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Analysing physico-chemical parameters of water

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Abstract
Water is the most essential substance in shaping the land and regulating the climate. It is one of the most important compounds which influence life. The life is globally threatened due to undesired changes in physical, chemical and biological characteristics of water, air and soil. Water is highly polluted due to growth of population, industrialization, use of fertilizers and man-made activities. Natural water is polluted because of weathering of rocks, leaching of soils and mining processing etc. The quality of drinking water should be tested regularly at certain intervals in order to prevent water born diseases and to maintain quality of life. To test the quality of water, it is necessary to know different physico-chemical parameters such as color, temperature, hardness, chloride, pH, DO, BOD, COD, alkalinity used for testing water quality. Heavy metals also affect the quality of water by chronic poisoning in aquatic animals. Reports of some water analysis with physico-chemical parameters are given to explore parameter study. Water Quality parameters are also compared the value of real water sample.

Keywords: Physico-chemical parameters, chloride, DO, BOD, COD and heavy metals

Introduction

Water is the inevitable requirement for the living organisms. Any type of alteration in water may lead to serious issue of survival for the organisms. Quality of water is indicated by its physical and chemical characteristics. Pollution and negligence deteriorate the quality of water. Overwhelming industrial growth throughout the world in the past few decades, to fulfil the increased demand of human civilization, has caused overexploitation and pollution in the available water resources. Speedy industrialization, urbanization as well as anthropogenic activities cause excess water pollution which has brought about a water crisis over the globe. Anthropogenic pollutants have the potential to affect the aquatic ecosystem in several drastically harmful ways. Such environmental pollutants can be assessed by physicochemical studies of the water bodies. In India, almost 70% of the water has become polluted due to the discharge of domestic sewage and industrial effluents into water resources such as rivers, streams and lakes. Water is the essential requirement for all lives, from microorganisms to human beings. Its consumption is being increased day-by-day but access to safe drinking water has become a serious problem because all water resources have reached to a point of crisis due to unplanned urbanization and industrialization. As per the report of WHO, about 80% of water pollution in India is caused by domestic waste. The unplanned and irregular management of water systems causes undesirable and more serious problems in availability of drinking water. When waste from different industries is discharged without proper planning into water resources, grave situations arise. The physical, chemical and biological characteristics of water are altered in such a way that they are not useful for the purpose for which they are intended. Water quality evaluation of wetlands and water bodies is important because a host of interacting physical and chemical factors can influence the levels of the primary productivity and thus influence trophic structure and total biomass production throughout the aquatic food web.

The paper presents few important parameters to assess water quality on the basis of the works carried out by the author and other workers

Water quality parameters

It is very essential to test the water quality before it is used for agricultural, drinking, industrial or domestic purpose. Water should be tested for different physico-chemical parameters through faster methods. Parameter selection depends upon for what purpose we are going to use water and what extent we need its purity and quality. Different types of suspended, floating, dissolved, bacteriological and microbiological impurities are found in water. There must be some physical test to find out the physical appearance such as temperature, color, odor, pH, turbidity, TDS, color, odor, turbidity, pH etc. Some chemical tests are to be performed for its dissolved oxygen, BOD, alkalinity, COD, hardness and other characters. In course of getting more pure water, it should be tested for its trace metals, heavy metal contents and organic residues. For drinking water, all these tests are the essential. At the same time, potable water should also contain required amounts of essential minerals. To go through all these tests, highly sophisticated analytical instrument and trained man power are required. Following different physico-chemical parameters are required to monitor water quality.

Review of some literature from India and neighbourhood

Appavu *et al* (2016) [4] discussed water quality parameters of Cauvery river of Erode district in connection to pollution concentration due to anthropogenic activities, industrial effluents, domestic sewage and discharge of wastes into the river. Begum and Harikrishna (2007) had extensively studied quality of water

