THE GEOLOGICAL SURVEY OF THE ÇİMSA SITE
FOR
THE STUDY ON REGIONAL SOLID WASTE MANAGEMENT
FOR
ADANA – MERSİN IN THE REPUBLIC OF TURKEY
REPORT

Executed and issued
as per the specification prepared by

KOKUSAI KOGYO CO.
on behalf of JICA
(Japan International Co-operation Agency)

Adana – June – 1999
YER-BİL Co. Adana

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ABBREVIATIONS :

w_n	: natural moisture content of a soil, (%)
γ_n	: bulk densities of a soil, (t/m^3)
γ_s	: unit weight of a soil, (t/m^3)
k	: permeability of a soil Poor graded sand
w_l	: liquid limit, (%)
w_p	: plastic limit, (%)
CH	: medium dry density of a soil, (t/m^3)
CL	: low plasticity inorganic clay
CL – CH	: medium to low plasticity inorganic silty clay
SP	: poor graded sand

CHAPTER ONE-GENERAL

I. INTRODUCTION

A Geo-phisical survey has been carried out in Mersin, at the site called "CIMSA Sanitary Landfill" in order to study and verify the same from the stratification, resistence and permeability points of view. The readings were made on 13 points along 3 alignments with 25 metre observation depth. The execution has been accomplished by a Schlumberger Electrical Testing device.

II. SURVEY AREA

II.1. Location

The area in scope is about 15 km East of Mersin City, and reported to be called as "CIMSA Sanitary Landfill"

II.2. Climate

At the survey area, warm and rainy winter, hot and dry summer forming the characteristics of the Mediterranean Climate. According to the information furnished by the Meteorological Department of Mersin, the average annual precipitation is 641 mm whereas the most dry month is August and most rainy one is December. The coldest month is recorded to be January. The average annual temperature has been reported to be 18,6 centigrade celcius.

III. METHODS OF SURVEY

Making use of the topographical maps, the area and its environs were subjected to a visual observation by means of contact follow-up. Consequently, a 25 mt deep geo-electric survey over 13 points has been conducted to reveal the underground formation particulars. All the findings acquired with the above works have been verified and reconfirmed with the results of 3 boreholes.

IV. GEOLOGY

The dominating geology of the study area is outcropping as tertiary flisch with rotation of clay, sandstone and marl. As to the verification, it should be noted that the clear-cut and sufficiently deep excavations at and around the survey area has been very useful to compile dependable stratification data as to the estimations for the underground formations.

Over this instrumental possibility, 13 geo-electrical readings in harmonic positioning along with the 3 bore-holes reflected all together precision results.

The positioning of survey points to match the boreholes were as follows:

- **JF 5**, almost at B3
- **JF 8**, almost at B1
- **JF 1**, almost at B2.

As a general expression, it can be stated that the area is basing on silty clay over the dominating part of the survey area, representing a thickness about and over 9 metres (**see the profiles A-A and B-B**). In same zones, however, the thickness comes down to 7 mt (**see the profile C-C**).

The silty clay is topped by a layer varying from 2 mt to around 7 mt outcropping mainly clay dominating formations on the layer part.These formations consisting in variable values calische, gravel silt and sand.
These two layers are placed over limestone.
The silty clay has proven itself to be highly impermeable because of the low percentage and fine grain size of the silt contained therein. The laboratory tests results presented in the report are evidently confirming this. Scatteredly laying sandy clay too, is showing a similar character with very fine grains in a low percentage Kalische has appeared white and light cream, fine grained, is densified at the uppermost and progressively softer towards the lover levels. Accumulation of $CaCO_3$ detected.

V. GEO-ELECTRIC SURVEY INSTRUMENT

The utilised instrument operates by low freqency alternative current (03 cps), composed of three units, the power generator, induction unit and recepting unit.

The power generator has been coupled with an inverter fed by a 12 volt battery, Adjustable to apply the current as necessary into the ground.

The current from the source is then converted in to AC of 0,3CPS, by means of a relay, was applied to the ground on the observation points adopted. The Round stainless steel bars have been used as the electrodes for both the induction and reception.

