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Geotechnical Analysis of Fine Soil and Valorization for a Deposit Center of Waste

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Abstract: The following study aims to present some works which are going on in our laboratory of materials and durability of structure as a part of a research program, at the University Mentouri of Constantine (Algeria) The research is dealing with the quantification and the evaluation of the potential swelling of the fine particles in the area of Constantine to attempt a geotechnical barrier in the study of the deposit center of waste and the waste disposal. The analysis of the physical-chemical and mineralogical properties has lead to define the major characteristics of the samples, which were tested. A methodical analysis was used called a geometrical figure or A print to describe and structure the results which give a real classification and identification of soil accordingly to the U.S.C.S classification. This tool allow to choice the specimen in term of selected way and take in consideration a lot of variables which can reduce the rate of error and provide a better understanding and behavior of the deposit center of waste.

Key words: Geotechnical characterization, clays, swelling, A. print, waste disposal

INTRODUCTION

The selected sites to be used as a center of wasted deposit are in fact formed by soils, which have an important proportion of fines particles less than 2 μm. Even more than the natural barrier, we used other device of constituted confined natural or artificial materials Alter (1987) and Alter *et al.* (1985).

In this plan of action, which represents the active barrier, the compacted fine soils have an important part in the generated control solution by the organic polluted contact and the inorganic waste and the flow of water Estornell (1991). The Algerian rules providing by the environmental ministry proposed that the active layer must have permeability less than 10^{-9} m s^{+} .

However, the principles parameters, which governed the solute transportation Lo *et al.* (1994) are the coefficient of permeability and their diffusion. Recent studies have shown that the diffusion is an important parameter in the solute transport Monjoi *et al.* (1992).

Our research project is to evaluate the capacity of fine soils in the North of the Constantine region to receive watertight barrier. That's why we have got an important program of research in this way. In this study we present A print methodology used to choice soils, which can be used as a watertight barrier and soils that have characterization parameters for this type of project.

TEST DESCRIPTION

Physical: The physical characterizations of all tests were realized following the AFNOR methods. The free swelling tests were done by the Holtz and Gibbs methods. The operating way consisted to put 10 cm^3 of dry soil sieved in the 400 μm and dried in the oven for 24 h in a graduated bottle of 100 cm^3. The free index of swelling was calculated as a proportion of the quantify swell specimen versus the initial volume of dry soil.

The optimum dry density and the maximal water content Wopt were determined by the classical procedure following the AFNOR standard where some precautions were taken in considerations for the specimen conservation and the uniformization of the humidity of specimen.

Physical-chemical: In the following part we used the bleu of methyl and the pH of soil method. The test of the methyl bleu will allow the capacity of cationic exchange and the total specifically surface.

This test was performed on a fraction of 30 g. Less than 400 μm dried in the oven during 24 h at 105°C. This was versed in 200 mL of demineralized water during 24 h then this mixture was put in 1000 cm^3 and taken in a permanently agitation (velocity 400 to 700 trs min^{-1}). In this mixture, a concentration of the methyl bleu was

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injected by successive doses till all the fine particles of clays were completely saturated. This phenomenon was detected by the test called spot. The test has to do with a drop of the suspension a spot on a paper filter within the middle, which is bleu and all around it, will blank and in color. The excess will follow a halo bleu, which can be positive if the halo will persist after 5 min. The total specifically surface SST would be determined by taking that the bleu of methyl would be fixed on the particles of soil in a layer monomolecular.

RESULTS AND DISCUSSION

The inventory has permitted to choice few selected sites, which have an important percentage of fine particles of clays. Consulting the geological and geotechnical reports done before over the area from different public services and authorities such as the laboratory and so on have done this.

The test results shown realized on the laboratory of materials, soil and structures over different specimen, which were selected from sites, are in Table 1. We can see that the clayey fraction (2 μm) of the specimen lies from 4.9 to 54.1%, silt (0.02 mm and 2 μm) from 7.5 to 39% and sand from 16.6 to 75.8%.

The representation of all specimen tested in the diagram of Casagrande shows that most of the soil is over the strait line A. The specimen E4 and E1 are lined up on two lines and parallel to line A. The two others E3 and E10 are under line A, which can predict a same origin. Following the Holtz and Gibbs classification E9 presents a lower potential of swelling, specimens E3, E4, E6, E7, E8, E10 have a middle potential of swelling only E1, E2 and E5 have higher potential of swelling (Ig>100%). The Magnan and Youssefian defining classification from methyl bleu value and the percentage of fine particles, the E7, E3 and E6 are very active. Table 2 shows the capacity of cationic exchange and specifically surface as determined by the tests results from the methyl bleu values. We can see that the specimens tested are subdivided in 3 parts.

