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Effects of Some Environmental Factors on Release of Chloride to Overlying Water from Selective Fertilized Soil of Udaipur District, Rajasthan

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Abstract: ***The range of chloride in the experimental medium maintained at higher temperature of 32° C varied between 0.0 to 25.0 ppm in both black and red soils. In the red soil the average per hour release was 1.235 while in the black soil the same was 1.123 ppm. As regards the experiments as the lower temperature, the values are more than that of higher Temperature (0.0 to 60.0/40.0 ppm) in the case of red and black soils respectively. The per hour release in both the soils was however, higher (1.842 for red soil and 1.561 ppm in black) than in the experiments at elevated temperature of 32° C. The percentage drop was 15.26% in black soil in relation to red (Table 7.2, Fig 7.3 and 7.4). The per hour release being 1.460 in red while, 0.786 ppm in the black soil (Fig 7.5 and 7.6). In the alkaline pH the results were matching, the average per hour release being 0.449 for red and 0.561 ppm for black soil (Table 7.4, Fig 7.7 and 7.8). The per hour release in the lux values of 565 and 590 varied between 0.0 to 33.0 ppm in red soil and between 0.0 to 28.0 ppm in black soil. In the case of the lux value of 6000, the chloride release obtained was 0.0 to 30.0/25.0 ppm in the two soils. As regard the percentage drop in average per hour release was more in black soil with 15 and 60 watt bulbs (590 and 3900 lux), while the same was more in red soil being 15.96 with 6000 lux and only 0.32% in 6500 lux. The average per hour release of chloride in the case of black was 1.786 in relation to 1.741 ppm of red soil. The percentage drop in average per hour release of chloride was 9.07 in black soil in relation to red soil. The percentage drop in average per hour release of chloride was 15.26 in black soil in relation to red. The chlorides are the salts resulting from the combination of the chlorine with other metallic ions. But in the case of 6000 lux the chloride release was low and in the case of 3900 lux the chloride release was again high. In nature, the higher illumination would initiate higher photosynthetic release of oxygen, which may also be playing role in more chloride release.***

Keywords: Temperature, pH, Turbation

1. Introduction

The behaviour of chloride in natural water is of subdued nature in comparison to that of major nutrients. Chlorides have little role in oxidation - reduction processes in the aquatic medium. They do not form important solutes with other ions unless of significantly higher occurrence. Chlorides do not have any biochemical role to play. Normally, though present in all natural waters, their concentration is low. The higher chloride occurrence is related to the presence of chlorite bearing rocks or crystalline rocks (Gambell and Fisher, 1966) and as such, is invariably more in ground water. It also occurs through anthropogenic activities such as release of sewage and industrial effluents in the wild waters. Contribution of rains especially in the coastal regions is reported to be another cause of higher chloride in the fresh water by some workers (Sutcliffe and Carrick, 1983ab; and Lesack and Melack, 1991). However, some workers do not agree substantially with this hypothesis (Hem, 1991). The air borne chloride has been reported in arid regions which subsequently get dissolved in the surface waters (Yaalon, 1961). Chloride ions are associated either with calcium, magnesium or sodium, the latter being of great significance.

2. Experimental results

Temperature: Table 7.1 indicates that the range of chloride in the experimental medium maintained at higher temperature of 32° C varied between 0.0 to 25.0 ppm in both black and red soils. In between the two soils there was no much difference in the readings obtained. In the red soil the average per hour release was 1.235 while in the black soil the same was 1.123 ppm. This works out to 9.07% lesser in black soil than that of red. Graphical representation of the data is depicted in Fig.7.1 while, the statistical treatment is shown in the Fig.7.2. As regards the experiments as the lower temperature, the values are more than that of higher Temperature (0.0 to 60.0/40.0 ppm) in the case of red and black soils respectively. The per hour release in both the soils was however, higher (1.842 for red soil and 1.561 ppm in black) than in the experiments at elevated temperature of 32° C. The percentage drop was 15.26% in black soil in relation to red (Table 7.2, Fig 7.3 and 7.4).

pH (Hydrogen ion concentration): At the acidic pH 4.5 (Table 7.3), chloride in both the soils varied between 0.0 to 65.0 ppm. The highest value of 65.0 ppm was obtained in red soil. The per hour release being 1.460 in red while, 0.786 ppm in the black soil (Fig 7.5 and 7.6). The percentage drop was 46.17 in black soil in relation to red. In the alkaline pH the results were matching, the average per hour release being 0.449 for red and 0.561 ppm for black soil (Table 7.4, Fig 7.7 and 7.8). The percentage drop was 19.97 in red soil in relation to black. It would be noticed from the Tables 7.3 and 7.4 that the occurrence of 'nil' release was fairly common in the present sets of experiments on the variable "hydrogen ion concentration".