V.1. Adopted geo-electric method

The Adopted method was the schlumberger Electrical Ground Survey Method. The latter is conducted by means of four electrodes. The electrodes were positioned such that the two in the middle have been the potential ones (receptacles). These were kept inert whilst the outer two inducters were mobilised in order to active deeper electrification. During the survey the AB/2 (*half distance between the induction electrodes*) has been 25 metres. Taking into account both the aplied current and the measured reflection of the same, the values giving the Apparent Resistance Values, for every AB/2,using the formula of

$$(=K \frac{\Delta V}{1})$$

In consideration of that the Apparent Resistance Values were the function of the half distance of the induction electrodes, the electrical survey curves were provided by plotting on a double-logaritmical diagram.

These curves have been subjected to an evaluation by the three layers reference diagrams of Orellena Mooney, applying two layers theoretical curves with partial overlapping, in order to obtain and record the depth, thickness and the resistance values. Moreover, all these data have been re-evaluated on the computer using the program developped by Gewin V .T., a Dutch expert.

It is worthy to mention that this program has been reflecting a wide reputation upon its ability to add refined evaluations on the compiled records.

Definition of the underground formation layers were made by means of pre-recorded Resistivity values observations on the area and the data obtained from the 4 boreholes drilled at the involved site.

Definition of the underground formation layers were made by means of pre-recorded Resistivity values, visual observation on the area and the data obtained from the 4 boreholes drilled at the involved site.

VI. GEO-ELECTRIC SURVEY RESULTS

The Results of the geo-physical Surveys composed of 13 readings over 3 axes have been plotted on there profiles, titled A-A, B-B, C-C.

The profiles are specified and explained below.

The profile A-A is studied by the geo-electrical reading JF 10, JF11, JF12 and JF13. The upper layers is Kalische in thickness of 2-4 metre with a resistence range of 400-100 ohm/metre.

The high resistence represent presence of dense limestones whereas the lower ones represent the comparably soft particles. Below the calische, silty-clay with 13-25 ohm/metre resistence is taking place. The silty clay and the clay formations are giving the impermeable character.

The profile B-B is passing through the reading points JF5, JF6, JF7, and JF8. At the section covered by the JF5, JF6 and JF7, the uppermost layer with a thickness varying 2 to 6 metres is sandy clay with 14-25 ohm/metre resistence. The mass of silty clay below it, gives a resistence of 7-17 ohm/metre and is impermeable due to the fact that the grain size of the silt is very fine.

At the zone where the JF 8 is involving a resistence of 25-105 ohm/metre revealed conglomerates onto a 7 mt depth. Below it, again the silty clay with 7-17 ohm/metre resistence is laying. The silty clay mass laying over the limestone at 12,80mt, as observed particulary by the borhole B3.

Profile C-C is the axis on which the geo-electric reading JF1, JF2, JF3, JF4 are positioned. The top material, the calische with a depth of 5-8 metre, containing dense limestones reflecting 100-400 ohm/metre. Below this is the silty clay, which is impermeable for it contains a very low percentage of silt. The resistence value has been measured between 45-50ohm/metre. The limestone outcropping in the profile is fissurated and therefore permeable. However, it is quite down, end positioned below an impermeable layer.

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CHAPTER II

LABORATORY TEST RESULTS OF FILL MATERALS AND BOREHOLE SAMPLES

1. INTRODUCTION

This report has been prepared in accordance with the application of Aytaç Bilgen to the Faculty of Engineering and Architecture, the University of Çukurova on 29.04.1999.

The field which is under investigation will be the waste deposit site (where Mersin, Çimsa Area) of Mersin City.

Main concept to write the report is to present the laboratory test results, carried out on fill material and borehole samples, and to propose some necessary recommendations on the basis of the test results. A total number of 3 boreholes named B1, B2 and B3 were opened at the construction site. The stratification and some engineering properties of soil have been determined from visual inspection and standard penetration tests (SPT) done in the borehols. Soil samples were collected from the borings for laboratory testing. Fill materials taken from nearby soil pits to the site were also brought to the Civil Engineering Laboratory.

The location plan and the logs of borings, drilled previously, are presented in the final report. At the site, after the the top soil there exists mainly silty-clay. Cemented claystone layer with calcerous are observed below these

II. LABORATORY TESTING

Representative undisturbed and disturbed soil samples from different soils at various depth from the investigation site and fill material samples from the nearby soil pits were taken. The samples were subjected to necessary laboratory tests in the soil mechanics laboratory of Civil Engineering Department of the University of Çukurova in accordance with ASTM and related Turkish Standards (TS – 1900). The description, classification and compressibility characteristic of soils have been obtained from experiments. Most of the laboratory test results tabulated and plotted, are given in pages 13 to 40.

