 5 NTU is usually acceptable to consumers, although this may vary with local circumstances. Particulates can protect microorganisms from the effects of disinfection and can stimulate bacterial growth. In all cases where water is disinfected, the turbidity must be low so that disinfection can be effective. Turbidity is also an important operational parameter in process control and can indicate problems with treatment processes, particularly coagulation/sedimentation and filtration. No health-based guideline value for turbidity has been proposed; ideally, however, median turbidity should be below 0.1 NTU for effective disinfection, and changes in turbidity are an important process control parameter.

IV. Conclusion

Water analysis is essential to ensure its quality or to detect pollutants that should be removed by water treatment. However, water quality does not mean making the water suitable for human consumption; it depends on its end use. For example, completely different quality standards are applied in case of industrial water compared to those applied to drinking water, i.e., drinking water must be fit for human consumption, while industrial water should be free from any contaminants that may corrode or damage equipment. The monitoring of drinking water is crucial to ensure quality and safety. Water quality analysis is an important part of environmental monitoring. When water quality is poor, it affects not only aquatic life but the surrounding ecosystem as well.

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