Contribution to Phenomenon of Sechage-Humidification of a ClaySoil of Algiers: Case the Argillaceous Marnes

F. Z. Aissiou and A. Nechench

***Abstract*—Consecutive differential movements of ground to the dryness and the rehydration of the sols" are irregular movements of ground related to the phenomenon of withdrawal-swelling of clays. They appear in the clay soils and are related to the water variations of the ground. These movements are slow and involve a progressive deformation of the grounds, not always perceptible by the man. During the periods of dryness, the lack of water involves the retractation of clays: there is a phase of withdrawal. Contrary, a new contribution of water in these grounds produces a phenomenon of swelling. By risk of withdrawal-swelling, one understands the phenomenon "natural" likely to occur, with a probability of more or less large occurrence. For the phenomenon of withdrawal-swelling of the argillaceous grounds, one will speak about strong, average or weak risk.This article returns within the framework d' study of risk withdrawal - swelling or dryness-humidification of the argillaceous marnes of the area of Ouled Fayet and Ch éraga of Algiers.**

***Index Terms*—Dryness-humidification, risk, argillaceous Marnes of Algiers.**

I. Introduction

In certain cases of the world, the phenomenon of swelling is likely to induce very important disorders: Is immediately during the digging in the form mainly of rising and destructuration of the rock located in erasing and incidentally d' instability in base of oven wall is later on well after the startup in the form of very high pressures exerting on the rigid pavement, generally in erasing but also in certain cases (faded tectonic zones) on all the contour of the coating.The technical provisions to adopt to reduce the effects of swelling as far as possible are as much less expensive they are preventive and implementations before the manifestations of the phenomenon. Also it within the framework is appropriate; a project of tunnel in likely medium to induce swelling[1]:

To appreciate the probability correctly; occurrence of the phenomenon and to characterize quantitatively; intensity of the expected effects, so to be able to define and dimension consequently the adequate constructive provisions. Swelling is an extremely detrimental phenomenon which can occur during the completion of the work is (possibly a long time) after those. The phenomena of swelling will take place only in the presence of inflating materials and of water[2].

Manuscript received October 23, 2012; revised December 24, 2012.

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II. Experimental Protocols

A. Estimate and Forecast of Ground Heaving of Algiers

Two methods (indirect and direct) were used to characterize our clay soils studied in this article and which consist in indirectly determining a correlation between the free swelling “potential of swelling” and some parameters geotechnics like the limits of Atterberg, the shrinkage limit, the water content, dry density, the value of the blue which seems to be the factors influencing swelling of clays and directly by the calculation of the pressures and amplitudes of swelling. For this part, we took two samples of clay soil coming from “Cheraga (Sample n°1) of 4.70m of depth” and of “Ouled Fayet (Sample n°2) of 3m of depth”, these two sites belong to the same area which profits from a local climate of Mediterranean type semi - wet. This area is known also by these marnes plaisancians covering a broad surface in the south-west of the Sahel of Algiers[3].

B. Identification of Samples

The granulometry of the two samples shows that almost 100% of the particles are lower than 80 micro meters and still best the majority of these particles are Inferiors than 2 micro meters which represents the argillaceous particles the remainder of the percentage represents the silt see (Fig. 1) [4].

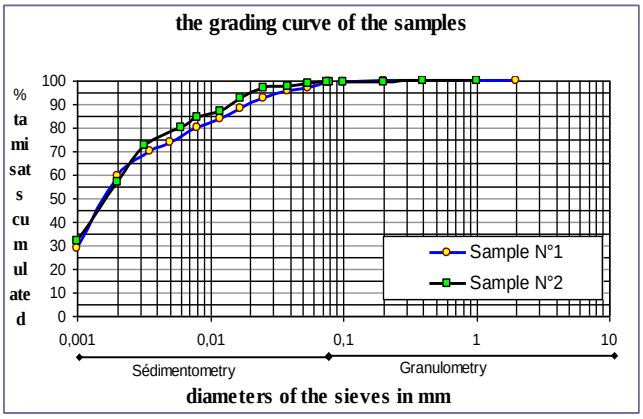

Fig. 1. The grading curve for the 2 samples

C. Summary Chemical Analysis

The chemical analysis gave us a percentage of limestone ranging between 10 and 30% with small quantities of sodium chlorides and traces for sulphates, the quantity of the organic matter are negligible for the two samples; one can say there that our grounds are inorganic marly clays according to the classification of Standard (Table I) [4].

