ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Removal of Nitrate from Drinking and Irrigation Water by Phisico-Chemical Methods

Dave RS *[1], Acharya DG [2] and Machhar MT [3], and Patel AR[1]

[1] Department of Chemistry, Arts, Commerce, & Science College, Pilvai (North Gujarat) India.,
[2] Department of Chemistry, Sir P. T. Science College, Modasa (North Gujarat) India.,
[3] Department of Chemistry, J & J Science College, Nadiad (Gujarat) India.

ABSTRACT

In the present study an attempt has been made to examine the water quality of various potable water sources of drinking and irrigation water of Modasa taluka, North Gujarat. Some physico - chemical parameters of ground water have been studied. Nitrate was estimated by using standard methods reported earlier. BIS (Bureau of Indian Standard) has recommended a desirable limit of Nitrate is 45 mg/L as the safe limit. Four samples were showed the amount of nitrate very high whereas three samples were showed the amount of nitrate very low.
Keywords: Drinking and Irrigation water, Nitrate, Chemical activation, Physico chemical.

Corresponding author

INTRODUCTION

Nitrate is relatively non toxic but it can be reduced to nitrite in gastrointestinal tract by bacteria which is toxic. It absorbs in blood and reacts with hemoglobin leading to a diseases methaemoglobinaemia (blue baby syndrome). Methemoglobin does not act as oxygen carrier leads to cyanosis and hypoxia [1], nitrate reacts with gastric juice to form nitrosamines and these nitrosamines are responsible for carcinoma. The guideline value for nitrate of 50 mg/litre as nitrate is based on epidemiological evidence for methaemoglobinaemia in infants, which results from short-term exposure and is protective for bottle-fed infants and, consequently, other parts of the population. Several nitrogen compounds including ammonia, nitrites and nitrates have been frequently present in drinking water and various types of agricultural, domestic and industrial wastewater[2] specially nitrates can cause severe problems, including eutrophication and infection diseases, such as cyanosis and cancer of the alimentary canal[3]. Traditional methods for removal of nitrates from water include two main groups of treatment processes: biological and physicochemical. Biological denitrification is an eco-friendly and cost-effective method by which facultative anaerobic denitrifying bacteria reduce nitrate or nitrite into harmless nitrogen gas in the absence of oxygen. The biological denitrification process is slow, particularly for industrial wastewater containing high concentrations of nitrate and for low temperatures. The most conventional physico-chemical processes for nitrate removal are ion exchange, reverse osmosis, electrodialysis and adsorption [4]. Activated carbon produced from environmental waste with high carbon content is the most important material to clean environmental pollution (gases and liquid impurities). Environmental wastes are very important starting materials for preparing activated carbon. Various polymeric wastes, based on petroleum, agriculture by-product (ligno-cellulosic) and coals are commonly used as a starting material for preparing activated carbon [5].

In recent years, there has been considerable research concerning the preparation of low-cost activated carbon from agricultural wastes such as coconut shell, corn cob, hazelnut bagasse, palm shell, rice husk, cherry stone and apricot stones [6-16]. Sugar beet production and sugar industry have a very significant role in Turkey's agriculture industry. In Turkey, 13,000,000 tonnes of sugar beet were produced in 2007[17]. Sugar beet bagasse is the by-product of sugar production and large quantities of bagasse are obtained after sugar production [18-23].

In this study, an attempt has been made to examine the water quality of various potable water sources of drinking and irrigation water of Modasa taluka, North Gujarat. Some physico - chemical parameters of ground water have been studied.

METHODS AND MATERIALS

Chemicals and Reagent

Brucine- sufanilic acid solution: Dissolve 1 g brucine sulphate and 0.1 g of sulfanilic acid in about 70 ml of hot distilled water. After addition of 3 ml cone. HCL make up the volume to 100 ml. The pink colour develops slowly does not affect the sensitivity. Sulphuric acid solution: Add 500 ml conc. H_2SO in 125 ml distilled water and cool. Sodium chloride solution: Dissolve 300g NaCl in distilled water and cool.

Sodium arsenite solution: Dissolve 0.722 g of KNO_3 in distilled water and make up the volume to 1 litre. This solution contains 100 mg N/1. Dilute it to 100 times to prepare a solution having 1 mg N/1. Dilute it to 100 times to prepare a solution having 1 mg N/1 (10 →1000 ml.)