The first one can be assimilated to kaolin, the second one to the illite and the third one the samples E7, E3 and E10 are of natural clay nature, which can be classified following the total specifically surface as chlorite whose value of C.E.C is between 10 and 40 meq 100 g^{-1}.

The plastic limit of samples has shown a good relationship with the Wopt. Therefore a used soil as a watertight barrier of confined wasted or hydraulic structure must be compacted at moisture content higher than this moisture content optimal in a way that no more cracks will appear (Fig. 1).

Lambe 1958 has shown a relationship between the particles orientation in the beginning of the drying procedure and the value of the shrinkage at the end of drying for the compacted bleu Boston clays. The experience has shown that more particles are parallel; higher would be the shrinkage after drying. We can suggest that a soil with a higher flocculation particles and a higher liquid limit undergo less shrinkage than a soil with a less flocculated particles and a less liquid limit.

The less value of C.E.C has been obtained for sample E1 and the highest one for sample E7. All the others samples have values in between which can be due to the percentage of active mineral (montmorillonit). P_{90} of the samples E6, E3, E7, E2 and E4 sieved at 0.08 mm (= 80 μm) the samples present a percentage of particles less than 2 μm between 28 and 54.2%, which agree with their C.E.C and a high specifically surface and can be assimilated to a montmorillonite Ca since this activity index is higher than 1.5 and could be taken as active clay soil. Figure 2 The tests results show a high plasticity only one of them with a lower value with a less content in clay.

The A print consists of plasticity chart represented in the first quadrant Casagrande (1956) activity Skempton (1964) and Van Der Merwe (1964) represented in the second quadrant, particles size distributions, represented in the third quadrant and the fourth quadrant will closed

Table 1: Tests results from different specimen of the area of constantine

Samples	Sand	Silt	Clay	γs	wp	Wl	wr	Ip	IR	γd	Wopt	Ig	A
E1	46.5	26.6	27.5	2.72	16	31	12	15	19	1.941	12.1	120	0.58
E2	27.9	34.6	37.5	2.79	23	49	16	25	33	1.846	15.4	140	0.68
E3	20.0	25.9	54.1	2.78	29	55	14	26	40	1.742	24.4	80	0.48
E4	30.0	33.3	36.7	2.82	19	41	12	22	29	1.875	15.2	70	0.59
E5	36.0	35.7	28.3	2.76	22	37	12	15	25	1.800	16.0	142	0.53
E6	16.6	39.8	43.9	2.73	27	59	14	32	45	1.710	18.4	60	0.73
E7	19.6	27.9	52.5	2.8	31	51	13	20	38	1.563	25.4	90	0.38
E8	52.2	32.1	15.4	2.77	23	44	15	21	29	1.74	17.5	65	1.36
E9	74.3	20.8	4.9	2.85	18	22	12	4	10	1.972	13.0	25	0.81
E10	75.8	7.5	16.7	2.65	37	48	22	11	26	1.565	24.0	50	0.54

Table 2: Values of cationic exchange capacity and specifical surface for specimen

Samples	Cationic exchange capacity (meq 100 g^{-1})	Specifical surface (m^2 g^{-1})	pH
	Methyl bleu method's	Methyl bleu method's(inside+out)	
E1	5	40	7
E2	6	44	5.3
E3	25	195	8.2
E4	9	69	7.8
E5	10	83	8.2
E6	14	27	8.8
E7	37	284	8
E8	13	99	8.7
E9	6	46	9.2
E10	23	179	8.5