II.1 Boring Samples :

The moisture content of the soils were determined on undisturbed and disturbed samples. It has been found that the moisture content of the soil samples, taken from various depths varies between

$$W_n = \%19 - \%35$$

The test results are given in Tables 5 and 6.

The Bulk densities of the soils were obtained from the undisturbed soils and the results are shown in Tables 3 and 6. The bulk densities of soils vary between

$$\gamma_n = 1.81 - 1.89 \text{ ton/m}^3.$$

The unit weights of the soils were obtained from Pycnometer tests and the results are shown in Tables 4 and 6. The Unit weights of soils vary between

$$\gamma_s = 2.69 - 2.74 \text{ ton/m}^3$$

In order to determine the coefficient of permeability of clayey soil falling head test method was used. The equation applicable to this test is given as

$$k = \frac{a.L}{A.(t_2 - t_1)} \ln \frac{h_1}{h_2}$$

Where;

a: cross-sectional area of buret (cm^2)

A: cross-sectional area of soil sample (cm^2)

h_1: hydraulic head across sample at beginning of test ($t=t_1=0$)

h_2: hydraulic head across sample at end of test ($t=t_2$)

L: sample length (cm)

ln: natural logarithm to base

The results of the tests are given in the table 1.

Table 1 The values of k (in cm/sec)

Borehole No	B1	B1	B2	B2	B3	B3
Depth (m)	7.50-7.95	12.0-12.2	4.50-6.00	9.0-10.50	7.50-7.75	9.00-9.20
k (cm/sec)	3.51×10^{-7}	8.20×10^{-8}	6.22×10^{-7}	1.60×10^{-7}	7.13×10^{-7}	9.03×10^{-8}

The consolidation test was also used to estimate the coefficient of permeability and the values of k were found in the order of 1×10^{-7} cm/sec.

Grain size distribution of the soil samples were determined by sieve and hydrometer analyses. Soils named clay or claystone in the field were pulverized after drying them in an owen. The results of the tests are shown together with the grain size curves in pages 15 to 20.

The consistency limits of clay soil samples were determined and the results are presented in pages 21 to 26. The Atterberg Limits vary between

Liquid Limit W_l= %58 - %68

Plastic Limit W_p= %17 - %38

From the sieve and hydrometer analyses it has been found that the borehole soil samples consist of mainly clay and silt size fine materials (over 90%). And, gravel-sand size coarse materials are less than about 10%. The soil type at the site was 'high plasticity inorganic silty clay (with the group symbol CH). It is known that the permeability of this type of soils are very low.

II.2 Fill Material Samples from a Nearby Pit :

The Moisture content of the fill materials were determined on undisturbed and disturbed samples. It has been found that the moisture content of these samples, taken from different depths, varies between

W_n = %10.0 - % 27.0

The test results are given in Table 9.

The bulk densities of the fill materials were obtained from the undisturbed soils and the results are shown in Table 7. The bulk densities of these samples vary between

γ_n =1.65 – 1.79 ton/m^3.

The unit weights of the fill materials were obtained from Pysnometer tests and the results are shown in Table 8. The unit weights of these soils vary between

$$\gamma_s = 2.71 - 2.73 \text{ ton/m}^3$$

Grain size distribution of the soil samples were determined by sieve and hydrometer analyses. Two different types of fill materials were observed from the tests. The results of the tests are shown together with the grain size curves in pages 29 to 31.

In order to determine the compressibility characteristics of the soil, standard compaction (proctor) tests were performed on the fill material samples. Two different types of fill materials were observed from the tests. The results of the tests and the dry density – moisture relationships were plotted by minimum five points and the curves are given in pages 32 to 37. The values of optimum water content and maximum dry density obtained from these tests are shown in Table 2.

Table 2 The standard Compaction (Proctor)Tests on Fill Material

Sample No	γ_{kmax}	W_{opt}(%)
1	1.52	12.0
2	1.58	11.0
3	1.49	22.0

As seen from the table, optimum water content and maximum dry density values of the fill material samples 1 and 2 were found to vary between 12.0% - 11.0% and 1.52 – 1.58 ton/m³, respectively. The result of sample 2 gave considerably different values.