Procedure

Free chlorine interfaces with the nitrate determination. If the sample is having residual chlorine, remove it by addition of 0.05 ml (one drop) of sodium arsenite solution for each 0.1 mg of chlorine. Add one drop in excess to a 50 ml sample portion. Take 10 ml of sample portion. Put all the tubes in a wire rack. Place the rack in cool water bath and add 2 ml of NaCl solution. Add 10 ml of H_2SO_4 solution after mixing the contents thoroughly swirling by hand. Add 0.5 ml brucine reagent and mix thoroughly. Place the rack in a hot water bath with boiling water exactly for 20 minutes. Cool the contents again in cold water bath and take the reading the reading at 410 nm. Find out the concentration of NO_3 – N from the standard curve. Prepare a standard curve between concentration and absorbance by taking the dilutions from 0.1 to 1.0 mg N/1 at the interval of 0.1, employing the same procedures as for the sample.

Calculation

mg of N per L = mg N from standard curve × 1000 / ml of sample

mg/L nitrate =mg of N/L × 4.43

RESULTS AND DISCUSSION

Measurement of nitrate in drinking water of Modasa Taluka (North Gujarat).

Water samples were collected from different villages of modasa taluka, sabar-khantha district, North Gujarat and then analyzed by the standard methods reported earlier. The results obtained are depicted in the table 4.5 to 4.8 given below and graphically represented in figure 3.1 to 3.4.

Nitrate of Modasa Taluka

BIS (Bureau of Indian Standard) has recommended a desirable limit of Nitrate is 45 mg/L [169]. Indian drinking water quality standards states that a value of 45 mg/L of nitrate is considered as the safe limit. The higher concentration of nitrate can cause methaemoglobinemia, gastric cancer and birth defects.

Table 3.1: East zone of Modasa Taluka

No.	Source no.	Village	Source name	Nitrate
1	S1	Khali	Hp1	31.01
	S2	Khalikpur (I.W)	Tw1	32.98
2	S3	Dariyapur (D.W)	Hp1	24.87
	S4	Dariyapur (I.W)	Tw1	34.8
3	S5	Sankariya (D.W)	Hp1	11.07
	S6	Sankariya (I.W)	Tw1	93.03
4	S7	Zalodar (D.W)	Hp1	34.8
	S8	Zalodar (I.W)	Tw1	32.7
5	S9	Faredi (D.W)	Hp1	32.7
	S10	Faredi (I.W)	Tw1	34.8
6	S11	Badodara (D.W)	Hp1	34,8
	S12	Badodara (I.W)	Tw1	35,9
7	S13	Surpur (D.W)	Hp1	90.81
	S14	Surpur (I.W)	Tw1	87.09
8	S15	Shinavad (D.W)	Hp1	24.30
	S16	Shinavad (I.W)	Tw1	23.8
9	S17	Munshiwada (D.W)	Hp1	199.36
	S18	Munshiwada (I.W)	Tw1	198.5
10	S19	Valavata (D.W)	Hp1	34,9
	S20	Valavata (I.W)	Tw1	43,8
11	S21	Hafsabad (D.W)	Hp1	32.9
	S22	Hafsabad (I.W)	Tw1	23.8
12	S23	Sayara (D.W)	Hp1	23.8
13	S24	Kuna (D.W)	Hp1	21.9
14	S25	Mora (D.W)	Hp1	42,8
15	S26	Vaniyad (D.W)	Hp1	93.03