Photic intensity: The comparison of all the photic variables viz; 15, 60, 100 and 200 watt bulbs giving lux values ranging from 565 to 6500 indicates that significant difference exists amongst the readings obtained with all

variables. The per hour release in the lux values of 565 and 590 varied between 0.0 to 33.0 ppm in red soil and between 0.0 to 28.0 ppm in black soil. In 3800 and 3900 lux the same ranged between 0.0 to 38.0 ppm in red and 0.0 to 40.0 ppm in black soil. In the case of the lux value of 6000, the chloride release obtained was 0.0 to 30.0/25.0 ppm in the two soils. At 6500 lux, values ranged between 3.0 to 45.0 ppm in red and 5.0 to 48.0 ppm in black soil. As regards average per hour release the same was found to be highest with 6500 lux lowest with 565 lux. From the study of all Tables (7.5 to 7.8) it would be seen that while, there is a continued rise in the release from lowest to highest intensity, there is a drop at the intensity of 6000 lux (100 watt bulb). This is inexplainable, and need further experimentation (Tables 7.5 to 7.8 and Fig.7.9 to 7.16). As regard the percentage drop in average per hour release was more in black soil with 15 and 60 watt bulbs (590 and 3900 lux), while the same was more in red soil being 15.96 with 6000 lux and only 0.32% in 6500 lux. The latter observation thus needs further confirmation.

Turbation: With the variable of turbation the situation of chloride release was marginally same in both the soils. However, the black soil indicated a slightly higher level of release in comparison to red. The average per hour release of chloride in the case of black was 1.786 in relation to 1.741 ppm of red soil. However, when the serial readings of two soils are compared, there are intermittent ups and downs in the readings pattern. The percentage drop was 2.52 in red soil in relation to black. In general it is felt that turbation does play part in pushing up the chloride release.

3. Discussion

The chlorides are the salts resulting from the combination of the chlorine with other metallic ions. Chlorine alone is very toxic (Cl2) however, when combined with other metallic ions such as magnesium and sodium it becomes essential to life, especially with sodium ions. Chlorides are known to be essential for normal cell function (Franzen Dave, Tech file - obtained from internet). Chloride is also useful as a charge balancing ions for turgor, keeping plant cells free of infection by disease and is also essential for photosynthesis. Chlorides are also considered as contaminants of fresh waters. When in high quantities it may become lethal to fish and other aquatic life. As stated earlier the sources of chlorides are leaching from chlorite bearing rocks, agricultural runoff, industrial wastewater, oil well waste, waste water treatment plants and road salts. In normal waters the chlorides rarely exceed 500 mg/l. In Udaipur the chloride values have been reported to range 7.3 to 38.9 ppm in surface waters (Sharma, 1980). In ground waters the lowest and highest values are reported to be 57.00 and 1234 ppm respectively (Agrawal and Jagetia, 1997). There is no significant difference in the average per hour release of chloride between two soils, taking into account all the readings of different experiments. From the data presented above, it appears that the release of chlorides is dependent on photic intensity. Higher the photic intensity, higher is the release. But in the case of 6000 lux the chloride release was low and in the case of 3900 lux the chloride release was again high. This however needs further confirmation as already stated earlier. It is felt that in nature this higher release of chloride at elevated intensities is related to increased metabolism in the lake system. Probably, this is due to the indirect increase in temperature brought about by increased illumination. In nature, the higher illumination would initiate higher photosynthetic release of oxygen, which may also be playing role in more chloride release. Further, it needs to be mentioned here that the release of chloride is not related to sediment water interface and the redox potential. It is directly soluble in water from a source such as organic matter and chlorite bearing rocks.

Table 7.1: Chloride levels under different simulated temperature and conditions
Variable - Heating (32^{o}C)

Red soil		Black soil	
Periodicity of reading (hours)	Chloride in ppm	Periodicity of reading (hours)	Chloride in ppm
48	5.0	24	5.0
50	15.0	26	5.0
52	10.0	28	5.0
76	0.0	52	10.0
78	10.0	54	5.0
80	0.0	56	15.0
104	5.0	80	5.0
106	20.0	82	25.0
108	25.0	84	5.0
132	10.0	108	10.0
134	0.0	110	0.0
136	10.0	112	10.0
Average per hour	1.235	Average per hour	1.123

Table 7.2: Chloride levels under different simulated temperature conditions
Variable - Heating (32^{o}C)

Red soil 4^{0}C		Black soil 5^{0}C	
Periodicity of reading (hours)	Chloride in ppm	Periodicity of reading (hours)	Chloride in ppm
48	60.0	24	40.0
50	8.0	26	3.0
52	0.0	28	0.0
76	20.0	52	3.0
78	10.0	54	5.0
80	8.0	56	0.0
104	20.0	80	38.0
106	0.0	82	0.0
108	0.0	84	0.0
132	13.0	108	20.0
134	25.0	110	25.0
136	0.0	112	5.0
Average per hour	1.842	Average per hour	1.561

Table 7.3: Chloride levels under different simulated pH conditions
Variable – Acidic pH 4.5

Red soil		Black soil	
Periodicity of reading (hours)	Chloride in ppm	Periodicity of reading (hours)	Chloride in ppm
48	65.0	24	50.0
50	0.0	26	0.0
52	0.0	28	0.0
76	0.0	52	0.0
78	0.0	54	0.0
80	5.0	56	0.0
104	10.0	80	0.0
106	0.0	82	0.0

108	10.0	84	0.0
132	40.0	108	20.0
134	0.0	110	0.0
136	0.0	112	0.0
Average per hour	1.460	Average per hour	0.786

The percentage drop in average per hour release of chloride was 46.17 in black soil in relation to red.

