BIO WASTE AND CHEMICAL EFFECTS ON SOIL HEALTH

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ABSTRACT

Consistently Indian warm force plants delivered in excess of 100 million tons of fly debris, which is relied upon to arrive at 175 million tons in close future1. Removal of this enormous amount of debris is an incredible issue because of its constrained use in assembling of blocks, concretes, roof and other common development exercises. This would additionally bring to changes in land-use example and add to land, water and environmental debasement, if legitimate administration choices for fly debris taking care of are not embraced. Utilization of fly debris in agribusiness gives an attainable option in contrast to its protected removal to improve the dirt condition and upgrade the yield efficiency. Fly ash contains several nutrients including S, B, Ca, Mg, Fe, Cu, Zn, Mn and P, which are beneficial for plant growth, as well as toxic metals such as Cr, Pb, Hg, Ni, V, As, and Ba. Its addition increases the availability of Na, K, Ca, Mg, B, SO4 and other nutrients except N.

In this study three industrial effluents (amino acid surfactant and pharmaceutical) are selected for investigating their effect on natural soils cohesive and locally available) and on commercial soils. It is concluded that: - The three chosen effluents namely amino acid, surfactant and pharmaceutical are found to possess unique characteristics. Amino acid effluent is very Sound to be very 'highly acidic' (pH = 3 to 4) and highly concentrated with respect to organic contents (COD - 19000 to 20000 mg/L). Hence it has the potential to destroy the physical properties and the geotechnical characteristics of a soil. Surfactant effluent has the tendency to form a 'scum' and 'impact imperviousness' to a soil mass. The above effluent is found to be of 'medium alkaline' in nature (pH = 6 to 12) and contain a 'higher concentration of COD' (10,200 to 14.500 mg/L) then the other two. Pharmaceutical effluent is found to be very 'highly acidic' (pH = 3 to 4) with extremely high concentration of total dissolved solids (TDS) in the range of 18,500-25,000 mg/L. The above effluent is categorized as 'highly toxic' due to the presence of antibiotics and its various intermediates (recalcitrant iii nature i.e., not easily degradable) which have the potential to completely destroy the nutrients and the beneficial microbes present in a soil mass. It has a tendency to take a very long duration of time for bio-transformation. To attain a stable state, due to the absence of supporting nutrients required for initiation and completion of biological reactions. The commercial soil kaolinite (CS) is classified as silt and clays of low compressibility (liquid limit = 33%) according to IS classification. The chosen natural soils (NS) are classified as silt and clays of high compressibility (liquid limit lies in the range of 60 -70), according to IS classification incidentally. The effect of all the industrial effluents on all the two soils considered are found to be Similar (i.e. show an increasing trend with time) with respect to liquid limit and plastic limit of the soils, after contamination. However, the effect of the above index properties on NS is found to be closer to the CS due to (artificial) contamination of all the effluents. The effect of all the industrial effluents, except, surfactant effluent on all the two soils are found to be similar (i.e. show an increasing trend with time) with respect to shrinkage limit of the soils after contamination. The effect of surfactant effluent on shrinkage limit of CS, NS are found to be insignificant. Whereas significant effect on shrinkage limit of CS and NS are observed. However, surfactant effluent induces a 'negative influence' on the soils CS and NS (i.e., shrinkage limit values becomes higher to lower) and hence, the soils become 'better to worse' from the Geo technical perspective. It is suggested that the 'shrinkage limit test' may be used as a 'distinctive test' (among the index properties) to identify the effect of industrial effluents on soils. The impact of the considerable number of effluents is to expand the UCC estimations of all dirts up to 30 - 90 days of sullying and from there on to diminish 11 up to 180-200 days which is credited to the dirt toxin communication. The impact of all effluents on all the dirts considered is to lessen the UCC esteems by around 20 % (inside the time of tainting) Hence the dirt - poison association ought to be permitted to finish, before the quality qualities (for example UCC) are resolved and utilized for any designing judgment.

