

PARTICLE SIZE AND ZETA POTENTIAL ANALYSIS OF COASTAL SOIL SAMPLES OF WEST COAST OF KANYAKUMARI DISTRICT

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Abstract : The total land mass of the earth we can live only 30% of our planet. About 20% of the population of India lives in coastal area. Coastal soil is one of the most important resources of the nature. The climate and other factors largely affect the coastal soil formation. Our survival is threatened the non-biodegradable wastes were accumulated in the coastal region. Soil texture has an important role in nutrient management because it influences nutrient retention. Electrophoretic light scattering technique and Malvern instruments are used to measure the electrophoretic mobility of particles in dispersion. Photon correlation spectroscopy clearly represents the size distribution, Z average values, size and percentage of intensity of coastal soil samples of Kanyakumari district. The zeta potential value is approximately -10mv to -30mv it is clearly represented the incipient stability behavior of coastal soil samples.

Keywords: Photon Correlation Spectroscopy, Zeta analyzer, Soil.

I. INTRODUCTION

Photon correlation spectroscopy (PCS) has become a powerful light-scattering technique for studying the properties of suspensions and solutions of colloids, macromolecules and polymers that is absolute, noninvasive and non-destructive. (Walther Tscharnuter, 2000). It is widely used to determine the sizes of particles in solution (Carlson, 1975; Pecora, 1972; Lee et al., 1972). Any soil that has a potential for shrinking or swelling their moisture content is changed. These soils bring about more damage to structures, particularly light buildings, pavements, buried lifelines, sidewalks, and pipelines, than any other natural hazard, including earthquake and floods (Jones and Holtz, 1973). The complex mechanism of swelling is influenced by a number of factors including type, the amount, and the specific surface area of present clay minerals in the soil (Mitchell, 1976). It is well known that the swelling properties of expansive soils significantly affected by cation exchange capacity (CEC) (Grim, 1968), pH (Abdullah et al., 1999), and zeta potential of soil media (Mitchell, 1976; Sparks, 1986; Van Olphen, 1963).

The potential difference between the surface of the particles and the external solution is called electro kinetic potential, or Zeta potential (ζ). This is an important electrostatic parameter for the particles suspended in an aqueous medium as an index of evaluating the stability of the suspended colloidal dispersions with respect to particle aggregation (Kim and Sansalone, 2008). The "zeta potential" of particles (a measurement of the electrostatic repulsion between particles) is a good, but certainly not the only, predictor of the stability of a suspension. Unless the sample is sterically stabilized, a low zeta potential increases the probability for aggregation within a short time; thus the determination of this parameter is very important. Frequently a simple change of the pH value is all that is required to achieve a stable suspension. The zeta potential can be used to constrain the parameters (sorption equilibrium constants, capacitance(s)) of the electrostatic surface complexation model (Wolthers, 2008; Wolthers, 2012).

2.1 Study Area:

The study area chosen for the present work is Kanyakumari District (Figure.1) which is covering a distance of 75 km from Vattakottai to Vallavilai of Tamilnadu coast. Kanyakumari District is situated at the extreme south of the Indian subcontinent; the coast line is formed nearly by three seas namely Arabian Sea, Indian Ocean and Bay of Bengal. But the main part of coast faces the Arabian Sea. The study area chosen for the present work is Kanyakumari District (Figure.1) which is covering a distance of 75 km from Vattakottai to Vallavilai of Tamilnadu coast.

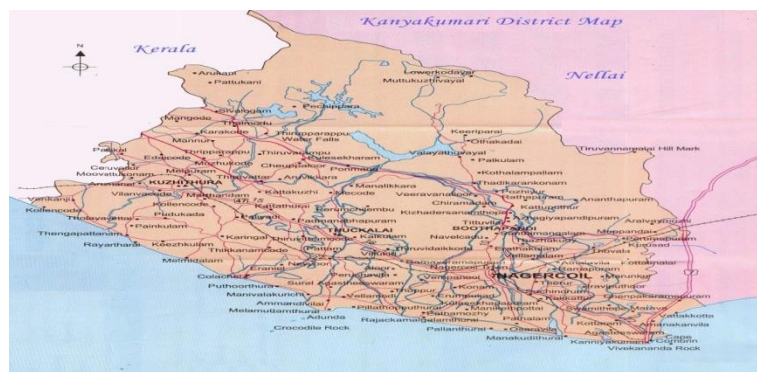


Fig. 1. Coastal regions in Kanyakumari District, Tamilnadu, India.

2.2. Soil collection and preparation:

Coastal soil sample were collected using Peterson grab at all the designated location during low tide. The samples collected sites under study were labeled as S₁, S₂, S₃, S₄, S₅, S₆, S₇, S₈, S₉ and S₁₀. The distance between each site falls around 6kms the collected soil sample stored in polythene bags immediately after the soil was withdrawn the colour and texture were identical. The soils were air dried, crushed using pestle and mortar and then passed through a 10 mesh (2mm) screen before analysis. The soil analysis was completed within two months after collection.