in some streams of Cauvery River. They concluded that the water becomes polluted as the sensitive species normally disappear while tolerating ones survive the pollution stress and the response of Rotifera to influent pollution varied greatly. Umamaheshwari (2016) [33] studied CCME water quality index in Cauvery river basin at Talakadu, South India. The river is an important source for Hydro Power and agriculture. He studied water quality index (WQI) of the river during a festival. There was fecal contamination. H_2S test was positive. Biological parameters MPN and Total bacterial count were higher in value. Some planktons like *Synedra ulna*, *Oxillafia* sp. and *Fragillaria biceps* were found which confirmed the Water pollution. The CCME WQI of Cauvery was 48:49 which showed up at marginal level. Some precautions and extra care could be taken to prevent pollution during festivals since they can be the source of bacterial diseases. Islam *et al* (2019) [15] investigated Surface water quality of the Buri Ganga River in Bangladesh. They found that the most of the physico-chemical parameters were within the permissible limit set by DOE and WHO. Concentration Cl^-, K^+, Pb^{2+} and Mn^{2+} were beyond the permissible limits. That indicated that water of Buri Ganga was not safe for drinking. The necessary steps could be taken to improve the degraded water quality. Due to the discharge of tannery effluent and metal plating industries, EC was high. This river is perennial the lifeline for a large population. Bassi *et al* (2014) [5] studied status of wetlands in India (a review of extent, ecosystem benefits, threats and management strategies). Sanyal and Paul (2019) investigated the interrelationship and variation among the water quality characteristics of surface water of a perennial pond in Patna (Bihar), India. The pond water appeared to be hard. Higher concentration of TDS caused increase in nutrients status of the water body. They concluded that the water was unfit for human consumption and could only used for aquaculture, irrigation and recreational purposes. Bhavimani and Puttaiah (2014) [7] studied water quality parameters and fish culture of Madikoppa pond Dharward Tq, Karnataka. The values of different physico-chemical parameters, except turbidity, were within the range prescribed by "Guidelines for water quality management for fish culture in Tripura" by ICAR research complex, NEH region Tripura Centre. Turbidity value was little more and was reduced by scattering gypsum on the entire pond. It was concluded that the pond condition was more or less maintained. It was economically advantageous to farmers because of better fish yield. Bhiyan and Gupta (2007) [8] did a comparative study of few ponds of Barak valley, Assam and their sustainable water resources. The study was conducted in different ponds of a rural area of Barak Valley, Assam. Most of the parameters reported under permissible levels of drinking water quality standard of WHO and ISI. But only Iron content was higher in most of the ponds. They observed the relationship between iron concentration and euglenoids. They concluded that the pond water was fit for drinking, domestic use and fishery and could be conserved at any cost. A hydrological study was conducted by Choudhary *et al* (2014) in regards to physico-chemical and biological parameters of three rural ponds of Sasaram of Bihar, India. The parameters were within permissible limit for fish culture. They found BOD under moderately polluted category which could be solved for better productivity. Shrivastava *et al* (2008) [30] studied the physico-chemical quality of four ponds in Bilaspur, Chhatisgarh. The study indicated that the pond waters were quite heavily polluted particularly with organic pollutants. Golder and Chattopadhyay (2016) [12] studied physico-chemical parameters in a trophical lake, Bonhoogly situated at Baranagar, Kolkata. The interrelationship between these physico-chemical parameters as well as their impact on biodiversity indices were analysed. There was stable increase in CO_2 content in water due to decaying of plant material and slight fall of pH. Between pH and CO_2 content, there was significant negative correlation ($P<0.01$) and also a significant negative correlation with O_2 content as well. Increase of a legal bloom was there during February and March. There was increase in free dissolved CO_2 and significant decrease in O_2 content and pH. A definite correlation between phosphate with nitrate content was found. The algae *Chlamydomonas* and *Chlorella* were observed. Temperature played most important role in bringing the diversity in the plankton community.

Gopalkrushna (2011) [13] investigated physico-chemical parameters of surface water samples in and around Akot city and results were compared with standard prescribed by WHO and ISI. The results found that the water samples collected from different sampling sites were contaminated. Gutpa *et al* (2019) studied geochemistry of ground water in Burdwan district, West Bengal (India). Most of the water samples were not suitable for drinking purpose. Kiran (2010) [19] studied physico-chemical characteristics of two fish ponds located near Bhadra project region at Karnataka.

