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A study of effectiveness of an inorganic heterocycle $(S_6N_4)^{2+}$ Cl_2^- in reclamation of acidic soil of Andaman and Nicobar islands

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ABSTRACT

Cyclohexa thiazenium chloride $(S_6N_4)^{2+}Cl_2^-$ has been tested against varying pH 3 – 4.5 of acidic soil of Andaman and Nicobar islands. It has been observed that there were remarkable increase in pH 7.4 in normal time.

Key words: Cyclohexa thiazenium chloride, acidic soil, PM

INTRODUCTION

The soil of Andaman and Nicobar islands is affected by the halogen salts of alkali metals. The major content of the salt adsorbed on the land surface is leached out by heavy rainwater. Even though few contents of the salt remain adsorbed on the soil resulting the soil to be acidic. Few inorganic hetercyclics like tetrasulphurtetranitride (S_4N_4), thiotrithiazyl chloride $(S_4N_3)^+Cl^-$ have been successfully tested in reclamation of alkaline (Sharma, 1986, 2000) as well as acidic (Sharma, 1994) and to reclame alkaline soil (Sharma *et al*, 1994) has already been investigated. To explore the further utility of $(S_6N_4)^{2+}Cl_2^-$ in agriculture, a study of effectiveness of $(S_6N_4)^{2+}Cl_2^-$ on varying pH of acidic soil of Andaman and Nicobar islands is being presented here.

MATERIAL AND METHODS

$(S_6N_4)^{2+}Cl_2^-$ was prepared (Goehring, 1957) by refluxing S_2Cl_2 and NH_4Cl in nitromethane. The sequence of reaction in the preparation are:

$$[S_3N_2Cl]^+Cl^- + S_2Cl_2 \xrightarrow[reflux]{nitromethane} [S_6N_4]^{2+}Cl_2^- + 2SCl_2$$

$$4S_2Cl_2 + 2NH_4Cl \xrightarrow[reflux]{nitromethane} [S_3N_2Cl]^+Cl^- + 8HCl + 5S$$

Black green coloured product formed was separated and washed with distilled water, nitromethane and CS_2 to remove unreachted NH_4Cl, S_2Cl_2 and S. The formed product being soluble in water, nitromethane supports its ionic nature (Goehring, 1970), was dried in vacuo. To study the effect of $(S_6N_4)^{2+}$ Cl_2^- on varying pH 3 - 4.5 of acidic soil, the soil samples from different places of Andaman and Nicobar islands namely Mayanbunder, Bambooflat and Miletilak were collected upto desired depth 15 cm by means of sampling tools. Each soil sample (20 gm) was taken in 100 ml beaker to which 40 ml distilled water was added. The suspension was stirred at regular intervals for 30 minutes. To determine the pH, the each suspension was stirred well just before the electrodes were immersed and then the pH of each extract was noted before and after each addition of fixed quantity (10 mg) of $(S_6N_4)^{2+}$ Cl_2^- at 10 minutes time interval. In each determination, the electrodes

were washed with distilled water and water was removed from the surface with a piece of filter paper. Different ions present in the soil sample were analysed by spot tests (Feizi Fritz, 1957).

RESULTS AND DISCUSSION

Quantities analysis of soil samples indicates that soil samples contain Cl^-, Zn^{2+}, Fe^{2+} and Na^+ ions. The acidic characters of soil may be due to Cl- ions. Zn^{2+} and Fe^{2+} show amphoteric character in aqueous extract of soil sample. $(S_6N_4)^{2+}$ Cl_2^- having three planer fused rings possesses cyclic structure (Banister 1974, 1975). The S – S bonds (303 pm) holding the two S- N (161 pm) rings together and forming the middle ring are very long. $(S_6N_4)^{2+}$ Cl_2^- undergoes hydrolysis in acidic soil as:

$$[S_6N_4]^{2+}Cl_2^- + 6H_2O \xrightarrow{H^+} 4NH_3 + 2S_2O_3^{2-} + 2Cl^- + 2S$$

The hydrolysis products were analysed qualitatively and quantitatively by standard methods (Vogel, 1968). The nitrogen is completely converted into NH_3 confirming the physical structural deduction that there is no N – N bond in the molecule but there are S- N and S – S bonds. During the present study $(S_6N_4)^{2+}$ Cl_2^- used against acidic soils of different pH 3 – 4.5 show a remarkable increase in pH of acidic soil (Table 1) and the pH has increased upto 7.4 in normal time. There is no further increase in pH of the soil indicating that after retaining pH 7.4, $(S_6N_4)^{2+}$ Cl_2^- creates a buffer state due to formation of NH_4Cl and NH_4OH during the hydrolysis in acidic soil.

Table 1: Change in pH of soils on adding $(S_6N_4)^{2+}$ Cl_2^-

Time (min.)	Wt. of $(S_6N_4)^{2+}$ Cl_2^- added (mg)	Soil of pH 4.5	Soil of pH 4.0	Soil of pH 3.0
00	-	4.5	4.0	3.0
10.0	10	4.6	4.1	3.2
20.0	20	4.8	4.4	3.4
30.0	30	5.0	4.6	3.6
40.0	40	5.2	4.8	3.8
50.0	50	5.4	5.0	4.1
60.0	60	5.8	5.3	4.4
70.0	70	6.0	5.5	4.6
80.0	80	6.4	5.8	4.9
90.0	90	6.8	6.1	5.2
100.0	100	7.0	6.5	5.6
110.0	110	7.2	6.9	5.9
120.0	120	7.2	7.1	6.4
130.0	130	7.4	7.4	7.0
140.0	140	7.4	7.4	7.7
150.0	150	7.4	7.4	7.4

$$NH_3 + H^+ \rightarrow NH_4^+$$

$S_2O_3^{2-}$, Cl- ions formed during hydrolysis of $(S_6N_4)^{2+}$ Cl_2^- are exchanged by Zn^{2+}, Fe^{2+} and Na^+.

$$Zn^{2+} + S_2O_3^{2-} \rightarrow ZnS_2O_3$$
$$Fe^{2+} + S_2O_3^{2-} \rightarrow FeS_2O_3$$
$$2Na^+ + S_2O_3^{2-} \rightarrow Na_2S_2O_3$$
$$Zn^{2+} + 2Cl^- \rightarrow ZnCl_2$$
$$Fe^{2+} + 2Cl^- \rightarrow FeCl_2$$
$$Na^+ + Cl^- \rightarrow NaCl$$

$(S_6N_4)^{2+}$ Cl_2^- is a suitable chemical to reclame acidic soil because.

i. It checks the acidity and increases the pH of soil upto 7.4 which is a most suitable state for farming.

ii. The main ions responsible for acidity are Cl- ions. These ions are taken up by NH_4^+ ions of compound formed during the hydrolysis of $(S_6N_4)^{2+}$ Cl_2^-.

Since ammonia is evolved during the hydrolysis of $(S_6N_4)^{2+}$ Cl_2^- in acidic medium it may be a good fertilizer to make up N – deficiency in acidic soil as well as in normal soil which remains unaffected.

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