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Water Characteristics and Treatment: A Review

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Abstract: Water is the most important thing in the presence of human, animal and plant, there are two forms of water, fresh and salt. Fresh water is the main source of drinking water. Whilst fish and other organisms are live in salt water. Water pollution is a main international problem around the world, where the facilities for suitable sterile conditions are poor and the sewage duct lines in the lack of suitable monitoring surveys. The focal pollution of water is fecal and, therefore, *E. coli* was measured as a determinant of fecal contamination as recommended by WHO standard guiding principle for drinking water quality. This paper reviews the literature of characteristics of water and pollution. The details on polluted water treatment methods using chlorine and porcelanite. The main goal of this study is to offer an overview of the principles, development and current research status of water and methods of treatment.

Key words: River · Lake · *E. coli* · Chlorine · Porcelanite

INTRODUCTION

Water is known as the basic material found most abundant in the protoplasm which is the backbone of life. It may be of great importance in human life and for the rest of living organisms. The evolution of human societies and the progress of agriculture, industry and increase in the prosperity and eradication of pests and diseases have contributed to increase in population numbers. These are secreted forms of waste and contaminants which were not known to water previously, leading to the pollution of natural water varying in different degrees. Water has the ability to purify itself, which attaches its impurities and environmental factors which help the impurities in its ability to afford the source and treatment [1] .The increase in volumes and concentrations due to flowing has become difficult for the water purification itself [2]. Note that the different uses incurred by human societies have made the amount of pollutants rise into the rivers [3].

Water is the largest ecosystems on Earth, where about 70% of the area is in the form of ocean water and occupies about 97% of the total water which is unfit for drinking. The fresh water constitutes only 3% and includes lakes, rivers, groundwater and snow [4]. These small percentages of fresh water play a fundamental role in human life because it is the most appropriate source of water for household needs. In addition, it provides as a cheap system for the disposal of waste and its associated water plants [5]. Water pollution is due to the fundamental problems of inappropriate human actions such as discharge of agricultural, industrial pollutants and domestic ones to the sources of natural water [6]. As well as pollution is any quantitative or qualitative change in the components of living and non-living outside the natural ranges which lead to disruption of ecological balance.

Chemical and Physical Properties of Water: Physical and chemical properties of water play a direct role in the distribution of living and behavior. Temperature is among the most important of these properties and related to the contamination of water. Therefore, we note that all research and environmental studies put this aspect in the first place because of seasonal variations and this may lead to sudden breach and clearing and distribution of neighborhoods and this may be main factor of the contaminated environment [7]. In addition, it will directly or indirectly affects on the physical and chemical characteristics [8]. In addition it has an impact on key biological processes such as construction photosynthesis, respiration and osmosis organization along with their impact on the density and viscosity of water and soluble gases. The impact on the dissolved oxygen shall be reversing, This in turn has as an opposite

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effect on the vital requirement for oxygen. It has further attributed the importance of the presence of salts in the water to its role in the division of water bodies to salt water and fresh water. In addition to its role, it further significantly curb the growth of bacteria, even if found in low concentrations and is determined usually by measuring the viability of a model water to generate electric current for the adoption of measurement on the salt concentration of the ions dissolved in water, as well as on temperature.

The salinity of the water is directly related to the organization of osmosis cells of the organism, so it has been observed that the survival of microorganisms in fresh water is longer than survival in sea water [9]. Salts has important role in influencing rate of oxygen dissolved in the water. The percentage of dissolved oxygen decreases with increase of salinity in the water [10] pH is one of the main factors affecting the neighborhoods especially as the microstructure of acidic or basic conditions may lead to decomposition of some compounds cells such as Germ crash or some enzymes [11]. In general, it tends to base of natural water due to the presence of salt carbonate and bicarbonates [12]. The turbidity is a factor to contest directly or indirectly on biology and other environmental factors and it naturally affect water transparent to light rays passing through it.

Alternatively this feature change the appearance of dark material or alluvial clay or other materials and in infinitesimal manner remain stuck in the water and there is an inverse relationship between the turbidity and the depth of light region, which occur as per the process of photosynthesis. There is a direct relationship between Turbidity and microbiology [1]. The concentration of chlorophyll is the one of the indicators for the mass living (Biomass) in Hydrophytes. In any body of water and biomass, they are affected by different factors of water such as dissolved oxygen and optical depth of the region and temperature. The hydrological conditions impact on the amount and distribution of chlorophyll [13].

