BOOK CHAPTER

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Chapter: 14

BIOWASTE MATERIAL UTILIZATION FOR WATER DEFLUORIDATION & STATISTICAL INVESTIGATION OF GROUND WATER IN NALGONDA DISTRICT

Kiran Kumar K, Venkata Nadh Ratnakaram, Krishnaveni G, Rao KS

Introduction: According to World Health Organization, the permissible limit of fluoride concentration in drinking is under 1.5 mg l^{-1}. The presence of higher amounts of fluorine in potable water has adverse effects on human health. Nalgonda District of Telangana (erstwhile a part of Andhra Pradesh), India is reported to have high levels of fluoride in ground water which is used for drinking. It is confirmed by the occurrence of fluorosis amongst the villagers of the district.

Speedy industrialization and growth of population are creating water pollution. In parallel, continuous creation of biowaste is causing management problems. Global warming is caused by the conventional methods like landfill and incineration due to gases release [1]. However, biowaste is proved to be a good source for extraction of useful chemicals like ethanol [2], natural colours [3] and natural products of medicinal importance [4-10]. Another trend is conversion into adsorbents which are useful for abatement of water pollutants like chemical oxygen demand and toxic heavy metals – chromium (VI), lead (II), copper (II) etc [11-15]. In the reduction of water pollutants, adsorption technique is the well adopted technique. Though, activated alumina was proved to be the best adsorbent [16], the tweaking issue is its cost. Hence, preparation of activated carbons from biowaste (an abundantly available and inexpensive source) will help to substitute overpriced commercially available activated carbons. In addition, it also helps to the reduction of cost involved in disposal of biowaste [17].

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The objectives of the current research study are to explore the possibility of utilization of selected biowaste to defluoridize the water and to apply statistical analysis on physicochemical characteristics of ground water in Nalgonda district.

Experimental Procedures: Ground water samples were collected from the major villages including hamlets of Nalgonda district of Telangana (erstwhile Andhra Pradesh). Water samples were collected from two types of sources for investigation and chemical analysis. Sample collecting points (along with serial number) of Bore well water (B.W.W)are Appajipet (1), Medla Duppalapalli (2), Dandampalli (3), Kothapalli (4), Guttakindi Annaram (5), Marriguda (6), Donakal (7), Nalgonda (8), Mushampalli (9), Narsig Bhatla (10), Kudavanpur (11), Cherlapalli (12), Chandanpalli (13), Annareddyguda (14), Anantharam (15), Mamillaguda (16), Anneparthy (17), Gandamvarigudem (18) and Kanchanpalli (19). Sample collecting points (along with serial number) of Hand pump water (H.P.W) are Gollaguda (1), Mushampalli (2), Madavari Domalpalli (3), Seshammaguda (4), Pangal (5), Kothapalli (6), Nalgonda (7), Velugupalli (8), Kakula Kondaram (9), Gundlapalli (10), Arjala Bavi (11), Ammaguda (12), Cherlapalli (13), Buddaram (14), Rasoolpur (15) and Puttavari Domalpalli (16).

Activated carbons (CNC, BMC, PDLC and CLC respectively) were prepared from the concerned bio-waste materials by following the previously reported method [18]. These bio-waste materials were collected from agriculture fields and fruit shops in Nuzvid Mandal, Krishna District, Andhra Pradesh. In the present study, used instruments (along with the measured physic-chemical parameters) are pH meter (pH), Conductometer (Electrical conductivity), TDS anlyser (Total dissolved Solids), Spectrophotometer (NO_3^-, NO_2^-, SO_4^{-2}, PO_4^{-3} and F^-) and Flame photometer (Na^+ and K^+). Titrimetry (Ca^{+2}, Mg^{+2} and total hardness using EDTA; Cl^- by Argentometry) was used for other parameters.

Results and Discussion:

Statistical Analysis: The main objective of statistical investigation is to establish relationships, which makes it possible to predict one or more variables in terms of others. For this purpose, regression analysis is employed. Regression analysis is carried out to find out the relation between two variables measured simultaneously; particularly where one variable is dependent and the other is independent.

