



Pelagia Research Library

Der Chemica Sinica, 2012, 3(4):1020-1023



Anion concentrations in soil and their contributions to gully erosion menace in Anambra State, Nigeria

**** E. N. Ojiakor, *A. N. Eboatu and *** I. E. Otuokere**

**Department of Pure and Industrial Chemistry, Nnamdi Azikiwe University, Awka*

***Department of Pure and Industrial Chemistry, Anambra State University, Uli*

****Michael Okpala University of Agriculture, Umudike Abia State*

ABSTRACT

Samples were collected from three different erosion zones of the twenty-one Local Government Areas of Anambra State. The sieved samples were digested. Atomic Absorption Spectrophotometer 205 and other qualitative and quantitative analyses were carried out including pH. Results obtained show that the mean anion concentrations for Highly Erosion areas, HEA; Intermediately Erosive areas, IEA; and Non-Erosive areas NEA, were as follows: HEA Cl^- 16.54ppm < IEA 17.64ppm < NEA 20.88ppm; PO_4^{3-} HEA 6.59ppm < NEA 5.78ppm < IEA 7.81ppm; NO_3^- HEA mean value is 43.60ppm < IEA 47.53ppm < NEA 49.59ppm; SO_4^{2-} HEA 559.06ppm > IEA 402.75ppm > NEA 49.40ppm; CO_3^{2-} concentration is found to be 94.93ppm, 388.74ppm and 1,172.53ppm for HEA, IEA AND NEA respectively. For silica, HEA contains 75.47%; IEA 82.70 and NEA 83.40%. pH values are seen as HEA 5.86; IE 6.07 and NEA 7.02. Principal component analysis of variants showed that anions such as SO_4^{2-} , Cl^- and PO_4^{3-} are common in HEA and IEA whereas CO_3^{2-} and SiO_2 are significant in NEA. Therefore HEA are prone to erosion as the soil is acidic.

INTRODUCTION

Fertile soil which supports plant and animal life is formed by the systematic degradation of hard rocks and caustic chemicals^[1]. Over time a given environment tends to reach a state of equilibrium after which it turn to be a havoc to the environment and all forms of organism due to erosion^[1,2]. The human effect on the land surface of the world is already conspicuous and irreversible^[3]. Gulling is part of natural process of landscape evolution in Western IOWA and so also is the modern gulling which causes so much concern.^[4] The record of human impart on humanity became more and more pronounced with each succeeding culture^[3]. The rise of city states and dependence on agriculture has been documented from archaeological excavation^[3].

Different views had it that Anambra State gulling has its influencing factors as soil type, topography, climatic and anthropogenic activities. Some authors expressed their opinion that active gulling is indicated at the discharge areas of ground water systems^[5,6]. Other authors attributed the causative factors of the ecological problems to mainly soil characteristics and human activities^[7,8,9]. Nwajide *et al* said that gulling is caused by topography, climatic and soil characteristics. Erosion has constituted one of the most important ecological agricultural problems world -wide and has given rise to economic, social and ecological disasters.

Soil contains clay minerals and organic substance. Clay minerals are complex, negatively charged nuclei which will move towards the positive electrode when subjected to the action of an electric current. Soil acidity is primarily a function of the colloidal fraction of soils but soluble acids contribute to the condition to some extent. Much of the colloidal material of soil reacts as a complex acid radicals of very low solubility around which are clustered positive ions at varying distances from the particle surface. This study aimed at analyzing soil of three erosive areas of the state to find out anions present in them and their effect on the erosion menace of the area in the state.

MATERIALS AND METHODS

Core samples were obtained from the twenty-one Local Government Areas of the State. Two towns were chosen from each Local Government area and five samples were sourced from each town. These samples were poled to form a representative composite for the town. These were collected in polyethylene bags. Samples were air dried in the laboratory for two weeks, they were then ground into fine particles and sieved through a 2mm sieve. The pH of the samples were determined by the method described by Hendershot *et al*, 1963^[11]. Molybdenum blue reagent was prepared fresh and mixed with the digested soil samples. Standard phosphate solution was also prepared. Absorbance of solutions were measured at 880nm against that of standard and used for determining the concentration of phosphate ion^[2]. Nitrate ion was determined using brucine method as described by Uzochukwu B.A. *et al*, 2004^[3]. Turbidimetry methods were used for sulphate ion^[14]. Carbonate was determined by indirect displacement of calcium and magnesium ions by atomic absorption spectrometry model 205. The digestion was carried out with 20ml of a mixture of concentration HClO₄ and HNO₃ at a 2:1 ratio (u/v) on a hot plate. The residue from each digested soil samples and paper was taken in a porcelain crucible and dried in a furnace at 600°C. The weight of the residue gives the weight of silica in the soil sample^[10].