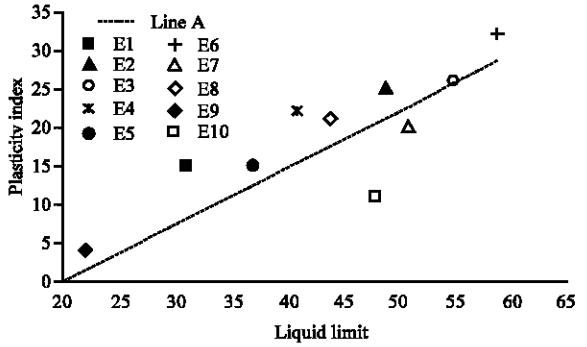

Fig. 1: Plasticity index versus liquid limit

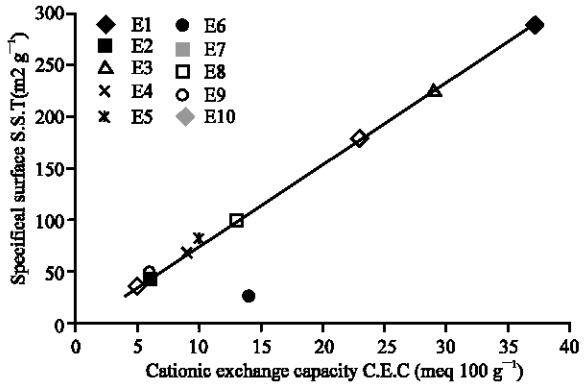

Fig. 2: Specifical surface versus cationic exchange capacity

the A print Andrei *et al.* (1993, 1995). The obtained graph is a graphical representation of soil from a physical point of view. This graphical representation allows the comparison between different soils and defines as used A print or not which permit the choice of soil for wasted watertight.

The A print shows well that soils which can be used as a watertight barrier must have their A print not in the central quadrant. Actually measures of coefficient of permeability are under going in our laboratory of soil mechanics and structure for a better understanding of the behavior of these soils Fig. 3. A print for samples from the area of Constantine with its lithological view.

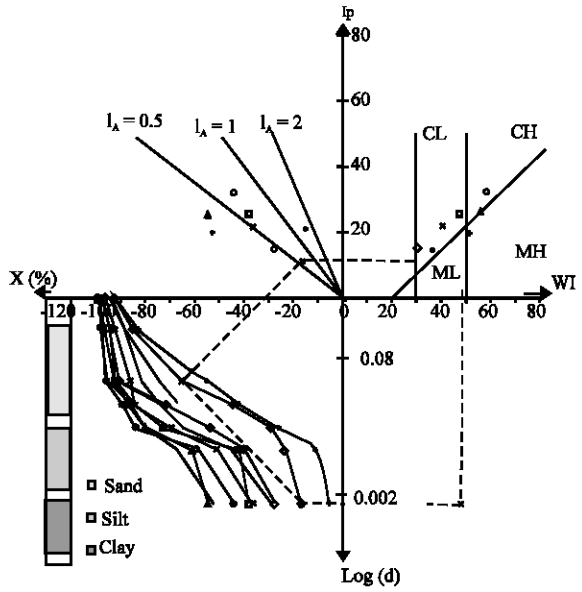

Fig. 3: A print for samples of the area of Constantine (Algeria)

CONCLUSION

The analysis of the properties has shown that in natural soils, the strait line relationship found by others authors, whom have used soils in melange proportions are essentially due to the composed effects of a lots of parameters, which undergo in between.

The A print method is used to describe the global information of soils and structure the data in giving them a geometrical form and its lithological aspect to classify and to identify the soil which we are dealing with.

In this study, the A print technical was used to have an object to select samples easily in taking a lot of parameters touchy to serve as a watertight barrier of confined wasted soil and over which would be conducted tests of permeability and diffusions.

REFERENCES

Alter, G.R., 1987. The qualifications of bentonite as soil sealant. Eng. Geol., 23: 177-91.

Alter, G.R., J.C. Evans, H.Y. Fang and K. Witmer, 1985. influence of inorganic permenants upon the permeability of bentonite. In hydraulic barriers in soil and rock, ASTM. STP., 874: 64-73.

Andrei, S. and S. Manea, 1993. Forecast of moisture movement in unsaturated soils. Proceeding of the Second International Seminar on Soil Mechanics and Foundation Engineering of Iran, pp: 160-174.

Andrei, S. and S. Manea, 1995. Systematisation, Stockage and Re-used of Data Regarding Soil Stabilisation Romanian Soc. Soil Mech. Foundation Eng., pp: 43.

Estornell, P., 1991. Bench-scale hydraulic conductivity tests of bentonics blanket materials for liner and cover systems of science in Engineering. University of texas at Austin.

Lo, I., M.C., H.M. Liljestrand and D.E. Daniel, 1994. Hydraulic Conductivity and Adsorption Parameters for Pollutant Transport Through Montmorillonite and Modified Montmorollinite Clay Liner Materials. In: Hydraulic Conductivity and Waste Contaminant Transport in Soils. ASTM STP 1142, D.E. Daniel and S. Tautwein (Eds.), STM. Philadelphia, pp: 442-438.

Monjoi, A., J.M. Rigo and C.I. Polo-Chiapolini, 1992. Vade Mecum Pour la Réalisation Des Systèmes D'étanchéité-drainage Artificiels Pour les Sites D'enfouissement Technique en Wallonie, (Eds.), Derouaux-Ordina. Liège Belgique.

Van Der MerWe, D.H., 1964. The prediction of heave from the plasticity index and the percentage Clay Fraction. Trans. S.A Ins. Civil Eng., 6: 103-107.