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Table 1: The Correlation Coefficient (r) Values Amongst Different Quality Parameters of Bore Well Water

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Table I: The Correlation Coefficient (r) Values Amongst Different Quality Parameters of Bore Well Water

	EC	TDS	Turbidity	TA	TH	F^{-1}	Cl^{-1}	NO_2^-	NO_3^-	SO_4^{-2}	PO_4^{-3}	Ca^{+2}	Mg^{+2}	Na^{+1}	K^{+1}	Fe^{+2}	Mn^{+2}
pH	-0.19	0.19	0.39	-0.26	-0.12	-0.22	-0.35	-0.10	0.33	0.17	-0.26	-0.07	0.09	0.08	-0.17	0.10	0.25
EC		0.99	-0.07	0.35	-0.09	-0.28	0.14	-0.04	-0.13	0.00	0.06	0.05	-0.06	-0.34	0.09	-0.11	-0.37
TDS			-0.06	0.34	-0.08	-0.28	0.12	-0.04	-0.12	-0.01	0.06	0.05	-0.06	-0.34	0.09	-0.12	-0.37
Turbidity				0.45	0.45	-0.02	-0.33	0.17	-0.12	-0.35	-0.35	-0.17	0.28	-0.13	-0.13	-0.45	0.30
TA					-0.34	-0.10	0.37	0.31	-0.06	0.17	0.58	0.10	0.08	-0.50	0.58	0.22	-0.25
TH						0.22	-0.05	0.10	-0.05	-0.32	-0.25	0.07	0.26	0.14	-0.19	-0.34	0.43
F^{-1}							-0.02	-0.29	-0.44	-0.19	-0.02	0.12	0.17	0.26	-0.19	0.19	0.36
Cl^{-1}								-0.14	-0.09	0.84	0.02	0.61	0.28	-0.29	-0.17	0.08	-0.23
NO_2^-									0.54	-0.27	0.53	-0.16	-0.01	-0.39	0.77	-0.19	0.31
NO_3^-										0.18	0.05	-0.12	-0.23	-0.39	0.29	-0.29	0.33
SO_4^{-2}											0.02	0.20	-0.13	-0.32	-0.03	0.18	-0.16
PO_4^{-3}												-0.16	0.09	-0.38	0.70	0.28	0.17
Ca^{+2}													0.60	-0.08	-0.07	0.27	-0.12
Mg^{+2}														-0.16	-0.10	0.31	0.21
Na^{+1}															-0.40	-0.06	-0.19
K^{+1}																-0.02	0.06
Fe^{+2}																	0.09

The water analysis shows that sources are mostly found to be polluted. In some of the quality parameters, 90% of the collected samples are crossing the concerned rejection limits. Hence, indicates their unfitness for drinking. The correlation coefficient (r) values for different quality parameters of B.W.W. and H.P.W. are presented in tables I and II.Correlation was found to be positive between Fe^{2+} and Cl^- (r =0.08, 0.16), TDS and EC (r = 0.99, 0.22) for samples of B.W.W. and H.P.W. respectively (Tables I and II). It hints at the dependency of conductivity values on the chloride salts of iron. Similarly, a positive correlation can be observed for the selected anions (fluoride) and cations (calcium and magnesium) with total hardness. Hence, fluoride salts of these metals are contributing to the water hardness. Reasonably high positive r

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values (correlation > 0.8) can be observed between a good numbers parameter pairs. Existence of sulphates of Ca^{2+} and Mg^{2+} is clearly visible from significant values of correlation coefficients with EC and TDS. Determination of EC and TDS is quick and easy. Moreover, most of the other parameters are correlated with their values. Hence, groundwater quality can be easily monitored from EC and TDS values.

Table II: The Correlation Coefficient (r) Values Amongst Different Quality Parameters of Hand Pump Water

	EC	TDS	Turbidity	TA	TH	F^{-1}	Cl^{-1}	NO_2^-	NO_3^-	SO_4^{-2}	PO_4^{-3}	Ca^{+2}	Mg^{+2}	Na^{+1}	K^{+1}	Fe^{+2}	Mn^{+2}
pH	0.34	0.10	0.52	0.17	0.11	0.19	-0.01	-0.30	-0.68	-0.51	-0.18	-0.28	0.14	0.05	0.03	0.04	-0.33
EC		0.23	0.11	0.05	-0.05	0.42	-0.29	0.03	-0.17	-0.28	-0.36	0.23	-0.13	-0.39	0.27	-0.20	-0.21
TDS			0.02	-0.07	0.15	0.08	-0.42	0.31	-0.14	0.06	-0.09	0.39	-0.16	0.36	0.26	0.24	-0.47
Turbidity				0.02	0.08	0.22	-0.29	0.20	-0.45	-0.66	-0.04	-0.36	-0.33	0.22	-0.01	0.34	0.26
TA					0.16	-0.48	0.03	0.07	-0.06	0.06	-0.35	0.06	0.25	-0.05	-0.12	-0.19	-0.34
TH						-0.35	0.21	0.10	-0.03	-0.13	0.01	-0.14	0.17	0.05	-0.61	-0.17	-0.47
F^{-1}							-0.47	-0.16	-0.14	-0.09	0.02	0.14	0.15	-0.14	0.46	0.15	0.37
Cl^{-1}								-0.12	0.19	-0.04	0.29	-0.34	0.01	-0.04	-0.46	0.16	-0.13
NO_2^-									0.29	0.09	-0.10	0.01	-0.06	-0.06	-0.06	0.42	0.00
NO_3^-										0.49	0.09	-0.02	-0.24	-0.03	0.14	0.04	0.24
SO_4^{-2}											-0.33	0.08	0.01	0.13	0.29	-0.35	-0.21
PO_4^{-3}												-0.23	0.38	-0.03	-0.23	0.52	0.27
Ca^{+2}													-0.33	-0.15	0.29	-0.24	-0.21
Mg^{+2}														-0.31	-0.34	0.06	-0.25
Na^{+1}															0.26	0.37	-0.16
K^{+1}																0.02	0.02
Fe^{+2}																	-0.32