KEYWORDS: Soil, Pharmaceutical Effluent, Total Dissolved solids, Natural Solids

1. INTRODUCTION

Quick industrialization has brought about gigantic creation of fluid and strong squanders comprehensively and in creating nations like India. Unpredictable removal of waste in the past particularly ashore has caused genuine ecological issues which incorporate ground water pollution. Corruption of soil supplements, adjustment of soil conduct and so on. Among fluid and strong squanders, treatment of fluid squanders (effluents) present more prominent issue when contrasted with strong squanders, in light of the fact that. Pollution is activated at moderately quicker rate, because of its physical state (for example fluid), which encourages quicker and more extensive movement of contaminations in the mode (for instance in soil). Then again strong squanders can present issues to the earth just when a 'leachate' is framed out of it.

Case accounts are accessible in the writing featuring the disappointment of establishment/structure because of ground tainting because of incidental arrival of synthetic compounds and due to leachates from modern waste (both strong and fluid). At this point it is entrenched that the natural and inorganic poisons present in the modern effluents. As a rule influence the different geotechnical attributes of fine - grained soil, for example, its list properties, quality and twisting. Populace development and rising expectations for everyday comforts apply colossal weight on accessible land. Particularly on creating nations, whereby, many soil stores recently asserted to the unfit for private lodging and other development ventures, are currently being thought of and utilized. To adapt to such risky soil stores and unfriendly condition conditions the present regular development innovation needs to take by need. Another course it is in this way important to comprehend the dirt contamination associations, the impact of contaminants/modern effluents on the different geotechnical properties, for surveying the appropriateness of ground soil for designing reason/start appropriate measures to make the ground soil tit for development.

2. EXPERIMENTAL SCHEME

The fabricated experimental set - up was used for two modes of study, namely (i) batch -mode and (ii) continuous - mode, with varying hydraulic retention times (HRTs). 'HRT' is defined as the time taken by the first droplet of the effluent to flow from inlet to outlet of soil column. The batch-mode was operated to study the chemical equilibrium that gets established between various types of soils and the pollutants of the effluents, whereas continuous-mode of operation was aimed at analysing and reporting soil-pollutant interactions (with respect to HRT) as applicable to field conditions (i.e. discharge of effluent on soil is continuous with varying flow rate and concentration of pollutants). It (i.e. continuous mode) is intended to explain the mechanism involved and suggest possible measures for the remediation of contaminated site. In fact comprehensive review of literature reveals that no attempt has been made so far to conduct experiments under continuous-mode and hence to understand the effect on soil pollutant interactions simulating field conditions. Hence both the modes of operation were employed for the comprehensive experimental investigations reported in this study 48 hours was assumed as the empty; bed dry period between the two-modes of operation which is minimum period stipulated in the literature.Soil samples (weighing about 2.7kg) were mixed with effluents the quantity added corresponds to the respective optimum moisture content (OMC) for each type of soiland to a height of 650 mm in the respective soil-column was carried out for the outlet effluent collected from the soil-columns marked as CT and soil analysis was performed for the soil samples collected from soil-column marked as ST for the respective soils. Soil samples weighing about 300 gm were collected at intervals of 15 days both in batch-mode and in continuous-mode of operation. Effluent samples from the drain outlet were collected at an interval of 24 hrs. during batch-mode and at intervals of 8hr; 12hr and 16hr during continuous mode of operation. The bases of selection of the various HRTs are:

Any process industry is operated in shifts of 8 hours duration. Hence 8 hours HRT can represent one shift and it also represents a shock-load imparted to soil (sample) at maximum flow rate and concentration of pollutants.

b)On the other hand, 16 hours HRT represents a situation where in the flow and the concentration of pollutants is likely to be minimum.

c)12 hours HRT was selected as it is likely to represent a medium to moderate floe and concentration of pollutants, discharged on to a soil. Hence, the chosen HRT can be expected to represent a field situation.

An effluent volume of 1.2 litres was used to fill the feed tanks for batch-mode of operation. However, for continuous-mode of operation, flow rates for the various soils and for the various HRTs considered were calculated based on the porosity of the soil samples at the end of the batch- node.