ISSN: 0975-8585

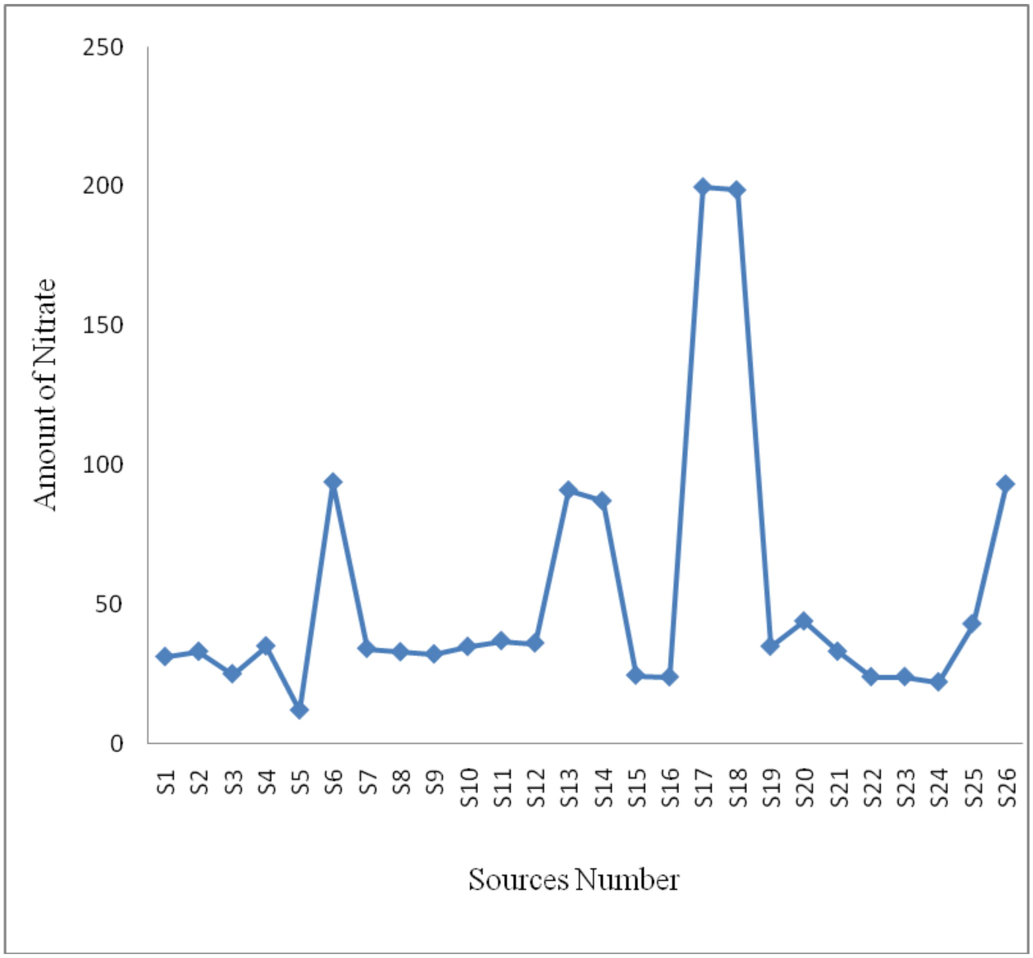

Fig 3.1: Nitrate of East-Zone of Modasa Taluka

Table 3.2: West zone of Modasa Taluka

No.	Source no.	Village	Source name	Nitrate
16	S27	Sabalpur (D.W)	Hp1	11.0
	S28	Sabalpur (I.W)	Tw1	12.59
17	S29	Modasa (D.W)	Hp1	15.6
	S30	Modasa (I.W)	Tw1	66.65
18	S31	Pahadpur (D.W)	Hp1	23.5
	S32	Pahadpur (I.W)	Tw1	21.6
19	S33	Jitpur (D.W)	Hp1	90.51
	S34	Jitpur (I.W)	Tw1	92.6
20	S35	Khadoda (D.W)	Hp1	12.7
	S36	Khadoda (I.W)	Tw1	32.6
21	S37	Galsundra (D.W)	Hp1	32.6
	S38	Galsundra (I.W)	Tw1	3.5
22	S39	Limbhoi (D.W)	Hp1	77.56
	S40	Limbhoi (I.W)	Tw1	80.5
23	S41	Khumapur (D.W)	Hp1	12.5
	S42	Khumapur (I.W)	Tw1	11.5
24	S43	Chichan (D.W)	Hp1	152.58

	S44	Chichan (I.W)	Tw1	150.65
25	S45	Vantada (D.W)	Hp1	34.5
	S46	Vantada (I.W)	Tw1	21.4
26	S47	Gadha (D.W)	Hp1	152.84
	S48	Gadha (I.W)	Tw1	153.6
27	S49	Itadi (D.W)	Hp1	43.5
	S50	Itadi (I.W)	Tw1	44.5
28	S51	Bayal (D.W)	Hp1	117.59
	S52	Bayal (I.W)	Tw1	119.5
29	S53	Dhankhrol (D.W)	Hp1	110.6
	S54	Dhankhrol (I.W)	Tw1	108.6
30	S55	Kishorpura (D.W)	Hp1	12.5
	S56	Kishorpura (I.W)	Tw1	12.4
31	S57	Jashwantpura (D.W)	Hp1	34.5
32	S58	Amodarda (D.W)	Hp1	32.4
33	S59	Ramosh (D.W)	Hp1	230.66
34	S60	Kidi (D.W)	Hp1	41.6
35	S61	Lalpur (D.W)	Hp1	21.5
36	S62	Kashipur (D.W)	Hp1	32.6
37	S63	Rampur (D.W)	Hp1	12.6