DOI: 10.7763/IJET.2013.V5.530

TABLE I: THE SUMMARY CHEMICAL COMPOSITION OF THE TWO CLAY GROUNDS

Designations	Sample n °1	Sample n °2
Insolubles	62.53	64.77
Carbonates ($Caco_3$) calcareous	19.3	27.19
Loss on the ignition with 1050 °c	17.93	20.3
Alumina and iron oxide (Fe2O3 and Al2O3)	7.08	6.13
Sulphates ($CaSO3, 2H_2O$)	traces	traces
Carbon dioxide (CO2)	8.49	11.96
Chlorides (NaCl)	0.29	0.23
Boiler feed water (H2O)	9.44	8.34
Ponderal chemical assessment	98.64	98.32

D. Limits of Atterberg

On a macroscopic level, the phenomenon of swelling is to be brought closer to the notion of the limits of Atterberg. IP is an important parameter in the properties of retention d' water of the ground and thus of swelling. Is the reason for which a certain number of correlations quickly were required between the limits of Atterberg and the properties of ground heaving[5]. One notices according to the values exposed in (Table II).

TABLE II: DIFFERENT PARAMETERS IDENTIFIERS SAMPLES OF GROUND DETERMINED AT THE LABORATORY

Parameters	W_l (%)	W_p (%)	I_p (%)	I_c (%)	W_n (%)	VBs (ml/g)	A_c
Marly clay Sample n °1	65.2	30.01	35.19	1.65	7.08	6	0.59
Marly clay Sample n °2)	81.87	34.23	47.64	1.58	6.38	6.5	0.83

That our samples are very plastic and extremely consistent material grounds, indices of plasticities thus exceed 35% these two grounds position with the top of the line has abacus of Standard (Fig. 2 and Fig. 3).

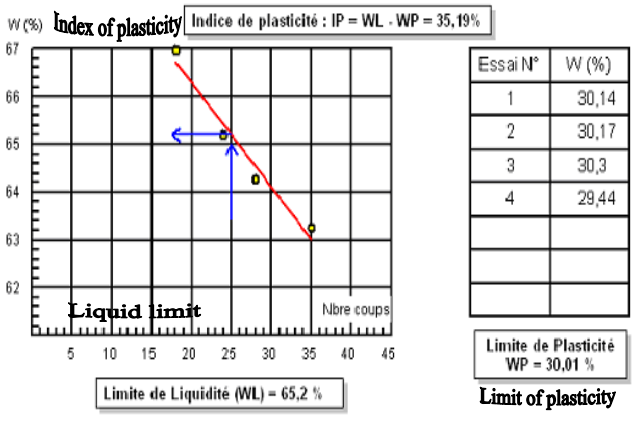

Fig. 2. Limits of the sample N °1

E. Diffraction by X-Rays

The mineralogical analyses are carried out using the diffraction of x-rays of the material powders on the level of laboratory of minerals at the institute of science of the ground of the U.S.T.H.B. The diffractograms obtained were recorded thanks to an apparatus *Philips XPERT* MPD. The diffractograms show that these materials are composed of following mineral phases: Quartz (D = 4.23 Å and D = 3.31 Å) like major impurity in the 2 samples; the dolomite (D = 2,84 Å) is present in the 2 samples; calcite (D = 3.01 Å) present in the samples (1et2) the reflexions at D = 3.82Å is allotted to feldspars of the plagioclase type as well as magnesites, the presence of kaolinite is noted (D = 7.15 Å and D = 3.53 Å); the peaks with 10.27 Å and 4.94 Å highlight the presence of illite. Laminated inters illite - montmorillonites are presented by reflexions of 12.36A °(See Fig. 4).