From The sieve and hydrometer analyses it has been found that the soil imported from nearby pits consist of mainly fine materials. And, gravel and sand size coarse materials are less than 3%. It can be concluded that these soil samples are highly plastic.

The consistency limits of clay soil samples were determined and the results are presented in pages 38 to 40.

$$\text{Liquid Limit } W_1 = \%52 - \%58$$

$$\text{Plastic Limit } W_P = \%20 - \%27$$

The soil Type of these fill materials are medium to high plasticity inorganic silty clay (With the group symbol CH). This type of soil has high compressibility and expansion properties.

III. CONCLUSION AND RECOMMENDATIONS

Investigation were carried out to get the soil properties of the waste deposit site (where Mersin Çimsa Area) of Mersin and the properties of the fill material which will be used in the site. The following suggestions need to be considered.

. The soil type at the site is 'high plasticity inorganic silty clay (with the group symbol , CH). Cemented claystone layer with calcerous are observed below this soils. It has been found that the permeability of the soil at the site is very low.

Fill material samples were tested and it has been found that all of the three soil samples were classified as medium to high plasticity inorganic silty clay (with the group symbol CH). A soil with this group symbole is generally not suggested to be used as fill material (since it gives low strength and high compressibility). But, when this type of soil is compacted properly, an impervious soil layer can be obtained. If any one of these pit materials are decided to be used as fill material, the best type of compaction equipment is a sheepsfoot roller. In that case, the fills should be done in 30cm thick layers. Compacted layers should be tested more often by in-situ density testing in order to confirm minimum 98% compression ratio. In the compaction control tests for each compacted layer the Proctor compaction values of maximum dry density and optimum water content should be considered as 1.58 ton/m^3 and 11%, respectively. So, for the relative compaction ratio of 98%, the value of maximum dry density shouldn't be less than the value of 1.55 ton/m^3. The values of optimum water content can vary in the range of 9.0%-13.0%. In order to prevent having loose parts in slope ends, fill area should be kept larger than planned and then cut as planned.

It is suggested for safety that control tests should be carried out whether the objectives of modifying the ground have been achieved. There is a great variaty of tests possible for evaluating the effect of mechanical ground modification, such as plate loading test and some laboratory tests on representative samples taken from the site.

Fills should be protected against any water including the ground water (in case of rise in ground water level) by means of a suitable drainage system. After the complition of fill,if there is need to excavate the fill for any reason, no water should permit to flow into the excavated holl.

03.06.1999

Prepared by

Assist. Prof. Dr. Mustafa LAMAN

Table 3 BULK DENSITY

Bore No.	Depth (m)	Can +soil (gr)	Volume (cm^3)	$\gamma_n (t/m^3)$
B1	7.50-7.95	132.3	73.25	1.81
B1	12.0-12.2	72.10	39.25	1.84
B2	4.50-6.0	144.51	39.25	1.82
B2	9.0-10.5	259.57	137.38	1.89
B3	7.50-7.75	125.00	67.31	1.86
B3	9.00-9.20	130.18	72.12	1.81

Table 4 SPESIFIC GRAVITY

Bore No.	Depth (m)	M1	M2	M3	$\gamma_s (t/m^3)$*
B1	7.50-7.95	75.9	624.78	672.87	2.73
B1	12.0-12.2	77.50	625.10	673.81	2.69
B2	4.50-6.0	75.50	624.19	672.00	2.73
B2	9.0-10.5	50.30	625.40	657.30	2.73
B3	7.50-7.75	76.00	624.79	672.90	2.72
B3	9.00-9.20	79.60	607.70	658.30	2.74

(*) Unit weigh (When it is devided by water unit weight, it is called gravity)

M1 : Mass of soil (gr)
M2 : Mass of bottle +water (gr)
M3 : Mass of bottle + soil + water (gr)

Table 5 WATER CONTENT

Bore No.	Depth (m)	Mass of Can (gr)	Can +Wet Soil (gr)	Can+Dry Soil (gr)	Water Content (%)
B1	7.50-7.95	33.76	75.43	64.62	35
B1	12.0-12.2	61.20	298.55	246.4	28
B2	4.50-6.0	66.70	210.8	187.81	19
B2	9.0-10.5	36.93	296.34	247.28	23
B3	7.50-7.75	76.5	473.86	396.94	24
B3	9.00-9.20	74.5	486.83	402.85	26