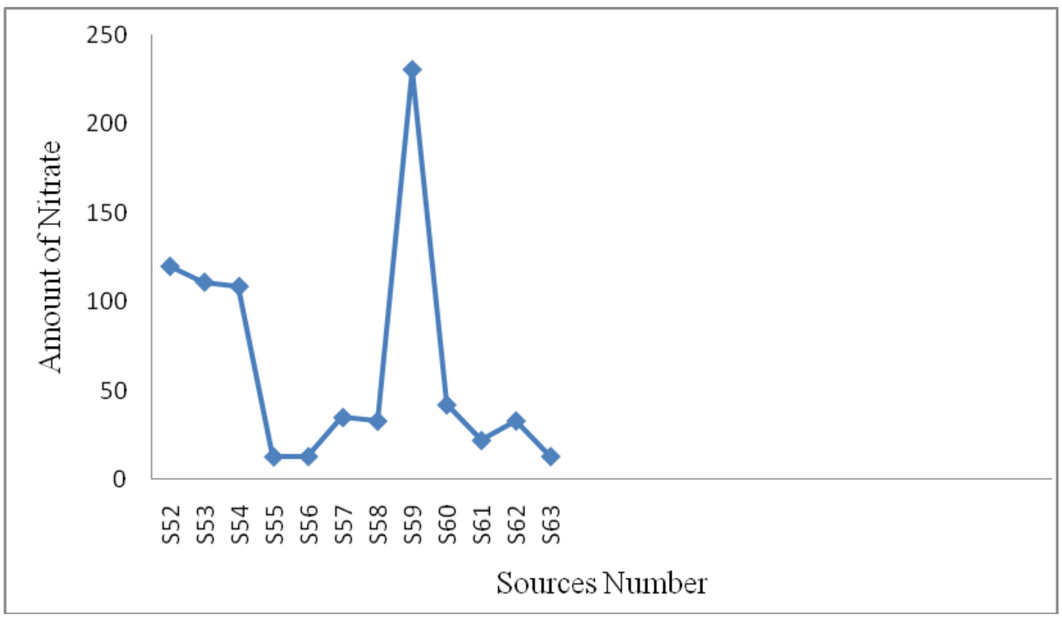

Fig 3.2 a: Nitrate of West-Zone of Modasa Taluka.

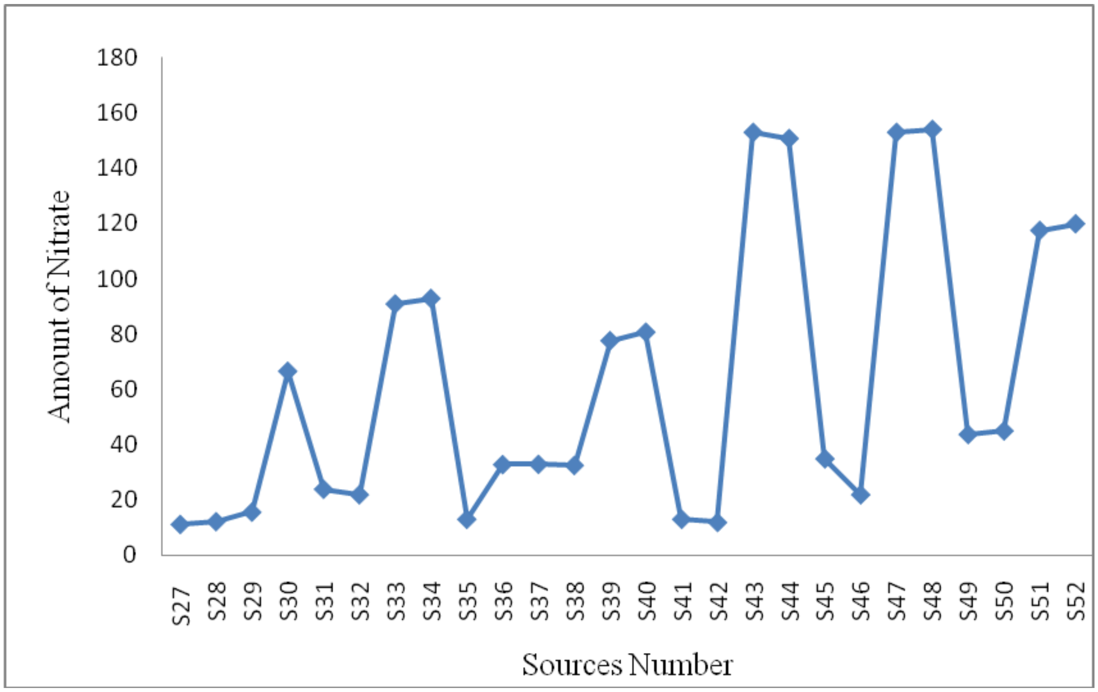

Fig. 3.2 b: Nitrate of West-Zone of Modasa Taluka.

