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pH concentration in groundwater of Kolar District, Karnataka, India

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Abstract
Kolar District is in eastern dry agro climatic zone ok Karnataka. It experiences a semi-arid climate, characterized by the typical monsoon, tropical weather with hot summer and mild winters. The rainfall in the District is very erratic and maximum fluctuations is recorded in recent years. The main occupation of people of Kolar District is agriculture. In the absence of surface water irrigation system, groundwater is the main source fordrinking as well as irrigation. Presently 94 % of drinking water is met by ground water. Hence quality is important for drinking water. The physico-chemical parameters of water are main criteria in determining of its quality. This paper deals with the study of pH concentration of groundwater drawn from bore wells of various villages of Kolar district. 50 different samplings source were selected for procurement of water and analyzed pH concentration. Variation in the concentration of pH in the water samples were observed according to norms of IS 10500:2012. The study helps to understand in the potential threat of pH concentration to the ground water resources and its quality.

Keywords: Kolar District, summer, groundwater, quality, pH

Introduction

Water is the most vital resource for the life molecule to act as best suited medium for the life activities as it is needed for drinking, irrigation, other household or domestic and industrial activities (Dutta *et al.*, 2018) [4]. Earlier few decades before surface water was plentiful and was main source of water as well as other purposes of mankind. When surface water resources are limited, groundwater is ultimate and most suitable freshwater source consumed for drinking, irrigation, other house hold or domestic and industrial activities (Mohammed and Gupta, 2009) [7]. It has been considered that the groundwater is subjectively, exceptionally safe, secure and free from contamination. High intervention of anthropocentric activities as well as landfill leachates causes disturbance of water cycle and contamination of groundwater with heavy metals as well as trace elements. It is a matter of gigantic dread at local and national level (Ngah *et al.*, 2012; Nowak *et al.*, 2012) [8, 9]. A decline in the water table due to long period of low rainfall is the main cause for increase of pH in groundwater (Steve *et al.*,2004) [13]. The lateric aquifer system with hard and leterite soil is usually considered as very good filter media for groundwater and effects groundwater pH (Premalal and Jayewarden, 2015) [11]. Four main factors that are responsible for the groundwater chemistry and acidity, such as acid atmospheric deposition, anthropogenic activities (industrial effluent discharge and spills), chemical weathering and coastal atmospheric deposition or cation exchange. Further investigations postulate that the continuous acid inputs into the soils have led to a weakening in the buffering capacity of the soil which results in acidification of shallow groundwater (Takem *et al.*,2015) [14]. When an average pH is slightly acidic indicate corrosive problems and they suggest proper treatment is essential before consumption (Oyem *et al.* 2014) [11]. Methods for treating of acid groundwater eight different conventional mechanical filters, especially deacidification filters are installed in indoors or in some cases inside the well. The majority of them performed well, providing acceptable value of pH and alkalinity. Further investigations concluded that acid groundwater can corrode plumbing systems and solubilized metals in the soil or in the plumbing systems. Since the soluble forms of metals are toxic, concern regarding the effects of groundwater acidification on human health. the increase in groundwater level is effective in preventing adverse pH level. The pH levels in greatly affected areas are often less than 4.0 and associated environmental impacts include fish kills, retorted growth of crops and changes in water chemistry (Indranath *et al.*, 1995) [6]. The extent of groundwater acidification is still largely unknown where bedrock and soil mainly consists of acidic crystalline rocks such as granite and genesis (Soveri, 1992) [12].