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Table III: Regression Analysis Values for Some Selected Samples

	Bore well water samples				Hand pump water samples			
	a	b	r	r^2	a	b	r	r^2
EC-TDS	24586.85	0.57	0.99	0.98	15196.30	0.72	0.22	0.05
EC-TH	12962.97	0.31	-0.09	0.01	7667.23	0.36	0.04	0.00
F-Ca	10485.40	151.37	0.01	0.02	1582.80	34.20	-0.11	0.01
F-Mg	1311.03	18.96	0.16	0.02	842.98	18.21	-0.17	0.03
F-Na	6496.47	94.00	0.25	0.06	3645.85	78.72	-0.10	0.01
F-K	661.11	9.60	-0.19	0.02	86.22	1.84	0.50	0.25
F-Fe	20.44	0.29	0.18	0.03	34.85	0.02	-0.14	0.02
F-Mn	1.46	0.00	0.35	0.12	0.96	0.75	0.36	0.13
Fe-Cl	20.14	0.00	-0.27	0.07	34.91	0.01	0.15	0.02
Fe-NO3	20.41	0.46	-0.29	0.08	34.85	0.98	0.05	0.00

Influence of Other Quality Parameters on Fluoride: The linear regression analysis was carried out in limited couples of quality parameters of water. Regression analysis results are précised in Tables III, also presented the value of correlation coefficient (r), empirical parameters 'a' and 'b'. The inter dependence of fluoride on other quality parameters and vice – versa was studied using regression analysis. The results are presented in table III. Correlation studies were conducted on the obtained results. A close examination of the table shows that an overall positive correlation exists in almost all cases between the concentration of fluoride with all parameters, except EC, TDS and TH. The (+) ve correlation values suggest that they all have a direct influence on fluoride concentration.

Sample Analysis Report: From the present water management studies in Nalgonda mandal, the following conclusions can be derived. The pH values of all water samples are greater than 7.0, indicating the alkaline nature of water. However, all the pH values are within the acceptable bounds except in some samples. The EC values of the remaining samples are within the permissible limit. For two to three water samples of B.W.W. and H.P.W., TDS exceeds the permissible limit. However, values in the rest of the samples are below the red mark. In number of samples, highest degree of hardness was found. Such waters need to be softened to make them suitable for consumption by human beings. In some samples, higher values for alkalinity and turbidity were found which are far away from the permissible limit. High chloride contents were observed in 6 samples of bore wells water and in 7-samples hand pumps water. In many samples, values of Ca^{2+}, Mg^{2+} and K^{+} were above the permissible limit. Sodium concentration has exceeded the limit in all the samples. It is observed that fluoride content was found to be beyond the WHO limit in an almost all samples.

Biowaste for Fluoride Removal: Inspite of the high efficiency of the selected processes (electro dialysis, ion exchange, Nano filtration), they are very infrequently used in industrial plants, mainly due to their high operating costs. In view of low cost and ease of operation associated with adsorption process, it is the technique which is broadly accepted. As synthetic

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adsorbents are costly [16] and the usage of agricultural waste for removal of heavy metals is well established [11-15], activated carbons from biowaste can be customized for fluoride removal from potable water. Hence, activated carbons were prepared from the selected bio-waste materials and utilized them for defluoridation of the above collected water samples in batch process. The results indicate that, the prepared active carbons from biowaste are capable of defluoridation up to 70-80% (Figures 1 and 2). Hence, these adsorbents can be used for the defluoridation of potable water at domestic level.