Table 6 The Result of Sieve and Hydrometer Analyses Borehole Samples

Location : Mersin

Bore No.	Depth (m)	$\gamma_n(t/m^3)$*	$\gamma_s(t/m^3)$/**	W(%)***	Soil Type****
B-1(1)	7.50 – 7.95	1.81	2.73	35	CH
B-1(2)	12.0 – 12.2	1.84	2.69	28	CH
B-2(1)	4.50 – 6.0	1.82	2.73	19	CH
B-2(2)	9.0 – 10.5	1.89	2.73	23	CH
B-3(1)	7.50 – 7.75	1.86	2.72	24	CH
B-3(2)	9.0 – 9.2	1.81	2.74	26	CH

* *Bulk density (measured in laboratory, test data is given in Table 3)*

** *Unit Weight (obtained from pycnometer test in laboratory test data is given in Table4)*

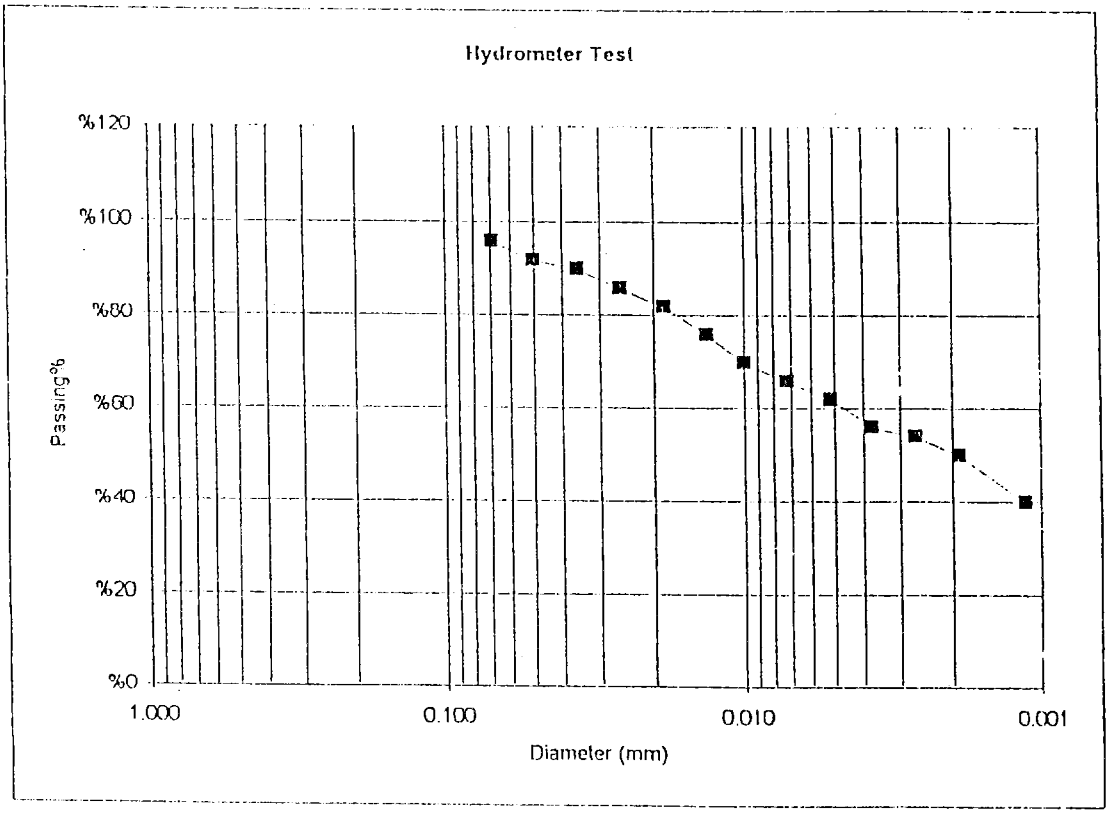
*** *Natural Moisture Content (Measured in laboratory, test Data is given in Table 5)*