Water Pollution: Water pollution is the most important problems of today, which is reflected in harm to human health and environmental regulations and the development of civilization [14]. The enormous development in agricultural fields and animal communities and the establishment of industrial and population on water resources has led for increasing problems of pollution and this has become a health risk to consumers of those waters [15]. There is no control on the extent of polluted water entering and are dependent on operations of clearing. In addition, the ability of the organic waste to be biodegrade is one of the most prominent water problems as they affect the amount of dissolved oxygen negatively. This is will not be further affected by the existence of the contamination of small amounts of organic material, but due to the pumping of large quantities of them continuously as is the case when discharging sewage into rivers will lead to the pollution of those receiving water bodies. In addition, there are high values of the vital requirement for Biochemical Oxygen Demand (BOD) that related to the depreciation of Dissolved Oxygen (DO) concentration in the freshwater stream.

The presence of sufficient amount of oxygen in the water helps the transformation of some compounds containing other elements to the chemical groups (roots) and then to the molten salts do not sharply affect the specification of the basic water [16]. Any deficiency in the oxygen concentration is harmful to aquatic life and a guide to organic pollution. Therefore, oxygen is used to estimate the amount of organic waste in the form of water by measuring the amount of oxygen necessary for the bacteria to oxidize waste aerobically to binary oxide, carbon and water for a certain period and the symbol of this measurement are indicated by BOD. The value of oxygen is reduced when increasing the nitrogen and phosphorus, which are nutrients that promotes growth and reproduction of aquatic plants that was through eutrophication that will lead to algal bloom phenomenon. Discharging of these two elements to the aquatic environment leads to speed up the case of enriched food where there is a high mass algal offset then a sharp drop in other types of neighborhoods such as fish for example, because these blocks blooms at her death collects in the bottom of the body of water and consume large amounts of oxygen to the process analyzes the dynamic which could lead to exhaustion, especially when the accumulation of large quantities of these algae collects in the bottom, causing high bottom and shallow water and the taste and smell become unacceptable as well as lack of oxygen, which destroys many aquatic organisms [17].

Many studies addressed on pollutants affecting the properties of rivers as well as some impacts of climatic factors including rain and storms. It reduces chlorophyll and increases the number of bacteria and affects the transparency of the water and dissolved salts. It was also noted that the role of contaminated water called in influencing the genes and cells [18]. The study addressed the comparison between the two rivers located in Juasma, Southern Spain in terms of physical and biological factors,

despite the geographical similarity. In contrast it also showed differences especially in the values ??of pH, also appeared that there are differences in the presence of bacteria and fungi [19]. Water pollution also increases the toxicity of some of the elements where it was observed that the effect of copper on bacteria increases with increasing of organic pollutants [20]. It further increases toxicity of sediment after rainfall where increasing concentrations of some elements more than the natural such as, elemental copper, lead, where bacterial enzymes inhibits the work [21].

In the last few decades, acquired water has added on importance because of the cost and increasing demand and coupled with its increasing pollution [22]. Untreated dirty water from rural communities and that from civil one are the main factors that lead to increase in the eutrophication of rivers and lakes. Also, the temperature is one of the main factors affecting the distribution of organisms in the dwelling as well as the change in water temperatures causing the solubility of most of the toxic substances [23]. Changes occurred based on standing qualities of physical and chemical of the river areas as it erodes through the geological layers of different, or in response to climate change [24]. That pollution of water sewage and household waste humans and animals are among the important sources of coli form [25].

E. coli is a Gram-negative, rod-shaped bacterium commonly found in the lower intestine of warm-blooded organisms [26]. At temperatures of up to 49°C (120.2°F), optimal growth of *E. coli* occurs at 37°C (98.6°F) but sometimes laboratory strains can multiply and growth, can be driven by aerobic or anaerobic respiration [27]. These bacteria exist naturally and are harmless and easily to prepare from a few sources which include bowels of humans and animals and also warm-blooded such as birds [28]. To indicate fecal contamination originating from human and animal waste, the presence of commensally *fecal coli* forms or *Escherichia coli* has been used. They suggest the possible occurrence of pathogenic microbes, albeit these indicator organisms are not pathogenic, which also are part of the normal intestinal flora [29].

In addition, the indicator bacteria usually used to test for fecal contamination do not reflect the origin of the contamination. As an alternative, in order to determine the source of fecal contamination in water, Bacterial Source Tracking (BST) approach that use genotypic and phenotypic differences in animal host intestinal bacteria normally been carried out. This technology goes with inference that members among bacterial species have become adapted to a specific host. As such, the source of fecal contamination may be inferred [30] and BST techniques can be subdivided further based on whether it is necessary to culture organisms from samples prior to analysis, if a match to a strain unique to a particular host is found in contaminated water. Alternatively, this can also happen if reference libraries consisting of known isolates are required.