RESULTS

Table 1 shows the anion concentration in the various local government areas of the state. The anions analyzed for are Cl⁻, PO₄³⁻, NO₃⁻, SO₄²⁻, CO₃²⁻ and SiO₂ the mean anion concentration is summarized in table II. It is observed that among the three erosive areas, non-erosive area, NEA, has the greatest concentration of Cl⁻ (20.38ppm) followed by intermediately erosive area IEA, 17.89ppm and highly erosive area. HEA, (17.11ppm). For phosphate ion concentration, non-erosive area, intermediately erosive area highly erosive areas have 5.78ppm, 7.81ppm and 6.59ppm respectively. Nitrate ion concentration is found to be high in non-erosive area. It is of the value 49.59ppm, while in highly erosive area is 43.53ppm and 47.53ppm is intermediately erosive area. Sulphate ion concentration value of the highly erosive area is 559.06ppm, 402.78ppm for intermediately erosive area and 49.40ppm for non-erosive area Carbonate ion concentrations also follow the same trend, i.e. the three areas are NEA (1,172.58ppm), IEA(388.74ppm) and (94.93ppm) for HEA. The result obtained from percentage silica (%SiO₂) shows that HEA contains 75.47%, IEA 82.73% and NEA 83.40% respectively. The soil of highly erosive area has a pH of 5.28, indicating upward trend intermediately erosive has 6.07 and non-erosive area 7.02, this shows decrease in acidity with increase in soil stability.

DISCUSSION

The acidic nature of the soils of highly erosive are and intermediately erosive areas tends to confirm the result from the principal component analysis of variance. Acidity enhanced the decay and removal of the commenting materials binding soils together such that soil are easily washed away [9]. The highly erosive area is more erosive than the intermediately erosive area probably because chloride ion is selected in place of phosphate ion. Phosphate ion is polyacids and therefore forms a more stable complex than the chloride ions. There is also high concentration of this phosphate ion in intermediately erosive areas.

Furthermore, through corrosion caused by the acidic nature of the soil, metal ions that are important in forming chelate compounds are destroyed, chloride ion helps in destabilizing soil as it forms acidic compounds that can easily dissolve and wear soil away^[1]. The high concentrations of carbonate ion and silicate shown in the NEA and IEAs are not surprising. It has been reported that high carbonate content in the form of basic carbonate leads to the solidification of soil, since carbonate aggregates do not allow easy percolation of water to take place. The silicate ion selected in the non-erosive area is of a great significance in that it is one of the main ligands that control soil aggregate formation. Silicates together with aluminum oxide and other hydrous oxides are major binding agents of the soil^[12]. Result from the principal compounds analysis^[12] of these anions concentrations in the three areas

indicate that three components are significant in the highly erosive and intermediately erosive areas, namely SO_4^{2-} (0.804), NO_3^{-1} (0.794) and Cl^{-1} (0.829) for HEA; and NO_3^{-} (0.775) SO_4^{2-} (0.795) and PO_4^{3-} (0.710) for IEA; two components selected for non-erosive areas are CO_3^{2-} (0.917) and SiO_2 (0.717).