Ramanathan and Amsath (2018) studied physico-chemical parameters of fresh water ponds in Puthukulam of Pudukottai town, Tamilnadu. The parameters were found within normal range. The pond water could be used for pisiculture and domestic work. Jalal and sanalkumar (2012) [16] assessed water quality of the Achencovil River in relation to pilgrimage season. This river is in Kerala state. They concluded that the river was highly contaminated especially during sabarimala pilgrimage season because pilgrims used the river water for various sanitary purposes. The deterioration was also caused by uncontrolled use of pesticides, chemical fertilizers and domestic wastes. Kumari (2017) analysed physico-chemical parameters in nine different ponds of Fatehabad (Muzaffarpur), Bihar. Most of the parameters were found within the permissible limit. But iron concentration was higher in most of the ponds. There was indirect relationship between Euglenoids and iron concentration. Phytoplankton present in the ponds were of Chlorophyceae, Cyanophyceae, Bacillariophyceae and Euglenophyceae. Nitrate was marginally low for fish production in 9th pond.

Lodh *et al* (2014) [21] investigated physico-chemical parameters of four lakes of Udaipur.

Samples were analysed for different physico-chemical parameters according to APHA (2005) [3] and the results were compared with standard values prescribed by WHO (1997) and BIS (1991) [9]. The lakes of Udaipur were highly polluted from the surroundings and the lake water was highly contaminated by sewage effluents.

Mahobe (2013) [24] studied water quality characteristics of six major ponds situated in Rajnandgaon town, Chhattisgarh. There were both surface and ground water pollutions due to increase in industrial waste. In drinking water, bacteriological pollution was found which caused different types of health problems like diarrhoea, skin disease etc. All ponds were polluted but, Lakholi talab was more polluted because of coliform bacteria.

Mishra *et al* (2014) [26] analysed physico-chemical characteristics of the ponds at Varanasi. There are anthropogenic influences on these ponds. Varanasi is religious city and is popularly known for its mythological ponds and kunds. The pond] water of Varanasi was not good for human consumption.

Artificial intelligent techniques in water quality assessment

Assessment of water quality may be performed by using techniques like regression analysis, fuzzy reasoning, support vector machine (SVM) and Artificial Neural Network (ANN) (Chang *et al*, 2001; Abaurrea *et al* 2011; Singh *et al* 2009) [1, 31]. All these techniques may be considered reliable, efficient and accurate (May *et al* 2008) [25].

Regression analysis was first of all observed in Spain (Abaurrea *et al*, 2011) [1]. This is the alternative statistical method which is able to detect presence of change in water quality that can be attributable to anthropogenic behavior compared to others. This model with Gaussian autoregressive moving average (ARMA) error was considered as one of the models that have been used to analyze four monthly conductivity (*C*) series that could simulate *C* behavior under different environment conditions.

The second technique fuzzy reasoning is to consider water quality assessments. In 2014, a comparative study of fuzzy evidential reasoning (FDS) and fuzzy rule-based system (FRBS) were conducted for water quality assessment in water distribution networks (WDN) (Aghaarabi *et al*, 2014) [2]. These two fuzzy approaches are called multi-criteria decision-making (MCDM) frameworks.

Support vector machine is the third technique of water quality assessments. A review of (Tan *et al*, 2012) [32] observed that least square with support vector machine (LS-SVM) is suitable for small sample of water quality and can produce good performance of the prediction model. This study carried out three types of water quality prediction methods, LS-SVM, multi-layer back propagation (BP) and radial basis function (RBF) neural networks.

The last technique in water quality assessment is the Artificial Neural Network (ANN). It is very powerful computational technique for modelling complex nonlinear relationship. ANN model was identified, validated and tested for the computation of dissolved oxygen (DO) and biochemical oxygen demand (BOD) concentrations in water quality at Gomti River, India. Three-layer feed-forward neural networks with back propagation (BP) learning were constructed for computation of the river water DO and BOD. The constructed ANN models (DO and BOD) were trained using the Leven berg Marquardt algorithm (LMA) as author was studied in 2007 by Zhao *et al*. From the result, the author observed that the ANN was to be found as a powerful predictive alternative to traditional modeling techniques (Singh *et al* 2009) [31].

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