Further in order to complete an assay, both library preparation and culturing can substantially increase the time and resources needed to complete [31]. After taken directly from environmental samples, culture independent methods of microbial community analysis examine signature biochemical [32]. In 1985, for children under the age of five from around the world [33] has indicated that contaminated water causes many diseases, especially diarrheal diseases in children per year that lead to the deaths of approximately 4.6 million [33]. Thus, for various diseases typhoid, polio, viral hepatitis, respiratory diseases and disease discloses amoebae; water is a mode of transport for many of the causes of these diseases. Further related disease caused infrequently are personal hygiene (water scarcity) related, bacillary diarrhea, fever counterpart, worm pinworm, disease discloses amoebae, scabies, poisoning, rot the skin, ulcers, lice and typhus, trachoma and conjunctivitis. Those diseases related to inappropriate sanitation are worm noodles, worms and ascariasis and disease lattice tail and hookworm [34-36].

Water Treatment

Chlorine: Chlorine is not only known as disinfectant agent that effectively kills bacteria but also because it being the most versatile chemical used in water and wastewater treatment with regards to easy in handling and cost effectiveness. Due to that several studies have focused on sewage treatment using chlorine. To be further elaborate on the favorable uses of chlorine, listed were some of the examples on the multi-purposes use of it such as in disinfection control of microorganisms, removal of ammonia, control of taste and odor, color reduction, destruction of organic matter, hydrogen sulfide oxidation, iron and manganese oxidation [37]. In order to kill bacteria and viruses associated with the water dam surface, chlorine was used for a long time in the sterilization of drinking water due to its effectiveness in doing so. As such, in order to eradicate these critical epedimic diseases there are no doubt that the use of chlorine has had a significant health benefits to society and as well as various intestinal diseases caused by bacterial contamination of drinking water.

In 1974, governing body recognized specialists in the treatment of drinking water issues on the importance of modifying the traditional methods of treatment with chlorine. Resulting from sterilization and its effects on public health, this recognition was done after winning scientific development in the chemistry of secondary metabolites. In 1979, the Environmental Protection Agency (EPA) limits was established for the concentrations of Trihalomethanes (THMs) compounds in drinking water at 100 micrograms per liter or the equivalent maximum of 0.1 ms grams per liter. In order to ensure reduction of concentrations of the THMs in drinking water to the permissible limits according to Environmental Protection Agency (EPA) and the World Health Organization (WHO). This will further prompted the stakeholders to the treatment and sterilization of drinking water for technical measurements and do some modifications of water treatment including reducing the contact time of chlorine with organic compounds in water. Followed by strengthening the role of coagulation process that helps to improve the disposal of organic matter prior to chlorination step. Lastly, the final treatment step of drinking water was carried out by ozonation process in the early stages of sterilization instead of chlorination. Thereafter, it was absolutely ascertained that the processors of initial sterilization of drinking water with ozone and the stages that may have followed had succeeded in getting rid of any presence of organic materials before sterilization with chlorine within the water.

Representative compounds like THMS in causing diseases like Cancer based on the recent studies which have shown the responsibility of organ chlorines. It is our duty today to reduce the causes of these cancers and to eradicate these causes for future generations as it is necessary to remove from the mind the phrase "no risk to drinking water as long as chlorination is done". Free chlorine is not a robust solution though it is useful in certain conditions but it also can cause damages in other areas. For that we must look forward in creating a formula balance in which the water consumption will be sterile-free of microbes. In addition it should be free compounds which are carcinogens resulting from the sterilization of conventional chlorination and is achieved through in-depth study of the seriousness of drinking water sources and review of the sterilization processes used entirely.

As per discussion earlier, it has a great ability to sterilize water, but what worries the experts is the material resulting from the interaction of chlorine with organic substances known as chlorinated hydrocarbons or Trihalomethanes (THMs). THMs generated when chlorine reacts with natural materials that most consist in drinking water such as the remains of trees decomposed and animal materials. Further it was found that some types of cancer associated with the use of chlorine in drinking water were due to THMs and make the body more susceptible to cancer. According to health reports made by Council of Environmental Quality in America among 44% of consumers who used water container that could not stand on the chlorine reaction, there is evidence on the relationship of colon cancer, bladder and rectum on consumption of chlorinated water that was stored in inappropriate container.