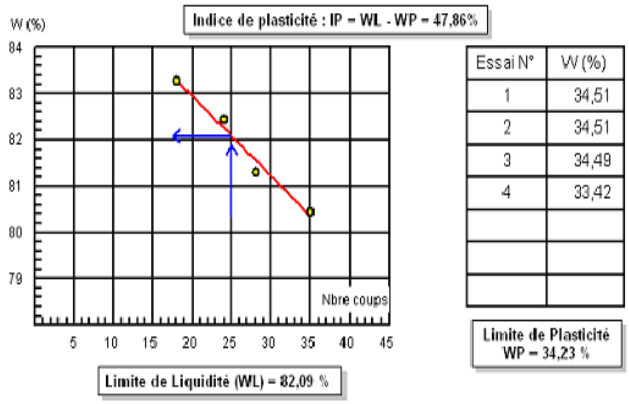

Fig. 3. Limits of the sample N °2

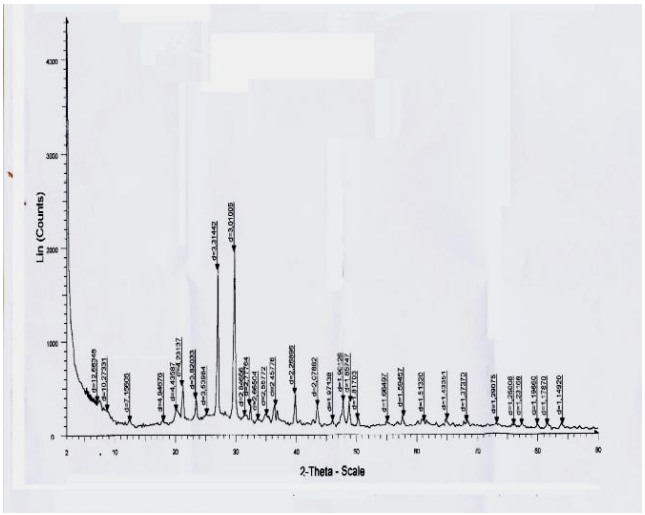

Fig. 4. The graph of diffractogram for the clay samples

III. ESTIMATE AND OF THE THEORETICAL APPROACHES ON SWELLING (INDIRECT METHOD)

The identification of the inflating grounds is generally approached starting from the easily measurable physicochemical parameters during the preliminary tests[6]. However, this identification is complicated by the existence of several approaches which are based neither on the same parameters nor on the same number. The census starting from bibliography [3],[6] of classifications makes it possible to arrange them in three classes according to the number of

physicochemical parameters used. The classification of Altemeyer (1955), that of Seed, Woodward and Lundgren (1962), that of Ranganatham and Satyanarayana (1955) base all on only one parameter. The classifications based on two parameters are that established by the establishment of research out of building (the United Kingdom, 1980) and that established by Chen (1988). Dakshanamurphy and Raman (1973). These two last classifications use the abacus of plasticity of Standard. One notices by these classifications, that our grounds are of potential of swelling raised with very high all the approaches quoted with the top indicate this character inflating for the samples of Algiers while being based on the limits of consistencies and the percentages of the argillaceous grains[7,8] (Table III).