2.3. Dynamic Light Scattering Particle Size Analysis:

The soil samples were processed by Ball Milling process for particle size analysis. Dynamic Light Scattering Particle Size Analyzer was used to find out the particle size distribution of soil samples. The processed soil samples were dispersed in HPLC water by horn type ultrasonic processor (Vibronics, model: VPLP1). Then experiment was carried out in computer controlled particle size analyzer (Malvern Instruments Zeta Sizer Nano ZS90 made in England) to find out the particles size distribution.

2.4. Dynamic Light Scattering Zeta Potential Measurement:

Zeta potentials values of soil samples were determined by Zeta Sizer Nano ZS90 made in England. Zeta potential of soil samples describes the electrical potential in the double layer of ions surrounding a particle at the boundary of the particles surface and the adsorbed ions in the diffuse layer. (Kirby, 2010).

3. Results and Discussion:

3.1 Size distribution analysis of coastal soil samples:

Electrophoretic light scattering technique and Malvern instruments are used to measure the electrophoretic mobility of particles in dispersion. This mobility is converted to zeta potential enable to comparison of materials under different experimental conditions. Photon correlation spectroscopy clearly represents the size distribution, Z average values (cumulant mean) are most stable parameter. Poly dispersity index (pdl) values are dimension less and scaled values. Pdl values smaller than 0.05 are rarely seen other than mono disperse standards. Pdl values are greater than 0.7 indicate the sample has a very broad size distribution (Table 1). In Figure 2 shows the particle sizes of coastal soil samples are in poly disperse medium and size distribution by intensity.

Table 1. Size distribution parameters of coastal soil samples of Kanyakumari district.

Sample no	Z Avg(d.nm)	pdl	intercept	Size(d.nm)	%intensity	Width (d.n)
S1	815.6	0.589	0.888	702.9 134.6	93.4, 6.6	178.1 23.12
S2	1624	0.440	0.867	1446 242.7 5560	86.2 10.9 2.9	388.7 44.08 6.104
S3	1712	1.000	0.996	599.3 108.6	94.4 5.6	97.79 12.21
S4	1204	0.468	0.877	890.1 5500	95.4 4.6	262.2 203.6
S5	854.7	0.451	0.888	659.7 5162	87.0 13.0	234.5 500.4
S6	649.8	0.882	0.868	740.9 5326	98.2 1.9	248.1 376.6
S7	737.9	0.732	0.977	629.7 175.5	84.7 15.3	143.5 31.14
S8	682.0	0.359	0.882	779.1 5320	97.4 2.6	415.0 385.4
S9	691.4	0.407	0.928	594.5 168.6 5487	92.5 4.7 2.8	185.7 28.12 209.6
S10	903.3	0.525	0.921	650.0 5560	97.2 2.8	164.2 6.104