3. RESULTS

Table 4.1 Effect of Artificial Contamination of Pharmaceutical Effluent on the Properties of Natural Soil-NS with time 141 days

Days	W_L	W_P	W_S	I_F	I_P	I_T	I_C	IL	SR	V_S	L_S	q_U
0	62.6	32.3	14	36.5	31	1.1	1.4	0	2	127.1	24	191.2
15	65.2	34.3	14.1	28.7	31	1.3	1.5	-0.6	2	115.5	21	
30	72.2	36.9	14.6	24.6	36	1.6	1.6	-0.9	2	85.5	19	245.5
45	73.2	48.5	14.8	37.9	25	0.9	2.3	-0.9	2	137.3	25	
60	78.4	51.5	10.4	34.7	27	1	2.3	-0.9	2	139.1	25	285.6
75	82.7	52.7	23.3	67.8	30	0.6	2.3	-0.9	2	90.8	20	
90	82.3	59.5	10.5	88.5	23	0.9	1.1	-0.6	2	101.4	21	235.6
108	86.4	58.5	21.5	65.6	28	0.6	2.1	-0.7	2	100.8	21	
123	87.4	58.6	20.3	71.3	29	0.6	2.5	-1.1	2	101.9	21	
141	89.3	59.3	20.4	86.5	30	0.6	2.5	-1.1	2	102.3	21	240.5

Table 4.2 Effect of Artificial Contamination of Amino Acid Effluent on the Properties of Natural Soil-NS with time 141 days

Days	W_L	W_P	W_S	I_F	I_P	I_T	I_C	IL	SR	V_S	L_S	q_U
0	60.8	22.6	10.1	32.99	38	2.2	1	0.17	2	231.3	33	270.2
15	46.2	31.5	3	126.8	15	0.3	1.1	0.23	3	191.1	30	
30	50.2	30.2	4.4	13.56	20	1.7	0.3	0.29	2	155.2	27	95.7
45	85.1	54.2	9.1	55.6	31	0.7	1.9	-0.5	2	126.6	24	
60	92.2	60.4	22.4	65.73	32	0.7	2	-0.7	2	148.4	26	202.7
75	98.7	62.7	23	66.96	36	0.7	2	-0.6	2	133.8	25	
90	110.5	74.8	27.6	79.22	36	1.2	1.3	0.15	2	170.5	28	170.4
108	111.5	75.4	25.1	126.9	36	0.5	2.2	-1	2	167.5	28	
123	112.5	72.5	28.3	137.9	40	0.5	2.2	-0.8	2	171.3	26	
141	113.8	73.3	29.1	150	41	0.5	2.2	-0.8	2	172.2	26	150.55

Table 4.3 Effect of Artificial Contamination of Surfactant on the Properties of Natural Soil-NS with time 141 days

Days	W_L	W_P	W_S	I_F	I_P	I_T	I_C	IL	SR	V_S	L_S	q_U
0	69.7	37	10.8	17.44	33	2.1	1	0.01	2	117.5	23	148.2
15	46.7	33.3	11.8	96.62	13	0.3	1.6	-0.2	2	180.5	29	
30	99.7	55.1	9.3	35.09	45	2.3	1.1	0.17	2	156.7	27	202.5
45	88.2	55.2	16.2	109.3	33	0.5	2	-0.7	2	151.9	27	
60	102.7	70.2	22.4	99.37	33	0.5	2.5	-1.1	2	150.2	27	288.45
75	101.4	71.2	28.5	81.15	30	0.6	2.6	-1.3	2	161.5	28	
90	91.8	66.9	25.7	22	25	3.3	3	-1.6	2	138.1	26	309.62
108	96	69	17.3	75.73	27	0.6	3.1	-1.7	2	123.1	24	
123	94.4	69.9	17.1	72.63	25	0.6	2.9	-1.5	2	101.9	23	
141	89.3	68.9	16.3	78.59	21	0.5	2.7	-1.1	2	102.4	22	290.45

Table 4.4 Effect of Artificial Contamination of Pharmaceutical Effluent on the Properties of Commercial Soil-CS with time 175 days