Conclusion: Physicochemical parameters of water samples were statistically analysed. The effect of co-ions on the defluoridation process and their correlation co-efficient values were systematically calculated. The water sources were mostly found to be polluted. In some of the quality parameters, 90% of the collected samples are crossing the concerned rejection limits. Hence, indicates their unfitness for drinking. Activated charcoals prepared from the present selected biowaste can be used for the defluoridation of potable water at domestic level.

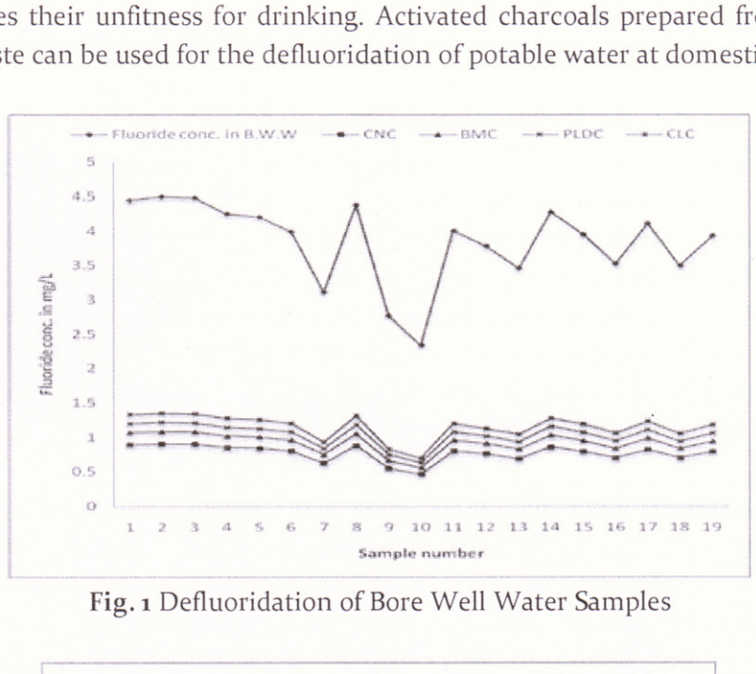

Fig. 1 Defluoridation of Bore Well Water Samples

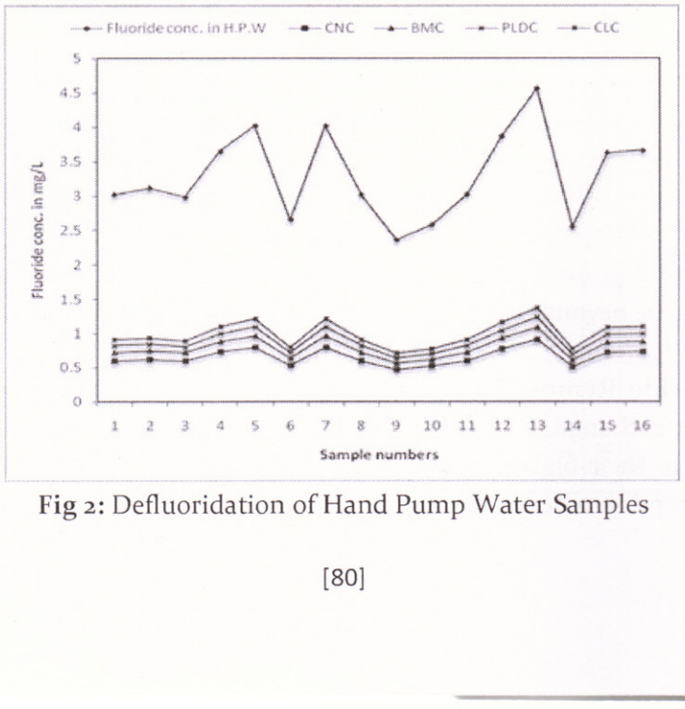

Fig 2: Defluoridation of Hand Pump Water Samples

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Chapter: 14

BIOWASTE MATERIAL UTILIZATION FOR WATER DEFLUORIDATION & STATISTICAL INVESTIGATION OF GROUND WATER IN NALGONDA DISTRICT

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KRISHNAVENI G [1]
and RAO KS [3]

Abstract: Physicochemical parameters of ground water in Nalgonda District of Telangana (erstwhile a part of Andhra Pradesh), India were measured and analysed by statistical investigation. Activated carbons were prepared from bio-waste materials *viz., Citrous nobilis, Bombax malabaricum, Pithacelobium dulce* and *Citrous limon sheaths* (CNC, BMC, PDLC and CLC respectively) and were utilized as adsorbents for defluordization of the collected water samples, which were found to be satisfactory.