Table 3.3: North Zone Of Modasa Taluka

No.	Source No.	Village	Source Name	Nitrate
38	S64	Bajkot (D.W)	Hp1	55.37
39	S65	Ganeshpur (D.W)	Hp1	23.9
	S66	Ganeshpur (D.W)	Tw1	34.9
40	S67	Palanpur (D.W)	Hp1	32.9
	S68	Palanpur (I.W)	Tw1	34.7
41	S69	Sabalpur (D.W)	Hp1	11.07
	S70	Sabalpur (I.W)	Tw1	12,6
42	S71	Rasulpur (D.W)	Hp1	21.9
	S72	Rasulpur (I.W)	Tw1	31.9
43	S73	Khumapur (D.W)	Hp1	22.9
	S74	Khumapu (I.W)	Tw1	23.0
44	S75	Rakhiyal (D.W)	Hp1	32.0
	S76	Rakhiyal (I.W)	Tw1	31.5
45	S77	Medhasan (D.W)	Hp1	21.9
	S78	Medhasan (I.W)	Tw1	34.8
46	S79	Khambhisar(D.W)	Hp1	130.68
	S80	Khambhisar (I.W)	Tw1	142.7
47	S81	Shampur (D.W)	Hp1	34.9
	S82	Shampur (I.W)	Tw1	32.0
48	S83	Gadhda (D.W)	Hp1	152.83
	S84	Gadhda (I.W)	Tw1	145.9
49	S85	Davali (D.W)	Hp1	97.46
	S86	Davali (I.W)	Tw1	92.6
50	S87	Salampur (D.W)	Hp1	34.0

	S88	Salampur (I.W)	Tw1	32.0
51	S89	Tintisar (D.W)	Hp1	32.9
	S90	Tintisar (I.W)	Tw1	32.5
52	S91	Sajapur (D.W)	Hp1	34.9
	S92	Sajapur (I.W)	Tw1	34.9
53	S93	Gokharva (D.W)	Hp1	32,8
	S94	Gokharva (I.W)	Tw1	34.9
54	S95	Mahadevgram(D.W)	Hp1	66.45
	S96	Mahadevgram(I.W)	Tw1	67.9
55	S97	Gajan (D.W)	Hp1	68.66
	S98	Gajan (I.W)	Tw1	70.9
56	S99	Malya (D.W)	Hp1	43.0
	S100	Malya (I.W)	Tw1	34.0
57	S101	Bhatkota (D.W)	Hp1	32.0
	S102	Bhatkota (I.W)	Tw1	23.9
58	S103	Bhachdiya(D.W)	Hp1	12.9
59	S104	Vantada(D.W)	Hp1	21.0
60	S105	Padar (D.W)	Hp1	84.17
61	S106	Lalpur (D.W)	Hp1	43.0
62	S107	Sardoi (D.W)	Hp1	42.0
63	S108	Bolundra(D.W)	Hp1	83.78
64	S109	Bamanvad(D.W)	Hp1	84.17
65	S110	Varthu (D.W)	Hp1	93.03
66	S111	Motipur (D.W)	Hp1	34.9
67	S112	Dadhaliya (D.W)	Hp1	12.1
68	S113	Hathipur (D.W)	Hp1	32,9
69	S114	Umedpur (D.W)	Hp1	31,9
70	S115	Madhupur(D.W)	Hp1	77.52
71	S116	Jambusar (D.W)	Hp1	53,16