Days	W_L	W_P	W_S	I_F	I_P	I_T	I_C	IL	SR	V_S	L_S	q_U
0	33.2	20.9	9.4	8.2	13	0.8	1.2	0.19	7	80.1	18	119.2
15	34.7	19.2	8.1	6.7	16	2.1	1.2	0.14	1	14.2	4.4	
30	35.2	18.5	10	12	17	1.3	1.2	0.17	1	20	6	120.5
45	37.2	18.3	7.5	8.3	19	1.9	1.1	0.2	2	18.1	5.5	
60	38.3	20.3	7.1	11.3	18	1.1	1.1	0.14	2	9.43	7.1	121.3
75	39.5	22.7	6.5	11.5	17	1.1	1.2	0.19	2	31.1	1.1	
90	34.2	20.2	6.2	15.6	14	1.1	1.2	0.11	2	36.1	9.9	121.2
105	36.7	17.3	7.1	3.3	20	4.8	1.2	0.14	2	42	11	
115	40.2	22.2	7.2	7.7	18	2.5	1.1	0.21	2	17.6	5.4	120.4
130	44.2	22	7.8	13.2	22	1.1	1.1	0.21	2	15.7	4.9	
145	42.2	23.2	7.7	16.3	19	1.9	1.2	0.7	1	12.6	4	18.2

160	41.3	20.2	7.7	17.7	21	1.4	1.1	0.6	2	44.1	12	
175	43.2	23.2	7.6	9.5	20	3.5	1.1	0.3	1	2.79	1.1	116.45

Table 4.5 Effect of Artificial Contamination of Amino Acid on the Properties of Commercial Soil-CS with time

Days	W_L	W_P	W_S	I_F	I_P	I_T	I_C	IL	SR	V_S	L_S	q_U
0	33.2	20.9	9.4	8.2	13	0.8	1.2	0.19	7	80.1	18	119.2
15	33.7	22.9	6.9	5.4	11	2.2	1.2	0.16	2	56.7	14	
30	34.3	22.2	7.8	11.5	12	1.2	1.2	0.19	1	23.8	7	123.8
45	34.5	19.1	7.6	5.7	16	2.9	1.1	0.17	2	23.3	6.9	
60	35.7	20.2	6.7	3.4	16	7.2	1.2	0.19	2	25.3	7.4	125.2
75	36.2	22.3	5.2	21.8	14	0.7	1.2	0.08	2	51.2	13	
90	36.7	20.2	6.1	4.6	17	3.9	1.2	0.15	2	56.9	14	128.45
105	38.3	25.2	7.6	9.8	13	1	1.2	0.14	2	22.6	6.7	
115	39.2	21.2	7	5.1	18	0.3	1.1	0.23	2	33.5	9.3	127.45
130	39.7	23.5	6.9	39	16	0.3	1	0.32	2	39.1	11	
145	41	23.2	7	8.3	18	2.7	1.2	0.58	2	44	12	127.45
160	42.3	23.2	6.9	10.1	19	2.1	1.1	0.25	2	22.1	6.6	
175	43	22.2	6.9	10.3	21	2.2	1	0.22	1	20.7	4.7	123.5

Table 4.6 Effect of Artificial Contamination of Surfactant on the Properties of Commercial Soil-CS with time

Days	W_L	W_P	W_S	I_F	I_P	I_T	I_C	IL	SR	V_S	L_S	q_U
0	33.2	20.2	9.4	8.2	13	0.8	1.2	0.19	7	80.1	18	119.2
15	35.4	19.2	7.2	2.4	16	5.6	1.2	0.18	2	68.1	16	
30	35.8	18.2	8.1	4.5	18	3.7	1.2	0.19	1	26.1	7.5	125.95
45	36.2	21.2	8	7.9	15	2	1.1	0.16	2	23.5	6.9	
60	37.7	18.2	6.4	9.7	20	3.2	1.2	0.18	2	56	14	128.2
75	38.4	23.2	7.1	5.4	19	1.4	1.2	0.3	2	42.2	11	
90	39.2	22.2	6.4	9.3	17	2	1.1	0.21	2	73.7	17	130.2
105	39.7	19.2	6.6	7.6	21	4.2	1.1	0.21	2	53.4	13	
115	41.2	21.2	6.9	5.6	20	3.6	1.1	0.22	2	27.7	7.9	134.45
130	42.7	23.2	5.9	8.8	20	1.1	1.1	0.22	1	4.3	1.5	
145	43.2	25.2	5.8	6.4	18	1.3	1.2	0.31	1	23	6.8	134.2
160	44.2	20.2	5.7	8	15	2.8	1.1	0.23	2	33.1	9.2	
175	44.2	20.2	5.6	14.8	12	1.4	1.1	0.24	2	26.6	7.7	135.45