**** *CH High plasticity inorganic silty clay*

HYDROMETER TEST

Project :		Bore No.	**B-1(1)**
Location :	- Mersin	Depth (m) :	7.50-7.95
Date :	20.05.1999	γs (t/m³) :	2.73
Temprature (°C) :	33	Mass of Soil (gr):	50

t(min)	Ra	Rc	Rm	Hc	D(mm)	Passing %
0.25	47.00	47.90	48.00	8.52	0.069	%96
0.50	45.00	45.90	46.00	8.84	0.050	%92
1	44.00	44.90	45.00	9.00	0.036	%90
2	42.00	42.90	43.00	9.33	0.026	%86
4	40.00	40.90	41.00	9.65	0.018	%82
8	37.00	37.90	38.00	10.14	0.013	%76
15	34.00	34.90	35.00	10.63	0.010	%70
30	32.00	32.90	33.00	10.95	0.007	%66
60	30.00	30.90	31.00	11.28	0.005	%62
120	27.00	27.90	28.00	11.77	0.004	%56
240	26.00	26.90	27.00	11.93	0.003	%54
480	24.00	24.90	25.00	12.25	0.002	%50
1440	19.00	19.90	20.00	13.07	0.001	%40



HYDROMETER TEST

Project :

Location : Mersin

Bore No. B-1(2)