TABLE III: CLASSIFICATION OF THE POTENTIAL OF SWELLING OF THE SAMPLES OF ALGIERS ACCORDING TO SOME MODELS

parameters	Cheraga	Ouled Fayet	results	Methods	Potential of swelling
W_1 (%)	65.2	81.87	50-70 and70-90	Dakshanamurthy and Raman, 1973	raised with very high
W_p (%)	30.013	34.23			
I_p (%)	35.19	47.64	> 35	Seed and al	very high
Ir (%)	59.70	77.87	> 60	Ranganatham and Satyanarayana,1965	very extremely
W_n (%)	7.08	6.38			
Wr (%)	5.5	4	< 10	Altemeyer, 1955	extremely
%<74µm	99.44%	99.66%	>95%	Chen ,1988	Very high
%<2 µ m	59.24%	56.76%	30-60%	BRE, 1980	means with high

The test oedometric with free swelling consists in placing the sample of ground in a cylindrical cell between two porous stones. Then following the imbibition it is authorized to inflate vertically under the pressure of the piston during several days until stabilization [6]. The end value makes it possible to calculate the relative variation of the volume of the sample which represents the rate of swelling noted per G (Table VI).

TABLE VI: THE VALUES OF THE FREE TEST SWELLING FOR THE TWO SAMPLES.

Parameters	Rate of swelling (%)	Pressure of swilling in (bar)	Index of swilling (%)	Premary swilling (%)	Secondary swilling (%)
Marly clay Sample n °1	50.76	2.08	3.06	4.42	8.31
Marly clay Sample n °2	37.76	2.48	3.56	3.51	6.31

According to the swelling numbers found for the two samples, one can say that our grounds are inflating because 0.02<Cg<0.25 the classification of Standard with pressures of swelling also raised (2.08 bar for the clay of Cheraga and 2.48 bar for the clay of Ouled Fayet) and the curve which gives the percentages of swelling obtained according to time indicates the presence of two phase the first phase of swelling, dependent on the migration of water in the test-tube starting from its ends, raises of a process of diffusion. It is more or less slow according to nature and the state of material, and according to the loading, and hard a few hours the percentages recorded for primary education swelling (Fig. 5 and Fig. 6).

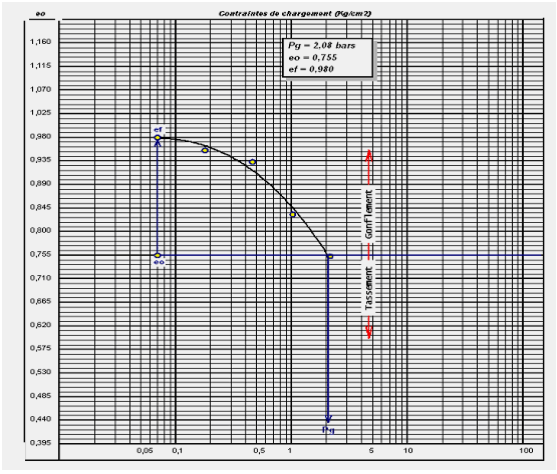

Fig. 5. The curve of free swilling of marly clay of cheraga

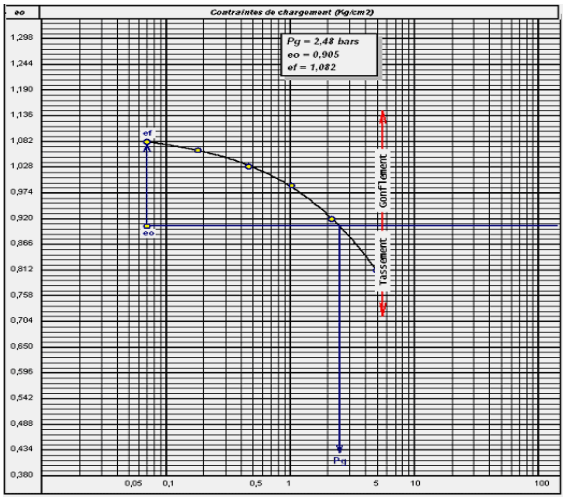

Fig. 6. The curve of free swilling of marly clay of ouled fayet

The secondary phase of swelling is more problematic, because the direction of the deformation of swelling is opposed to that of the loading, contrary to the creep which produces deformations of compression under loads of compression. The kinetics of secondary swelling is very slow and depends on the level of loading and, for weak loads, it is often impossible to reach a balance under reasonable conditions of realization of the laboratory tests the percentages of swelling obtained are definitely higher than that of primary education swelling (see Fig. 7 and Fig. 8).