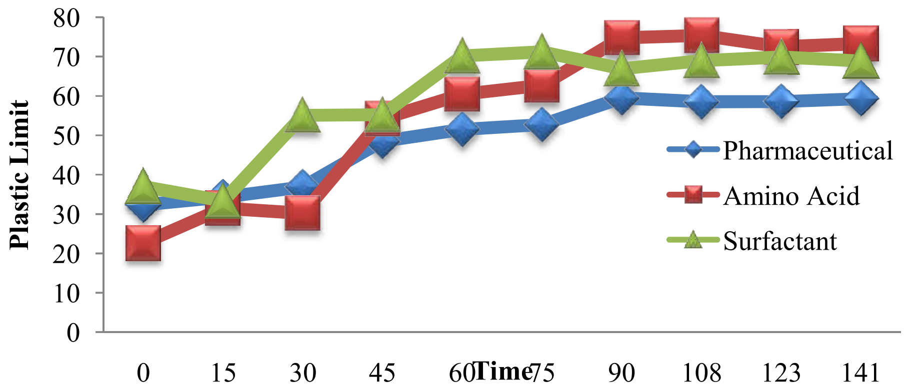

Fig 4.1 Plastic Limit VS Time: Variation of Index Properties with time due to artificial contamination of Amino Acid, Surfactant, Pharmaceuticals Effluents on Commercial Soil (CS) 141 days

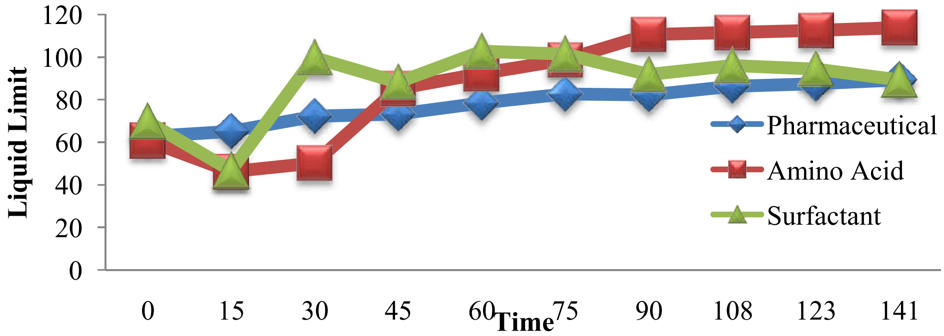

Fig 4.2 Liquid Limit VS Time: Variation of Index Properties with time due to artificial contamination of Amino Acid, Surfactant, Pharmaceuticals Effluents on Commercial Soil (CS) 141 days