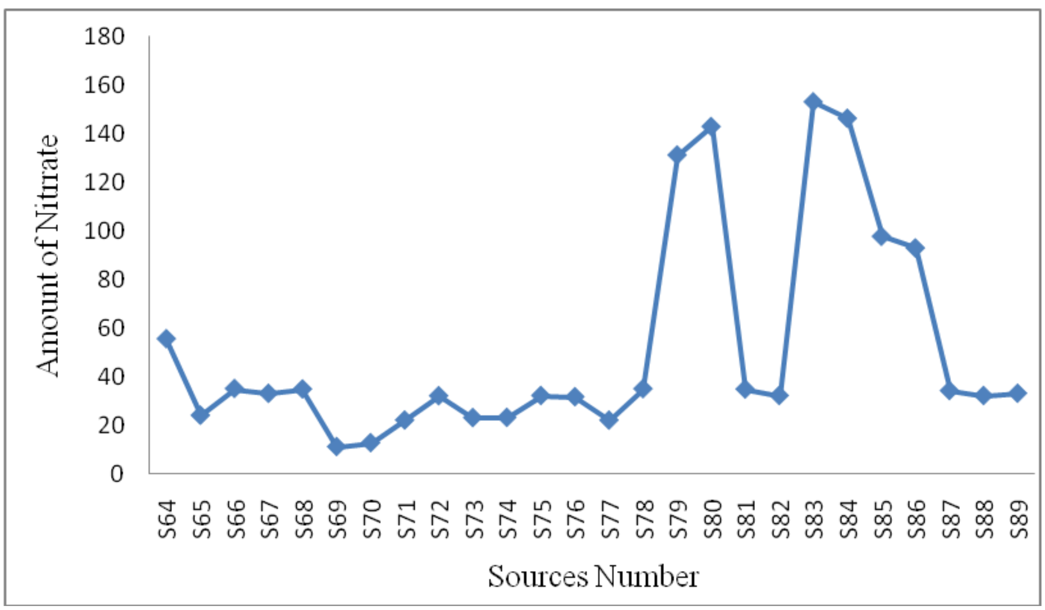

Fig 3.3 a: Nitrate of North-Zone,Modasa Taluka

ISSN: 0975-8585

Table 3.4: South Zone Of Modasa Taluka

No.	Source No.	Village	Source Name	Nitrate
72	S117	Bhlkuwa (D.W)	Hp1	32.8
	S118	Bhlkuwa (I.W)	Tw1	41.67
73	S119	Futa (D.W)	Hp1	23.6
	S120	Futa (I.W)	Tw1	32.8
74	S121	Jeevanpur(D.W)	Hp1	Nil
	S122	Jeevanpur (I.W)	Tw1	Nil
75	S123	Jitpur (D.W)	Hp1	90.68
	S124	Jitpur (I.W)	Tw1	94.59
76	S125	Rajpur (D.W)	Hp1	84.16
	S126	Rajpur (I.W)	Tw1	87.37
77	S127	Motivav (D.W)	Hp1	33.50
	S128	Motivav (I.W)	Tw1	33.57
78	S129	Borvai (D.W)	Hp1	31.5
	S130	Borvai (I.W)	Tw1	32.5
79	S131	Nanivav (D.W)	Hp1	33.35
	S132	Nanivav (I.W)	Tw1	34.44
80	S133	Buta (D.W)	Hp1	34.05
	S134	Butal (I.W)	Tw1	35.86
81	S135	Jamth (D.W)	Hp1	32.94
	S136	Jamtha (I.W)	Tw1	34.85
82	S137	Dolpur (D.W)	Hp1	81.96
	S138	Dolpur (I.W)	Tw1	86.24
83	S139	Bhesawada(D.W)	Hp1	32.6
	S140	Bhesawada(I.W)	Tw1	31.6
84	S141	Antisara (D.W)	Hp1	32.6
	S142	Antisara (I.W)	Tw1	31.5
85	S143	Rahiyol l(D.W)	Hp1	41.4
	S144	Rahiyol(I.W)	Tw1	42.5
86	S145	Garudi (D.W)	Hp1	45.4
	S146	Garudi (I.W)	Tw1	45.5
87	S147	Kolikhad(D.W)	Hp1	42.5
	S148	Kolikhad (I.W)	Tw1	43.5
89	S149	Alampur (D.W)	Hp1	23.4
	S150	Alampur (I.W)	Tw1	32.5
90	S151	Bherunda (D.W)	Hp1	32.6
	S152	Kolvada (D.W)	Hp1	43.5
91	S153	Rupan (D.W)	Hp1	11.47
	S154	Malekpur(D.W)	Hp1	23.5
92	S155	Ramana (D.W)	Hp1	32.6
93	S156	Bordi (D.W)	Hp1	32.5
94	S157	Kau (D.W)	Hp1	34.6
95	S158	Amlai (D.W)	Hp1	84.47
96	S159	Dugarwada(D.W)	Hp1	42.4
97	S160	Mathasuriya(D.W)	Hp1	45.5

98	S161	Antisara (D.W)	Hp1	42.4
99	S162	Khilodiya (D.W)	Hp1	32.50
100	S164	Alva (D.W)	Hp1	21.6
101	S165	Shika (D.W)	Hp1	43.59