Shallow groundwater in alluvial plains are more vulnerable to effluents containing hydrochloric acid and anthropocentric activities like discharge of industrial effluents containing hydrochloric acid are main contributions to the groundwater acidification (Beiyi and Yan 2018) [1]. The type of environment responsible for acidification of groundwater such as long term accumulation of calcium, magnesium, nitrate, sulphate, acid rain or melt water streams and lakes. Acidification of groundwater causes negative effects such as corrosion of water pipes which leads to leakage and high contents of chemicals in drinking water (Gert, 1994) [5]. The acidification of groundwater is due to acid rain impact and the mobilization of the trace metals like Ni, Be, Cd and Co in sandy aquifer (Claus *et al*. 2004) [2]. Elevated base cation and trace metal concentration in groundwater may results in corrosive or toxic water quality condition (David *et al*. 1985) [3]. Increased concentration of pH in water filled gravel pits pose serious environmental and geochemical threat to the groundwater thereby it causes formation of finely polished surface on aluminum hulls and causes pain full eye irritation (Tuija, 1997) [15].

Materials and Methods

Study area

Kolar district, spread over 4,012 Sq Km, has population of about 16.50 lakhs. 5 Taluks of Kolar District studied for the present work includes Kolar, Bangarpet, Malur, Mulbagal and Srinivaspur. They are stretched between north latitude $12^{o}45^{I}\,54^{II}$ to east latitude $77^{0}50^{I}\,29^{II}$.

The District Kolar has 1798 villages under 156 gram Panchayats. The main occupation of the people is agriculture which is supported by only bore well water. Meteorologically the district has dry agro climate, it experiences a semiarid climate, characterized by tropical monsoon, weather with hot summer and mild winter. There are no major surface water sources in the study area. However, main source of drinking water is only bore wells (groundwater).

Water samplings

Groundwater samples were collected from 50 different bore wells as samplings located at villages in Kolar districts during pre and post monsoon seasons of 2014 and 2015. Samples were collected in pre-cleaned and rinsed bottles of 2-liter capacity with necessary pre cautions and transferred to the laboratory to analyze the different physico-chemical parameters.

Analysis of samples

All the samples were analyzed for a physical parameter such as pH. The analysis of water samples was carried out in accordance of standard analytical methods. The chemical solutions used for the analysis of water samples were prepared with double distilled water and the chemicals used were of SD-fine. The details of the analyzed method is summarized in Table-1.

Table 1: Parameter and Method used in the analysis of ground water quality

Sl. No	Parameters	unit	Methods used
1	pH	-	Digital pH meter

Results and Discussion

The variations in pH concentration of the groundwater have been summarized in Table 2 and The Analytical results revealed pH concentration of water samples from 50 locations of study area in pre and post monsoon seasons of 2014 and 2015. In present study the data revealed that some of the groundwater samples were polluted slightly higher than the permissible limit**.** The pH of a solution is a measure of hydrogen ion concentration, which in turn is a measure of its acidity. The concentration of hydrogen ions in a solution is expressed usually in moles per litre. The pure water in self-ionization dissociates slightly and yields hydrogen ions (H^+) and hydroxyl ions (OH^-) in equal concentrations. The product of H^+ and OH^- ions always remains constant i.e. each being 10^{-7} moles per litre at 25 ºC. An excess of hydrogen ions (H^+ ions exceeds the OH^- ions) makes a solution acidic where pH value is always less than 7 and excess of hydroxyl ions makes a solution basic, where pH value always more than 7. A change of pH value from 7 to 6 indicates that there is a tenfold increase in the hydrogen ion concentration in the solution. Similarly, a change of pH value from 7 to 8 indicates a tenfold decrease in the hydroxyl ion in the solution. In very general term a solution is said to be neutral when the number of hydrogen ions and hydroxyl ions are equal.

Most commonly the pH of natural water varies on the influence of different environmental factors such as carbon dioxide, temperature and pressure. When water is exposed to carbon dioxide that can change the pH of natural water as more acidic. Therefore, in natural water pH is dependent on carbon dioxide-carbonate equilibrium. Sometimes temperature and pressure markabaly affect this equilibrium and obviously change the pH of natural water. Groundwater pH may also vary and lowered under the influence of salts along with the presence of phosphates, silicates, borates and fluorides in dissociated form.

Result of hydrogen ion on comparison showed highest concentration of 8.4 at source VIII of pre-monsoon season 2014, 8.6 at source VIII of post-monsoon season 2014, 8.3 at source XXIII of pre-monsoon season 2015,8.6 at source XLVII and had lowest concentration of 6.5(Table 2).