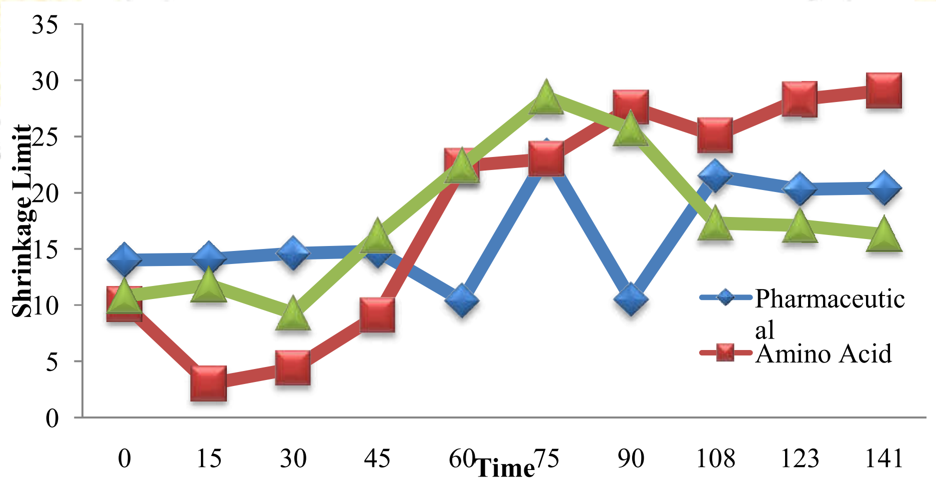

Fig 4.3 Shrinkage Limit VS Time: Variation of Index Properties with time due to artificial contamination of Amino Acid, Surfactant, Pharmaceuticals Effluents on Commercial Soil (CS) 141 days

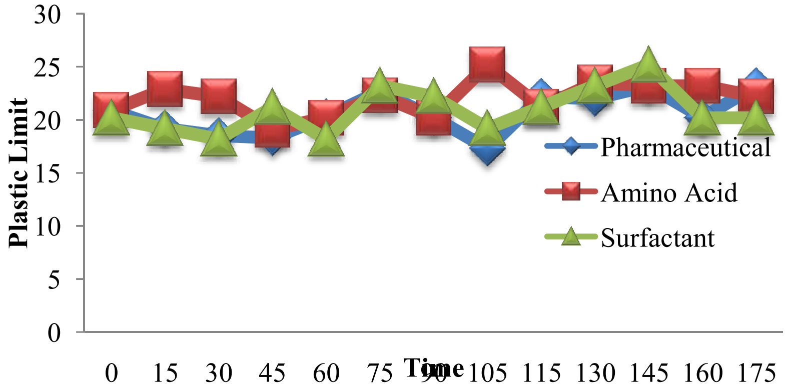

Fig 4.4 Plastic Limit VS Time: Variation of Index Properties with time due to artificial contamination of Amino Acid, Surfactant, Pharmaceuticals Effluents on Natural Soil (NS) 175 days

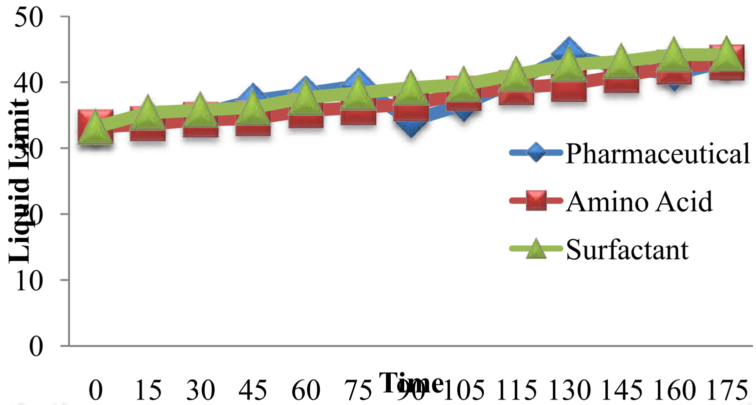

Fig 4.5 Liquid Limit VS Time: Variation of Index Properties with time due to artificial contamination of Amino Acid, Surfactant, Pharmaceuticals Effluents on Natural Soil (NS) 175 days

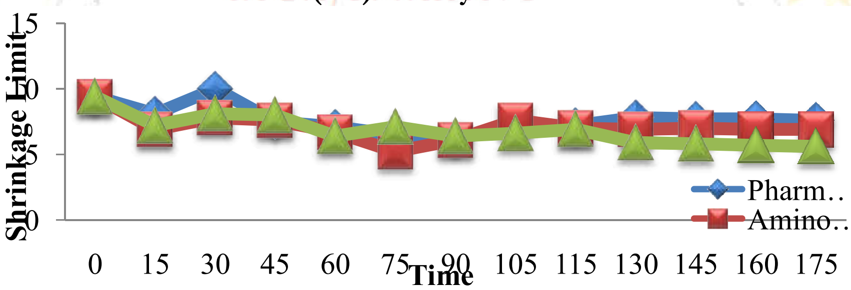

Fig 4.6 Shrinkage Limit VS Time: Variation of Index Properties with time due to artificial contamination of Amino Acid, Surfactant, Pharmaceuticals Effluents on Natural Soil (NS) 175 days