Key words: Defluoridation, biowaste, ground water analysis, Nalgonda district

Introduction

According to World Health Organization, the permissible limit of fluoride concentration in drinking is under 1.5 mg l^{-1}. The presence of higher amounts of fluorine in potable water has adverse effects on human health. Nalgonda District of Telangana (erstwhile a part of Andhra Pradesh), India is reported to have high levels of fluoride in ground water which is used for drinking. It is confirmed by the occurrence of fluorosis amongst the villagers of the district.

Speedy industrialization and growth of population are creating water pollution. In parallel, continuous creation of biowaste is causing management problems. Global warming is caused by the conventional methods like landfill and incineration due to gases release [1]. However, biowaste is proved to be a good source for extraction of useful chemicals like ethanol [2], natural colours [3] and natural products of medicinal importance [4-10]. Another trend is conversion into adsorbents which are useful for abatement of water pollutants like chemical oxygen demand and toxic heavy metals – chromium (VI), lead (II), copper (II) etc [11-15]. In the reduction of water

pollutants, adsorption technique is the well adopted technique. Though, activated alumina was proved to be the best adsorbent [16], the tweaking issue is its cost. Hence, preparation of activated carbons from biowaste (an abundantly available and inexpensive source) will help to substitute overpriced commercially available activated carbons. In addition, it also helps to the reduction of cost involved in disposal of biowaste [17].

The objectives of the current research study are to explore the possibility of utilization of selected biowaste to defluoridize the water and to apply statistical analysis on physicochemical characteristics of ground water in Nalgonda district.

Experimental Procedures

Ground water samples were collected from the major villages including hamlets of Nalgonda district of Telangana (erstwhile Andhra Pradesh). Water samples were collected from two types of sources for investigation and chemical analysis. Sample collecting points (along with serial number) of Bore well water (B.W.W) are Appajipet (1), Medla Duppalapalli (2), Dandampalli (3), Kothapalli (4), Guttakindi Annaram (5), Marriguda (6), Donakal (7), Nalgonda (8), Mushampalli (9), Narsig Bhatla (10), Kudavanpur (11), Cherlapalli (12), Chandanpalli (13), Annareddyguda (14), Anantharam (15), Mamillaguda (16), Anneparthy (17), Gandamvarigudem (18) and Kanchanpalli (19). Sample collecting points (along with serial number) of Hand pump water (H.P.W) are Gollaguda (1), Mushampalli (2), Madavari Domalpalli (3), Seshammaguda (4), Pangal (5), Kothapalli (6), Nalgonda (7), Velugupalli (8), Kakula Kondaram (9), Gundlapalli (10), Arjala Bavi (11), Ammaguda (12), Cherlapalli (13), Buddaram (14), Rasoolpur (15) and Puttavari Domalpalli (16).

Activated carbons (CNC, BMC, PDLC and CLC respectively) were prepared from the concerned bio-waste materials by following the previously reported method [18]. These bio-waste materials were collected from agriculture fields and fruit shops in Nuzvid Mandal, Krishna District, Andhra Pradesh. In the present study, used instruments (along with the measured physic-chemical parameters) are pH meter (pH), Conductometer (Electrical conductivity), TDS anlyser (Total dissolved Solids), Spectrophotometer (NO_3^-, NO_2^-, SO_4^{-2}, PO_4^{-3} and F^-) and Flame photometer (Na^+ and K^+). Titrimetry (Ca^{+2}, Mg^{+2} and total hardness using EDTA; Cl^- by Argentometry) was used for other parameters.

Results and discussion

Statistical analysis:

The main objective of statistical investigation is to establish relationships, which makes it possible to predict one or more variables in terms of others. For this purpose, regression analysis is employed. Regression analysis is carried out to find out the relation between two variables measured simultaneously; particularly where one variable is dependent and the other is independent.

Table I **The correlation coefficient (r) values amongst different quality parameters of bore well water**