TABLE 1: MEAN ANION CONCENTRATIONS IN THE THREE AREAS

ANIONS	Cl ⁻	PO ₄ ³⁻	NO ₃ ⁻	SO ₄ ²⁻	CO ₃ ²⁻	%SiO ₂	
AGUA TA	14.77	2.45	44.71	374.50	45.77	74.01	HEA
Aniocha	15.95	2.94	46.39	800.00	65.02	73.82	
Awka S.	16.54	2.94	43.64	174.50	78.77	81.99	
Idemili S.	18.91	18.91	41.31	700.00	81.84	62.81	
Njikoka	17.43	0.98	29.63	524.50	124.87	83.72	
Nnewi N.	18.61	11.27	42.53	1,000.00	4.95	84.31	
Orumba N.	12.13	2.94	36.44	274.50	64.04	76.99	
Orumba S.	18.02	10.29	64.19	624.50	294.18	66.11	
Mean	16.54	6.59	43.60	559.06	94.93	75.47	
Awka N.	15.65	5.39	58.12	274.50	164.86	79.66	
Dunukofia	14.75	3.97	47.83	49.00	464.82	86.83	
Ekwusigo	16.83	11.27	47.03	125.00	112.09	84.76	
Idemili N.	17.73	4.90	48.09	524.50	63.68	80.63	
Ihiala	17.49	5.39	33.04	224.50	10.88	82.83	
Nnewi S.	22.45	6.86	19.67	650.00	18.94	80.84	
Osha N.	18.61	12.45	69.91	124.50	372.01	92.31	
Osha S.	17.45	12.25	56.52	850.10	901.63	73.88	
Mean	17.64	7.81	47.53	402.75	388.74	82.73	
Anambra E.	19.78	6.37	34.15	49.00	743.70	83.02	NEA 83.40
Anambra W.	21.86	4.90	29.24	50.00	494.35	81.64	
Anyamelu	23.63	6.86	117.52	50.00	2,953.23	81.64	
Ogbaru	18.02	5.39	28.76	49.50	628.56	78.14	
Oyi	20.97	5.39	38.27	49.00	942.81	90.20	
Mean	20.88	5.78	49.59	49.40	1172.58	83.40	

MEAN ANION CONCENTRATIONS IN THE THREE AREAS

ANIONS	Cl ⁻	PO ₄ ³⁻	NO ₃ ⁻	SO ₄ ²⁻	CO ₃ ²⁻	%SiO ₂
HEA	16.54	6.59	43.60	559.06	94.93	75.45
IEA	17.64	7.81	47.53	402.75	388.74	82.73
NEA	20.88	5.78	49.59	49.40	1172.58	83.40

CONCLUSION

In conclusion, it is clear that erosive nature of highly erosive areas of Anambra state are due to the acidic nature of the soil and low concentrations of some erosion significant anions such as carbonate ion and silicates. This has established that the problem of erosion menace in the Anambra State is more than geology and mechanical Engineering can tackle.

REFERENCES

- [1] Alan, W **1994**. Soil and the Erosion Environment. An introduction, Cambridge University Press. pp. 7-67,166-188.
- [2] Black, C.A **1965**. Methods of Soil analysis Agronomy, No 9 part 2 America Society Agron. Madison Wisconsin.p.6.
- [3] Egboka, B.C.E. and Nwankwo, G.I. **1985**. *J. Afri earth Sci.* 3 (4), 417-425.
- [4] Egboka, B.C.E. and Okpoko, E.I. **1984**. Gully Erosion in the Agulu Nanka region of Anambra State, Nigeria. In challenges in African hydrology and Water Resources (Procc. Hasare Sysmp. 1984). Pp.335-374. IAHS publication no. 144.
- [5] Floyd, B. **1965**. *The Nigerian Geogr. J.*8(1), 33-34.
- [6] Kirby, M.J. and Morgan, R.P.C. **1989**: Soil Erosion, John Wiley and sons, New York pp. 1-4.
- [7] Ofomata G.E.K. **1965**. *The Nigerian Geog. J* 8(1) 45-48.
- [8] Ogbukagu, I.K.N. **1971**. *Nigerian J. Mining and GGeol.* 13 6-19.
- [9] McGraw-Hill **1971**. *Encyclopedia of Science and Technology* McGraw-Hill New York pp.96-112.

- [10] Nwajide, C.S. and Hoque, M **1979** *The Nigerian Field*, 44 (2)64-74.
- [11] Okenwa R. and Nwosu, M.D **2006**. Erosion control is every one's Battle, Maryland U.S.A. pp.28-30.
- [12] Retallack, G.J. **1990**. *Soils of the Past: An Introduction to Paleopedology*. Harper Collins Academic, pp.58-68.
- [13] Uzochukwu, B.A. and Onamate. O.R. **2004**. *Global Journal of Pure and Applied Sciences*, 10(1) 111-119.