Table 2: Showing seasonal changes in the concentration of pH from different sources at study area Kolar District for the period pre and post monsoon-season 2014 and 2015

SL. No.	SL No. of the Sources	Pre-monsoon season March-May 2014	Post-monsoon season October-December 2014	Pre- monsoon season March-May 2015	Post-monsoon season October-December 2015	Average
1	I	6.58	6.98	7.1	7.2	6.965
2	II	6.9	7	7	7	6.975
3	III	6.9	7.1	7	7.4	7.1
4	IV	6.5	6.8	7.6	7.1	7
5	V	6.52	6.58	7.5	7.2	6.95
6	VI	7.2	7.2	7.6	7.6	7.4

7	VII	6.89	7	7.5	7.1	7.1225
8	VIII	8.4	8.6	7.1	8	8.025
9	IX	7.2	7.6	7.8	7.8	7.6
10	X	7.85	7.87	7.7	7.1	7.63
11	XI	7.88	7.8	7.9	7.9	7.87
12	XII	7.9	7.8	7.9	7.9	7.875
13	XIII	7.5	7.1	7.2	7.2	7.25
14	XIV	7.5	7.6	7.8	7.8	7.675
15	XV	6.8	6.5	6.9	6.5	6.675
16	XVI	7.2	7.4	7.6	7.9	7.525
17	XVII	7.1	7.5	7.2	7.5	7.325
18	XVIII	7.8	7.6	7.2	7.5	7.525
19	XIX	6.89	6.91	7.5	8	7.325
20	XX	8	8.2	6.5	7.9	7.65
21	XXI	6.9	6.9	7.1	7	6.975
22	XXII	7.5	6.8	7.6	6.89	7.1975
23	XXIII	7.2	7.2	8.3	7.3	7.5
24	XXIV	7.8	7.4	8	7.5	7.675
25	XXV	7.21	7.51	8	8	7.68
26	XXVI	7.5	7.2	7.6	7.1	7.35
27	XXVII	7.89	7.74	8.1	7.9	7.9075
28	XXVIII	7.2	7.3	7.5	7.8	7.45
29	XXIX	7.5	7.3	7.8	7.5	7.525
30	XXX	6.98	7	8	7.9	7.47
31	XXXI	6.92	7	8	7.8	7.43
32	XXXII	7.2	7.5	8	7.6	7.575
33	XXXIII	7.8	6.7	6.8	6.8	7.025
34	XXXIV	7.6	6.98	7.7	7.4	7.575
35	XXXV	6.5	7	6.9	7.5	7.05
36	XXXVI	7.2	7.1	7.8	7.3	7.425
37	XXXVII	7.1	6.8	7.8	7.4	7.375
38	XXXVIII	7.8	6.58	8	7.7	7.825
39	XXXIX	7.52	7.2	7.6	7.3	7.485
40	XL	6.9	7	7.8	7.5	7.275
41	XLI	7.1	8.6	7.2	7.3	7.25
42	XLII	7.3	7.6	7	7.4	7.2
43	XLIII	6.8	7.87	7.1	7.5	7.25
44	XLIV	6.6	7.8	6.9	7.3	5.445
45	XLV	7.2	7.8	7.5	7.1	7.25
46	XLVI	7.4	7.1	7.1	7.8	7.5
47	XLVII	7.3	7.6	7.3	8.6	7.625
48	XLVIII	7.2	6.5	7.6	8.3	7.6
49	XLIX	7.4	7.4	7.2	8.1	7.55
50	L	7.4	7.5	7.5	7.4	7.425

Conclusion

In the present study the values of pH concentration observed that values for samples were beyond the permissible limit. The acceptance pH limit is 6.5 to 8.5, in present study pH ranged from 6.675 to 8.6. The results of study reveals that, quality of groundwater is in some samplesnot fit for drinking purposes Hence it is suggested that the water should be properly treated before consumption.

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