	EC	TDS	Turbidity	TA	TH	F^{-1}	Cl^{-1}	NO_2^-	NO_3^-	SO_4^{-2}	PO_4^{-3}	Ca^{+2}	Mg^{+2}	Na^{+1}	K^{+1}	Fe^{+2}	Mn^{+2}
pH	-0.19	0.19	0.39	-0.26	-0.12	-0.22	-0.35	-0.10	0.33	0.17	-0.26	-0.07	0.09	0.08	-0.17	0.10	0.25
EC		0.99	-0.07	0.35	-0.09	-0.28	0.14	-0.04	-0.13	0.00	0.06	0.05	-0.06	-0.34	0.09	-0.11	-0.37
TDS			-0.06	0.34	-0.08	-0.28	0.12	-0.04	-0.12	-0.01	0.06	0.05	-0.06	-0.34	0.09	-0.12	-0.37
Turbidity				0.45	0.45	-0.02	-0.33	0.17	-0.12	-0.35	-0.35	-0.17	0.28	-0.13	-0.13	-0.45	0.30
TA					-0.34	-0.10	0.37	0.31	-0.06	0.17	0.58	0.10	0.08	-0.50	0.58	0.22	-0.25
TH						0.22	-0.05	0.10	-0.05	-0.32	-0.25	0.07	0.26	0.14	-0.19	-0.34	0.43
F^{-1}							-0.02	-0.29	-0.44	-0.19	-0.02	0.12	0.17	0.26	-0.19	0.19	0.36
Cl^{-1}								-0.14	-0.09	0.84	0.02	0.61	0.28	-0.29	-0.17	0.08	-0.23
NO_2^-									0.54	-0.27	0.53	-0.16	-0.01	-0.39	0.77	-0.19	0.31
NO_3^-										0.18	0.05	-0.12	-0.23	-0.39	0.29	-0.29	0.33
SO_4^{-2}											0.02	0.20	-0.13	-0.32	-0.03	0.18	-0.16
PO_4^{-3}												-0.16	0.09	-0.38	0.70	0.28	0.17
Ca^{+2}													0.60	-0.08	-0.07	0.27	-0.12
Mg^{+2}														-0.16	-0.10	0.31	0.21
Na^{+1}															-0.40	-0.06	-0.19
K^{+1}																-0.02	0.06
Fe^{+2}																	0.09

The water analysis shows that sources are mostly found to be polluted. In some of the quality parameters, 90% of the collected samples are crossing the concerned rejection limits. Hence, indicates their unfitness for drinking. The correlation coefficient (r) values for different quality parameters of B.W.W. and H.P.W. are presented in tables I and II. Correlation was found to be positive between Fe^{2+} and Cl^- (r =0.08, 0.16), TDS and EC (r = 0.99, 0.22) for samples of B.W.W. and H.P.W. respectively (Tables I and II). It hints at the dependency of conductivity values on the chloride salts of iron. Similarly, a positive correlation can be observed for the selected anions (fluoride) and cations (calcium and magnesium) with total hardness. Hence, fluoride salts of these metals are contributing to the water hardness. Reasonably high positive r values (correlation > 0.8) can be observed between a good numbers parameter pairs. Existence of sulphates of Ca^{2+} and Mg^{2+} is clearly visible from significant values of correlation coefficients with EC and TDS. Determination of EC and TDS is quick and easy. Moreover, most of the other parameters are correlated with their values. Hence, groundwater quality can be easily monitored from EC and TDS values.

Table II The Correlation coefficient (r) values amongst different quality parameters of hand pump water

	EC	TDS	Turbidity	TA	TH	F^{-1}	Cl^{-1}	NO_2^-	NO_3^-	SO_4^{-2}	PO_4^{-3}	Ca^{+2}	Mg^{+2}	Na^{+1}	K^{+1}	Fe^{+2}	Mn^{+2}
pH	0.34	0.10	0.52	0.17	0.11	0.19	-0.01	-0.30	-0.68	-0.51	-0.18	-0.28	0.14	0.05	0.03	0.04	-0.33
EC		0.23	0.11	0.05	-0.05	0.42	-0.29	0.03	-0.17	-0.28	-0.36	0.23	-0.13	-0.39	0.27	-0.20	-0.21
TDS			0.02	-0.07	0.15	0.08	-0.42	0.31	-0.14	0.06	-0.09	0.39	-0.16	0.36	0.26	0.24	-0.47
Turbidity				0.02	0.08	0.22	-0.29	0.20	-0.45	-0.66	-0.04	-0.36	-0.33	0.22	-0.01	0.34	0.26
TA					0.16	-0.48	0.03	0.07	-0.06	0.06	-0.35	0.06	0.25	-0.05	-0.12	-0.19	-0.34
TH						-0.35	0.21	0.10	-0.03	-0.13	0.01	-0.14	0.17	0.05	-0.61	-0.17	-0.47
F^{-1}							-0.47	-0.16	-0.14	-0.09	0.02	0.14	0.15	-0.14	0.46	0.15	0.37
Cl^{-1}								-0.12	0.19	-0.04	0.29	-0.34	0.01	-0.04	-0.46	0.16	-0.13
NO_2^-									0.29	0.09	-0.10	0.01	-0.06	-0.06	-0.06	0.42	0.00
NO_3^-										0.49	0.09	-0.02	-0.24	-0.03	0.14	0.04	0.24
SO_4^{-2}											-0.33	0.08	0.01	0.13	0.29	-0.35	-0.21
PO_4^{-3}												-0.23	0.38	-0.03	-0.23	0.52	0.27
Ca^{+2}													-0.33	-0.15	0.29	-0.24	-0.21
Mg^{+2}														-0.31	-0.34	0.06	-0.25
Na^{+1}															0.26	0.37	-0.16
K^{+1}																0.02	0.02
Fe^{+2}																	-0.32