Table - 7.4: Chloride levels under different simulated pH conditions
Variable – Alkaline pH 9.0

Red soil		Black soil	
Periodicity of reading (hours)	Chloride in ppm	Periodicity of reading (hours)	Chloride in ppm
48	0.0	24	0.0
50	15.0	26	5.0
52	0.0	28	10.0
76	0.0	52	0.0
78	0.0	54	0.0
80	0.0	56	0.0
104	0.0	80	0.0
106	0.0	82	10.0
108	0.0	84	0.0
132	0.0	108	0.0
134	15.0	110	10.0
136	10.0	112	15.0
Average per hour	0.449	Average per hour	0.561

The percentage drop in average per hour release of chloride was 19.97 in red soil in relation to black.

Table 7.5: Chloride levels under different simulated photic conditions
Variable - Photic intensity (15 watt bulb)

Red soil		Black soil	
Periodicity of reading (hours)	Chloride in ppm	Periodicity of reading (hours)	Chloride in ppm
48	3.0	24	13.0
50	10.0	26	0.0
52	0.0	28	0.0
76	13.0	52	25.0
78	33.0	54	28.0
80	20.0	56	23.0
104	0.0	80	3.0
106	8.0	82	10.0
108	0.0	84	0.0
132	13.0	108	15.0
134	0.0	110	0.0
136	0.0	112	0.0
Average per hour	1.123	Average per hour	1.314

The percentage drop in average per hour release of chloride was 14.54 in red soil in relation to black.

Table 7.6: Chloride levels under different simulated photic conditions
Variable - Photic intensity (60 watt bulb)

Red soil		Black soil	
Periodicity of reading (hours)	Chloride in ppm	Periodicity of reading (hours)	Chloride in ppm
48	28.0	24	28.0
50	8.0	26	0.0
52	0.0	28	5.0
76	38.0	52	23.0
78	3.0	54	40.0
80	30.0	56	35.0
104	0.0	80	25.0
106	13.0	82	30.0
108	13.0	84	25.0
132	28.0	108	30.0
134	23.0	110	18.0
136	15.0	112	5.0
Average per hour	2.539	Average per hour	2.966

The percentage drop in average per hour release of chloride was 14.40 in red soil in relation to black.

Table 7.7: Chloride levels under different simulated photic conditions
Variable - Photic intensity (100 watt bulb)

Red soil		Black soil	
Periodicity of reading (hours)	Chloride in ppm	Periodicity of reading (hours)	Chloride in ppm
48	30.0	24	25.0
50	20.0	26	0.0
52	0.0	28	12.0
76	2.0	52	0.0
78	7.0	54	2.0
80	5.0	56	12.0
104	8.0	80	13.0
106	22.0	82	10.0
108	0.0	84	7.0
132	0.0	108	8.0
134	20.0	110	7.0
136	30.0	112	25.0
Average per hour	1.617	Average per hour	1.359

The percentage drop in average per hour release of chloride was 15.96 in black soil in relation to red.

Table 7.8: Chloride levels under different simulated photic conditions
Variable - Photic Intensity (200 watt bulb)

Red soil		Black soil	
Periodicity of reading (hours)	Chloride in ppm	Periodicity of reading (hours)	Chloride in ppm
48	25.0	24	15.0
50	3.0	26	18.0
52	3.0	28	5.0
76	30.0	52	43.0
78	10.0	54	8.0
80	25.0	56	28.0
104	45.0	80	48.0
106	30.0	82	30.0
108	30.0	84	18.0
132	38.0	108	45.0
134	40.0	110	18.0
136	33.0	112	35.0
Average per hour	3.505	Average per hour	3.494

The percentage drop in average per hour release of chloride was 0.32 in black soil relation to red.

Table 7.9: Chloride levels under simulated turbation condition Variable - turbulence

Red soil		Black soil	
Periodicity of reading (hours)	Chloride in ppm	Periodicity of reading (hours)	Chloride in ppm
48	5.0	24	25.0
50	10.0	26	10.0
52	0.0	28	8.0

76	20.0	52	23.0
78	18.0	54	15.0
80	15.0	56	10.0
104	28.0	80	15.0
106	23.0	82	13.0
108	23.0	84	15.0
132	0.0	108	0.0
134	13.0	110	10.0
136	0.0	112	15.0
Average per hour	1.741	Average per hour	1.786

The percentage drop in average per hour release of chloride was 2.52 in red soil in relation to black.

4. Result

The percentage drop in average per hour release of chloride was 9.07 in black soil in relation to red soil. The percentage drop in average per hour release of chloride was 15.26 in black soil in relation to red.