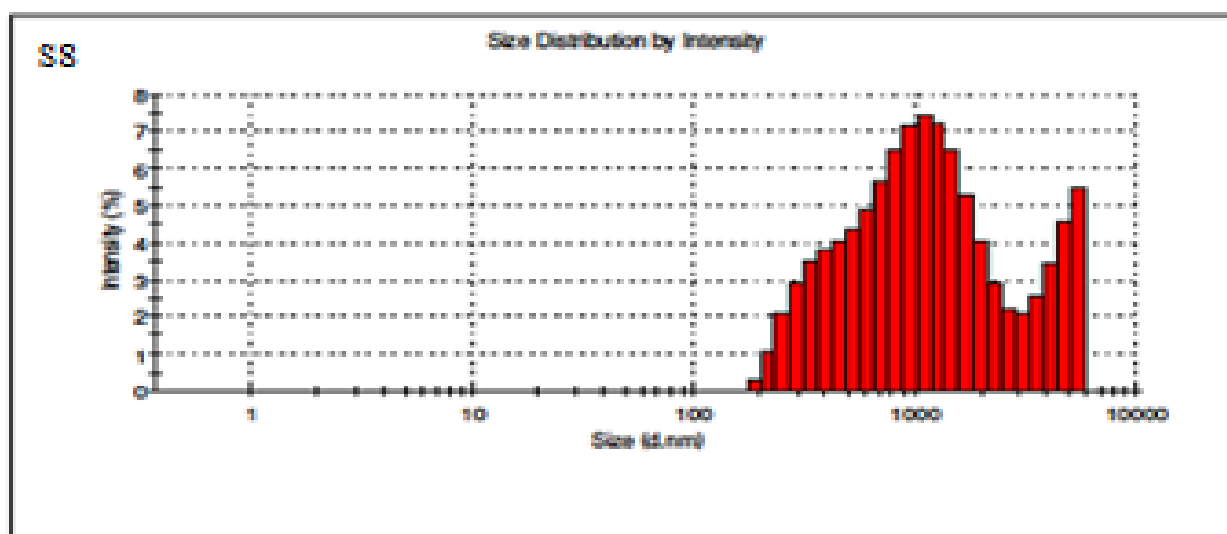


Fig. 2. Particle size spectrum of coastal soil sample

3.2. Zeta potential analysis of coastal soil sample:

Zeta potential is a measure of magnitude of the electrostatic or charge repulsion and attraction between particles. It is one of the fundamental parameter known to affect stability. Zeta potential measurements bring detailed insight into the causes of dispersion, aggregation or flocculation and can be applied to improve the formulation of dispersions, emulsions and suspensions. Zeta potential of soils changes in the presence of surfactants. Surfactants have been used to increase the efficiency of contaminant.

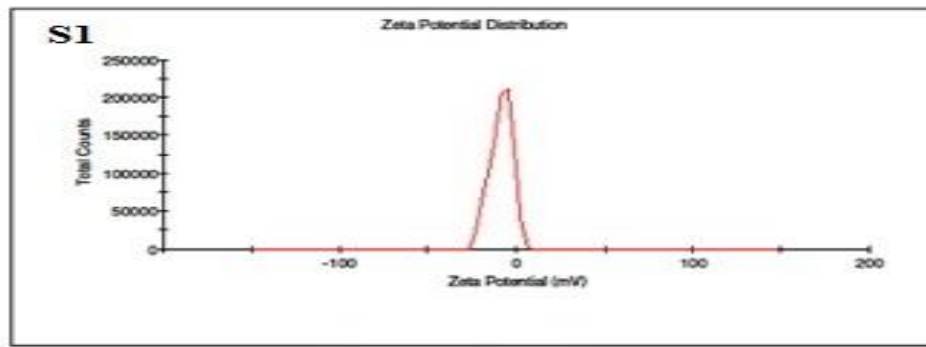


Fig. 3. Zeta potential curve of coastal soil sample

Zeta potential denotes the stability nature of coastal soil. Various physical parameters such as added ionic concentration, centrifugation rate and temperature also affect the zeta potential if the system. The PH is greater than 7 the coastal soil samples are highly alkaline nature. PH is related with zeta potential values if coastal soil is alkaline nature zeta potential value are very low. In acidic samples the zeta potential values are high due to the more concentration of H^+ ions. In basic samples the zeta potential values are low due to the more concentration of OH^- ions. Zeta potential values depend on the interaction between charged particles. This is due to the very high surface electrical conductivity, which is inversely proportional to the size of the particles. Zeta potential curve (Figure 3) represents the zeta potential values, zeta deviation conductivity and percentage of area. The zeta potential value (Table 2) is approximately -10mv to -30mv it is clearly represented the stability behavior of coastal soil samples are incipient stability.

Table 2. Zeta potential parameters of coastal soil samples of Kanyakumari district.

Sample No	Zeta potential (mv)	Zeta deviation	Conductivity (ms/cm)	Mean		Area%	Width(mv)
				Peak1	Peak 2		
S1	-8.72	6.17	0.690	-8.72	-	100.0	6.17
S2	-13.0	7.58	0.545	-8.50	-19.7	57.9	5.27
						42.1	3.92
S3	-10.3	5.68	0.442	-10.3	-	100.0	5.68
S4	-12.3	8.83	0.408	-7.09	-19.9	56.8	5.97
						43.2	4.58
S5	-13.4	6.99	0.397	-13.4	-	100.0	6.99
S6	-14.3	8.71	0.369	-14.3	-	100.0	8.71
S7	-12.8	7.19	0.406	-12.8	-	100.0	7.19
S8	-12.7	6.25	0.375	-12.7	-	100.0	6.25
S9	-14.4	8.33	0.384	-14.4	-	100.0	8.33
S10	-11.2	7.27	0.330	-11.2	-	100.0	7.13

4. Conclusion:

In coastal agro-ecosystem with the increasing human and animal population the competition between various lands uses are intensive. Photon correlation spectroscopy is applicable to particles suspended in a liquid, which are in a state of random movement due to Brownian motion. The pace of the movement is inversely proportional to particle size. Coastal soil samples are in poly disperse nature with broad Gaussian peak indicating the samples are not uniform the peaks were skewed unimodal or multimodal. PH is related with zeta potential values if coastal soil is alkaline nature zeta potential value are very low this is due to the more concentration of OH^- ions. The zeta potential value represents the stability nature of samples. The stability behavior of coastal soil samples are incipient stability.

5. References:

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