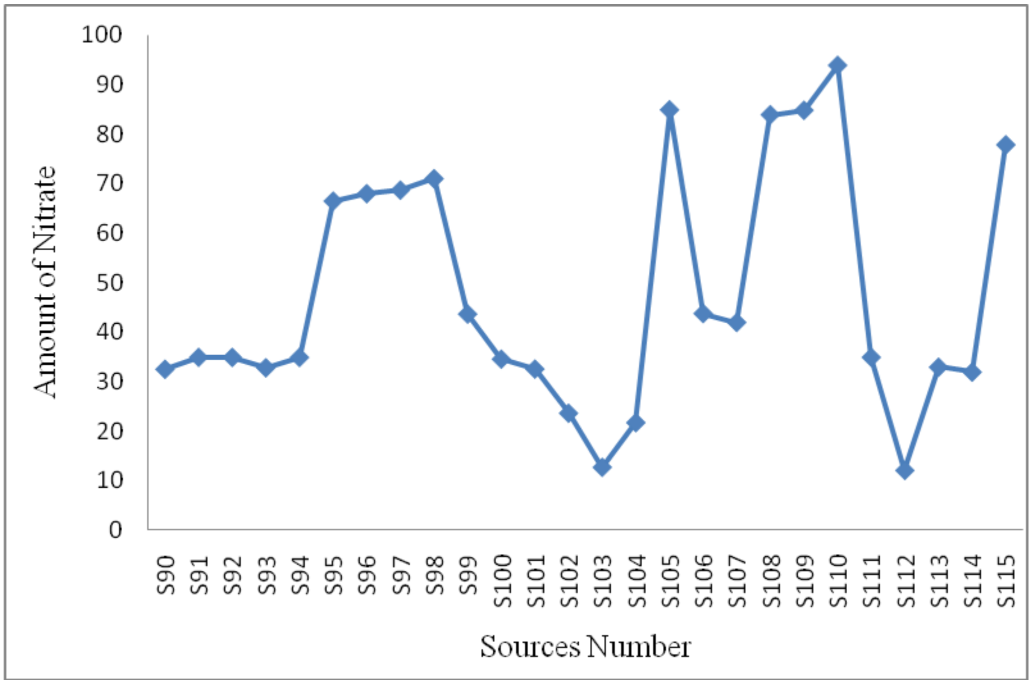

Fig 3.3 b: Nitrate of North-Zone,Modasa Taluk

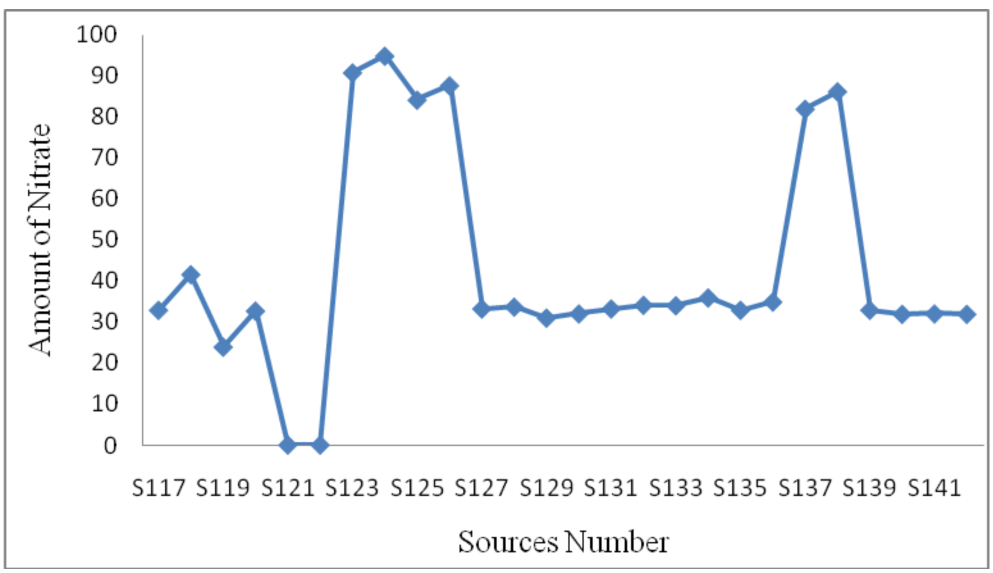

Fig 3.4 a: Nitrate of South-Zone,Modasa Taluka

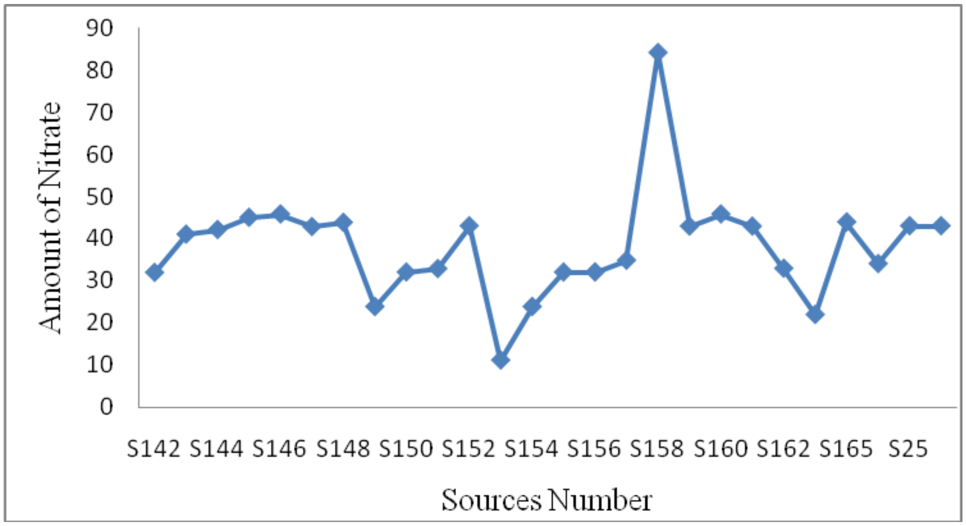

Fig 3.4 b: Nitrate of South-Zone,Modasa Taluka

The highest concentration of Nitrate was recorded 199.86 mg/L in drinking water at locality no. S-17 (see table no.-4.5 & fig. no-4.5), 198.8 mg/L in irrigation water at locality no. S-18 (see table no-4.5 & fig. no-4.5) , 230.36mg/L in drinking water at locality no.S-59 (see table no-4.6 & fig. no-4.6a) in the year 2007-08.

The lowest concentration of Nitrate was recorded zero 0.0 mg/L in drinking water at locality no. S-121 (see table no-4.8 & fig. no-4.8a), zero 0.0 mg/L in irrigation water at locality no. S-122 (see table no-4.8 & fig. no-4.8a), 12.8 mg/L in drinking water at locality no. S-103 is (see table no-4.7 & fig. no-4.7b) in the year 2007-08.

ACKNOWLEDGEMENT

The authors are thankful to Arts, Science & Commerce College, Pilvai (North Gujarat) for providing laboratory facilities. Thank to the University Grants commission, New Delhi, India. for providing financial support in form of Minor Research Project.

REFERENCES

[1] Guidelines, US National Research Council 1995.
[2] Azevedo DCS, Araujo CSJ, Bastos-Neto M, Torres E, Jaguaribe EF, Cavalcante CL. Micropor Mesopor Mater 2007; 100:361–364.
[3] Baskar CA. J Hazard Mater 2006; 135:232–241.
[4] Bhatnagar A, Ji M, Choi Y, Jung W, Lee S, Kim S, Lee G, Suk H, Kim H, Min B, Kim S, Jeon B, Joon-Wun Kang J. Sep Sci Tech 2008; 43:886–907.