Table III Regression analysis values for some selected samples

	Bore well water samples				Hand pump water samples			
	a	**b**	**r**	**r^2**	**a**	**b**	**r**	**r^2**
EC-TDS	24586.85	0.57	0.99	0.98	15196.30	0.72	0.22	0.05
EC-TH	12962.97	0.31	-0.09	0.01	7667.23	0.36	0.04	0.00
F-Ca	10485.40	151.37	0.01	0.02	1582.80	34.20	-0.11	0.01
F-Mg	1311.03	18.96	0.16	0.02	842.98	18.21	-0.17	0.03
F-Na	6496.47	94.00	0.25	0.06	3645.85	78.72	-0.10	0.01
F-K	661.11	9.60	-0.19	0.02	86.22	1.84	0.50	0.25
F-Fe	20.44	0.29	0.18	0.03	34.85	0.02	-0.14	0.02
F-Mn	1.46	0.00	0.35	0.12	0.96	0.75	0.36	0.13
Fe-Cl	20.14	0.00	-0.27	0.07	34.91	0.01	0.15	0.02
Fe-NO3	20.41	0.46	-0.29	0.08	34.85	0.98	0.05	0.00

Influence of other quality parameters on fluoride

The linear regression analysis was carried out in limited couples of quality parameters of water. Regression analysis results are précised in Tables III, also presented the value of correlation coefficient (r), empirical parameters 'a' and 'b'. The inter dependence of fluoride on other quality parameters and vice – versa was studied using regression analysis. The results are presented in table III. Correlation studies were conducted on the obtained results. A close examination of the table shows that an overall positive correlation exists in almost all cases between the concentration of fluoride with all parameters, except EC, TDS and TH. The (+) ve correlation values suggest that they all have a direct influence on fluoride concentration.

Sample analysis report

From the present water management studies in Nalgonda mandal, the following conclusions can be derived. The pH values of all water samples are greater than 7.0, indicating the alkaline nature of water. However, all the pH values are within the acceptable bounds except in some samples. The EC values of the remaining samples are within the permissible limit. For two to three water samples of B.W.W. and H.P.W., TDS exceeds the permissible limit. However, values in the rest of the samples are below the red mark. In number of samples, highest degree of hardness was found. Such waters need to be softened to make them suitable for consumption by human beings. In some samples, higher values for alkalinity and turbidity were found which are far away from the permissible limit. High chloride contents were observed in 6 samples of bore wells water and in 7-samples hand pumps water. In many samples, values of Ca^{2+}, Mg^{2+} and K^{+} were above the permissible limit. Sodium concentration has exceeded the limit in all the samples. It is observed that fluoride content was found to be beyond the WHO limit in an almost all samples.

Biowaste for fluoride removal

Inspite of the high efficiency of the selected processes (electrodialysis, ion exchange, nanofiltration), they are very infrequently used in industrial plants, mainly due to their high operating costs. In view of low cost and ease of operation associated with adsorption process, it is the technique which is broadly accepted. As synthetic adsorbents are costly [16] and the usage of agricultural waste for removal of heavy metals is well established [11-15], activated carbons from biowaste can be customized for fluoride removal from potable water. Hence, activated carbons were prepared from the selected bio-waste materials and utilized them for defluoridation of the above collected water samples in batch process. The results indicate that, the prepared active carbons from biowaste are capable of defluoridation up to 70-80% (Figures 1 and 2). Hence, these adsorbents can be used for the defluoridation of potable water at domestic level.

C o n c l u s i o n s

Physicochemical parameters of water samples were statistically analysed. The effect of co-ions on the defluoridation process and their correlation co-efficient values were systematically calculated. The water sources were mostly found to be polluted. In some of the quality parameters, 90% of the collected samples are crossing the concerned rejection limits. Hence,

indicates their unfitness for drinking. Activated charcoals prepared from the present selected biowaste can be used for the defluoridation of potable water at domestic level.