This brought a significant exposure for the consumers today on the exposure of chlorine while taking shower versus drinking the same chlorinated water having a higher potential risk of THMs getting into the digestive system. There was a link to bladder cancer [38] due to taking hot shower where the hot water will open up the pores of the skin and thus takes the chlorine and other pollutants on its way to the body through the skin. Further study indicated that inhalation of chlorine vapor during the bathing increases the problems of asthma, allergies and sinus exposure on short term for these conditions and may cause eyesore, cough, sputum, Admen nose and chest pain. Meanwhile on a larger scale it may cause accumulation of fluid in the lungs, pneumonia and bronchitis and shortness of breath. Keeping amount of chlorine constant, a professor of water chemistry at the University of Pittsburgh (USA) explained that exposure to chemicals vaporized during use of shower has the effect 100 times more to that of drinking the same water as the body absorbs the volatile chemical while taking shower bath [39].

Porcelanite: In western North Dakota, Wyoming, Porcelanite is a name given to the reddish siltstone rock that caps many ridges and buttes in the Powder River Basin which resembles the coal-burning waste called clinker or volcanic scoria. Based on study at North Dakota's Clinker a rock, semi vitrified clay or shale, somewhat resembles jasper which is composed of mullet and other high-temperature silicate and oxide minerals. These are formed due to combustion metamorphism (e.g., burning coal seams and dumps, mine fires) [40].

Researchers did not widely know about Ninivite and it was discovered in 1987 during detailed geological mapping of some areas in Mosul suburbs. Ninivite was then defined as a new form of Porecelanite [41] and was

Table 1: Chemical constituents of ninivite. Al-Naqib, Al- Dabbagh (1990)

Oxides	SiO_2	Al_2O_3	Fe_2O_3	Ca O	Mg O	SO_3	TiO_2	L.O.I
%	95.7	0.22	0.08	0.98	0.02	0.07	0.59	2.2

Table 2: Physical characteristics of ninivite. Al-Naqib, Al- Dabbagh (1990)

Sample No.	Porosity%	Density (g/cm)	Absorption ratio%
1	72.0	0.787	91.43
2	72.7	0.743	97.82
3	68.0	0.753	89.51
4	76.2	0.720	104.5
5	72.2	0.740	96.37
6	71.1	0.750	95.17
7	70.5	0.726	97.20
8	69.6	0.745	93.46
9	62.1	0.760	81.60
10	70.3	0.670	104.70

Permeability = 6.9x10-5 cm/s. Surface area = 739-765.5 m2/gm, Acid loss = zero color: white-grey, white when dry, grey when wet.

derived from the name of Nineveh. Table 1 and Table 2 are represented the chemical and physical characteristics of ninivite respectively. In comparison with other filters, Porcelanite as filter is superior in removal of turbidity and as the porosity of ninivite increases, the spaces among grains also increase. Consequently a more ability for accumulation of flocks has to be eliminated by various removal mechanisms. This ultimately will mitigate the breakthrough of impurities within the filters which may come out in the effluent and degrades filtrate quality [42] It was found experimentally that optimum percentage removal is attained when $G = 40\ sec^{-1}$ and $T_f = 20$ min. In addition, it was found that optimum doses of porcelanite are used as coagulant aids is 18 mg/L which gave maximum percentage removal of turbidity at G= 25 $sec^{-1}$and T_f =10min. Alternatively using alum alone, the mean G value can now be computed as postulated by (Camp and Stein) [43]. GT_f (Camp Number), where G and T_f is the velocity gradient and energy input time respectively [44].

At different filtration rates, bacterial counts are estimated at influent and effluent of the filter. The removal efficiency ranges fairly high from 92 to 95.4%. In relation to the biological quality of the treated water, production of such water will provide complete satisfaction [45] and further the granular media of the porcelanite filter could strain more small particles such as bacteria [46]. When the filtration rate increased, the average bacterial removal efficiency for the three filters decreased slightly. The thermal treatment of porcelanite rocks up to 800°C and it decreases the specific surface area and increases the permeability coefficient of the calcined porcelanite samples to values comparable to calcined industrial filtration aids [47]. Health Warning: No information on health risks for this material [40].

CONCLUSIONS

Water quality has been very interest research area since water is an important substance which is essential for all living variety of microorganisms, especially parasites, bacteria and viruses. Thus, water treatment projects were indicated to improve its quality using various means including physical and chemical methods of disinfection including in chlorine and porcelanite. Chlorine was widely used as bactericidal activity of disinfectants, however the responsibility of organ chlorines representative compounds THM_S in causing diseases like cancer. Recent studies have shown the Porcelanite as filter is promising and effective method for removing the turbidity and bacteria compared to other filters.

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