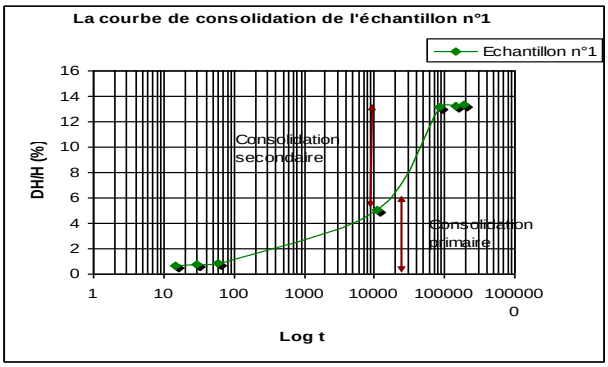

Fig. 7. The curve of primary and secondary swilling of the clay of Cheraga

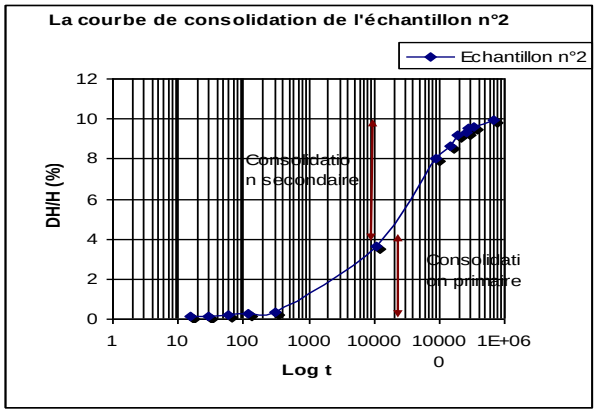

Fig. 8. The curve of primary and secondary swilling of the clay of Ouled Fayet

Thus a primary education phase of swelling (corresponding to the diffusion of water in the pores) and a secondary phase of swelling of hydration of argillaceous minerals

IV. Conclusion

Algeria knew damage caused by the phenomenon of swelling-withdrawal as the majority of the pleasing countries of the world for example in Ain (refinery of Sonnatrach) drew us the attention with its existence in our vast Sahara and even thing for the western area of Tlemcen and Maghnia, as well as the area of hodna Msila which knew itself of the damage (increase of foundation of the hospital and important cracks in the walls external), that is not finished since the ground of the area of the Sahel of Algiers in the majority is the marly argillaceous and muddy, which is inflatable grounds and returns within the framework of the risk of release of phenomenon of withdrawal swelling. Thus this article, lies within the scope of study of two samples of Algiers (Cheraga and Ouled Fayet) at the laboratory first of all by classification tests to be able to give an estimate and forecast with the potential of swelling of these samples thanks to an indirect method it is a series of correlations and approaches defined by researchers related to the parameters geotechnics, then by a direct method which is the test oedometric of free swelling and which revealed values of pressures and raised rates of swelling, in addition a study of the kinetics of swelling of the two samples for the evolution of swelling according to time enabled us to observe and notice according to the shape of the curves the existence of two slow phases of primary and secondary consolidation.

Acknowledgment

I would like to thank Mr Nechnech Ammar for his cooperation and his confidence in me, my gratitude goes to the mesieurs Aissa Mamoune, Bekkouche and Djeddid (professors at the University of Tlemcen in Algeria) who participated in the large part of the development of this topic and not forgetting Mr Bouafia (Professor at the University of Blida in Algeria) that got much encourage and me help writing this article)

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