[5] Chatterjee S, Woo SH. J Hazard Mater 2009; 164 (2–3): 1012–1018.
[6] Daud WMAW, Ali WSW. Bioresour Tech 2004; 93:63–69.
[7] Demiral H, Demiral I, Tumsek F, Karabacakog˘lu B. Surf Inter Anal 2008a; 40(3–4): 616–619.

[8] Demiral H, Demiral I, Tumsek F, Karabacakogˇlu B. Chem Eng J 2008b; 144; 188–196.
[9] Karim MM, Dasa AK, Lee SH. Anal Chim Acta 2006; 576:37–42.
[10] Marin O, Fernandez-Gonzalez C, Macias-Garcia A, Gomez-Serrano V. App Surf Sci 2006a; 252:5980–5983.
[11] Marin O, Fernandez-Gonzalez C, Macias-Garcia A, Gomez-Serrano V. App Surf Sci 2006b; 252:5967–5971.
[12] Onal Y, Bas_ar CA, Ozdemir CS, Erdogˇan S. J Hazard Mater 2007; 142: 138–143.
[13] Ozturk N, Bektas TE. J Hazard Mater 2004; B112:55–162.
[14] Qian Q, Machida M, Tatsumoto H. Bioresour Tech 2007; 98:353–360.
[15] Sudaryanto Y, Hartono SB, Irawaty W, Hindarso H, Ismadji S. Bioresour Tech 2006; 97:734–739.
[16] Tan IAW, Ahmad AL, Hameed BH. J Hazard Mater 2008; 154:337–346.
[17] Turkish Statistical Institute, Turkstat, 2008. Available from: <http:// www.turkstat.gov.tr>.
[18] Tay JH, Chen XG, Jeyaseelan S, Graham N. Chemosphere 2001; 44: 45–51.
[19] Wang S, Li L, Wu H, Zhu ZH. J Colloid Interf Sci 2005; 292:336–343.
[20] Wang Y, Gao BY, Yue WW, Yue QY. Colloids Surf 2007; A 308:1–5.
[21] Yang T, Lua AC. Mater Chem Phys 2006; 100:438–444.
[22] Youssef AM, Radwanb NRE, Abdel-Gawadb I, Singerc GAA. Colloids Surf A: Physicochem Eng Aspects 2005; 252:143–151.
[23] Demiral H, Gündüzogˇlu G. Biores Technol 2010; 101:1675–1680.