4. CONCLUSION

The three chosen effluents namely amino acid, surfactant and pharmaceutical are found to possess unique characteristics.Amino acid effluent is very Sound to be very 'highly acidic' (pH = 3 to 4) and highly concentrated with respect to organic contents (COD - 19000 to 20000 mg/L). Hence it has the potential to destroy the physical properties and the geotechnical characteristics of a soil.Surfactant effluent have the tendency to form a 'scum' and 'impact imperviousness' to a soil mass. The above effluent is found to be of 'medium alkaline' in nature (pH = 6 to 12) and contain a 'higher concentration of COD' (10,200 to 14.500 mg/L) then the other two.Pharmaceutical effluent is found to be very 'highly acidic' (pH = 3 to 4) with extremely high concentration of total dissolved solids (TDS) in the range of 18,500-25,000 mg/L. The above effluent is categorized as 'highly toxic' due to the presence of antibiotics and its various intermediates (recalcitrant iii nature i.e., not easily degradable) which have the potential to completely destroy the nutrients and the beneficial microbes present in a soil mass. It has a tendency to take a very long duration of time for bio-transformation. To attain a stable state, due to the absence of supporting nutrients required for initiation and completion of biological reactions.The commercial soil kaolinite (CS) is classified as silt and clays of low compressibility (liquid limit = 33%) according to IS classification.

REFRENCES

[1]. Abd-Allah, A.M.A. and Srorr. 'T. (2010), "Biodegradation of anionic surfactants in the presence of organic contaminants". Water, Research, Vol. 32. No. 3. pp. 944 - 947.

[2]. Acracy. and Ghosb, A. (2010), "Role of activity in hydraulic conductivity of compacted soils permeated with acetone". International Symposium on Environmental Geo technology, Pennsylvania. USA. Vol. I, pp. 391 - 412.

[3] .Adams, C.D., Spitzer. S. and Cowan, R.M(1996). "Biodegradation of non – ionic surfactants and effects of oxidative pre-treatment". Joio.1701 of Environmental Engineering, Vol. 122, No. 6: pp. 477 - 483.

[4]. Adams, J.A. and Reddy, K.R. (2010). "Laboratory study of air sparging of TCE Contaminated saturated soils and ground water". Ground water Monitoring and Remediation. Vol. 19. No. 3. pp. 182 -190.

[5] Adams. J.A. and Reddy, K.R. (2003) "Extent of benzene degradation in saturated soil column during air sparging", Ground water Monitoring c: nd Remediation. Vol. 23. No. 3. pp. 85 - 94.

[6]. A1 - Sanad. H.A., Eid. W.K. and Ismeal. N.F. (2010), "Geotechnical properties of soil - contaminated Kuwaiti". Journal of Geo technical Engineering. Vol. 121. No. 5. pp. 407-412.

[7]. Allah, A. A. and Srorr. T. (2010). "Biodegradation of anionic surfactants in the presence of organic contaminants", Water Research, Vol. 32. No. 4. pp. 944 - 947.

[8]. Ansoti. R.W. and Ilawkins, A.B.(2010), "The effect of calcium ions in pore water on the residual shear strength of Kaolinite and Sodium montmorillonite". Geo technique, Vol. 48. No. 6. pp.787-800.

[9]. Anson. R.1V.n'. and Hawkins, A.B. (2010). "The effect of calcium ions in pore water on the residual shear strength of kaolinite and sodium montmorillonite". Geo technique Vol. 52. No. 5. pp. 379-381.

[10]. APHA. (2010), Standard Methods for the Examination of water and waste water, 20th Ed.. American Public Health Association. Washington, DC.

[11]. Bachewar and Mehta (2010). "Assessment of waste effluent fro111 drug industry and its influence on soil quality", Indian Journal of Environmental Protection. Vol. 21. No. 9: pp. 834 – 830

[12]. Badv. K. and Kerry Rowe, R. (2010). "Contaminant transport through a soil liner underlain by an unsaturated stone collection layer". Canadian Journa1 of Geotechnical Engineering Vol. 33. pp. 121 - i45.