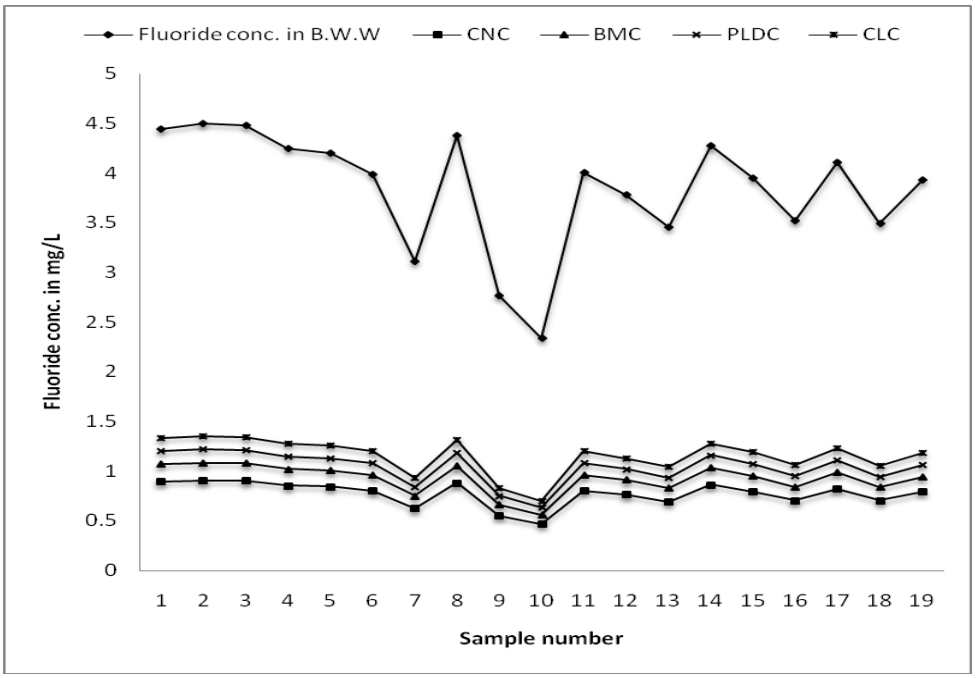

Fig. 1 Defluoridation of bore well water samples

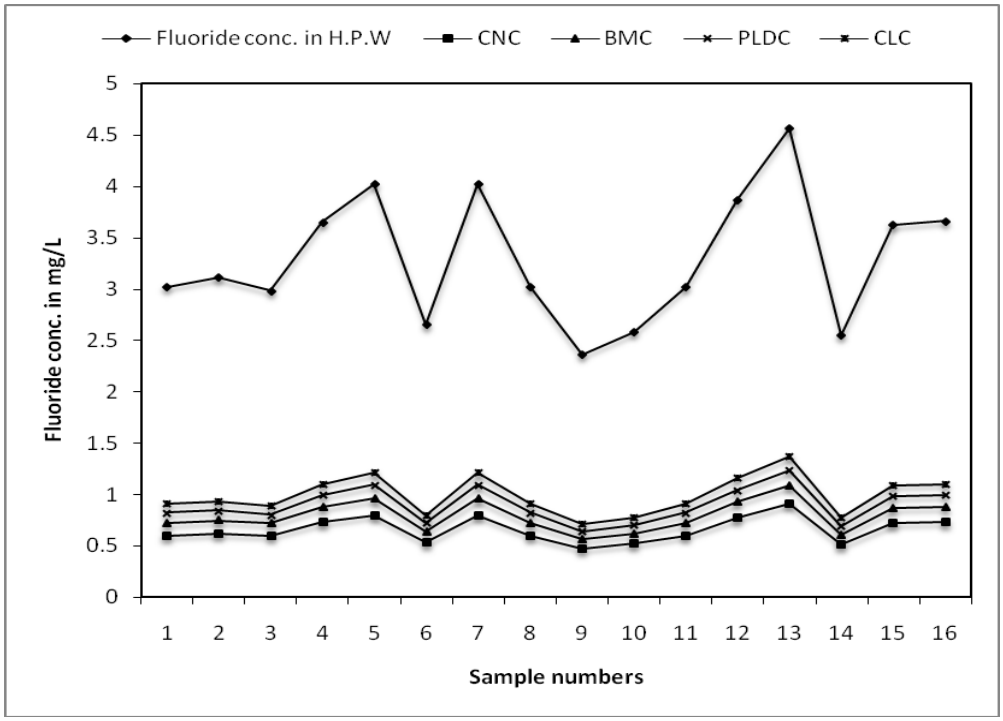

Fig 2 Defluoridation of hand pump water samples

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