Depth (m) : 12.00-12.20

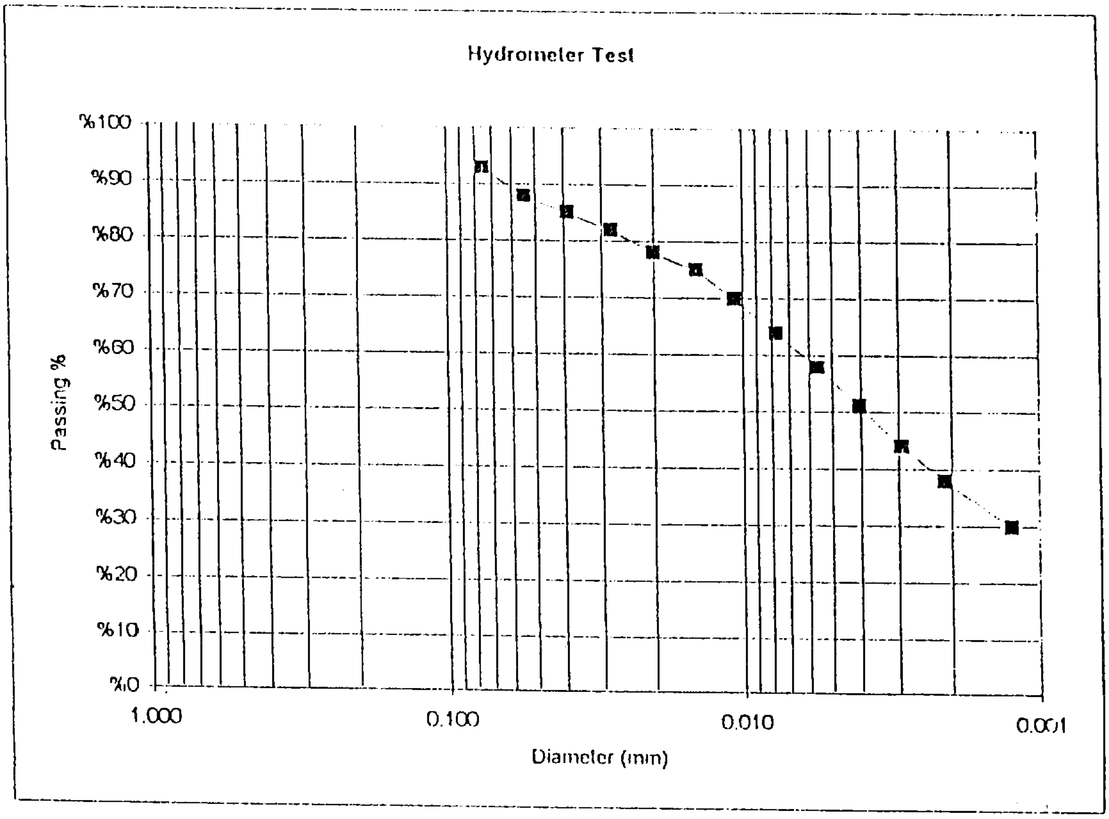
Date : 20.05.1999

Temprature (°C) : 28

γs (t/m³) : 2.69

Mass of Soil (gr): 50

t(min)	Ra	Rc	Rm	Hc	D(mm)	Passing %
0.25	47.50	46.40	48.50	8.76	0.075	%93
0.50	45.00	43.90	46.00	9.17	0.054	%88
1	43.50	42.40	44.50	9.41	0.039	%85
2	42.00	40.90	43.00	9.65	0.028	%82
4	40.00	38.90	41.00	9.98	0.020	%78
8	38.50	37.40	39.50	10.22	0.014	%75
15	36.00	34.90	37.00	10.63	0.011	%70
30	33.00	31.90	34.00	11.12	0.008	%64
60	30.00	28.90	31.00	11.60	0.006	%58
120	26.50	25.40	27.50	12.17	0.004	%51
240	23.00	21.90	24.00	12.74	0.003	%44
480	20.00	18.90	21.00	13.23	0.002	%38
1440	16.00	14.90	17.00	13.88	0.001	%30



HYDROMETER TEST

Project :

Location : Mersin

Bore No. B-2(1)

Depth (m) : 4.50-6.00

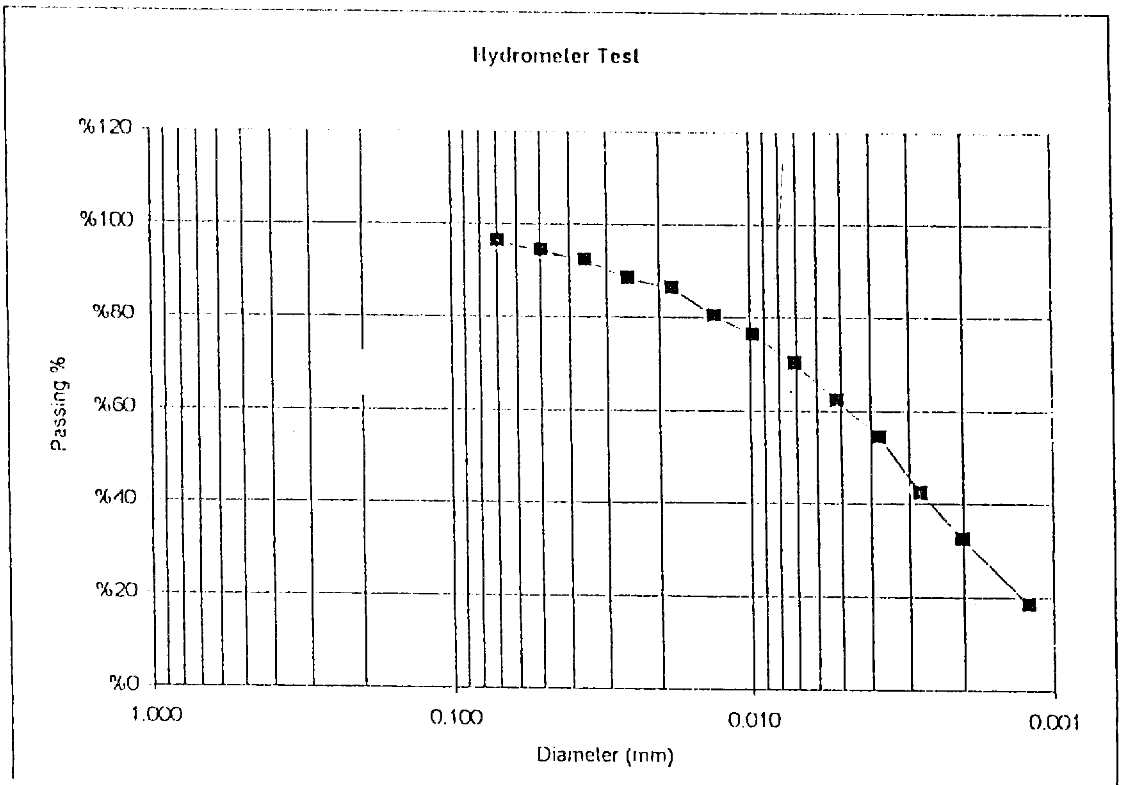
Date : 20.05.1999

Temprature (°C) : 30

γs (t/m³) : 2.73

Mass of Soil (gr): 50

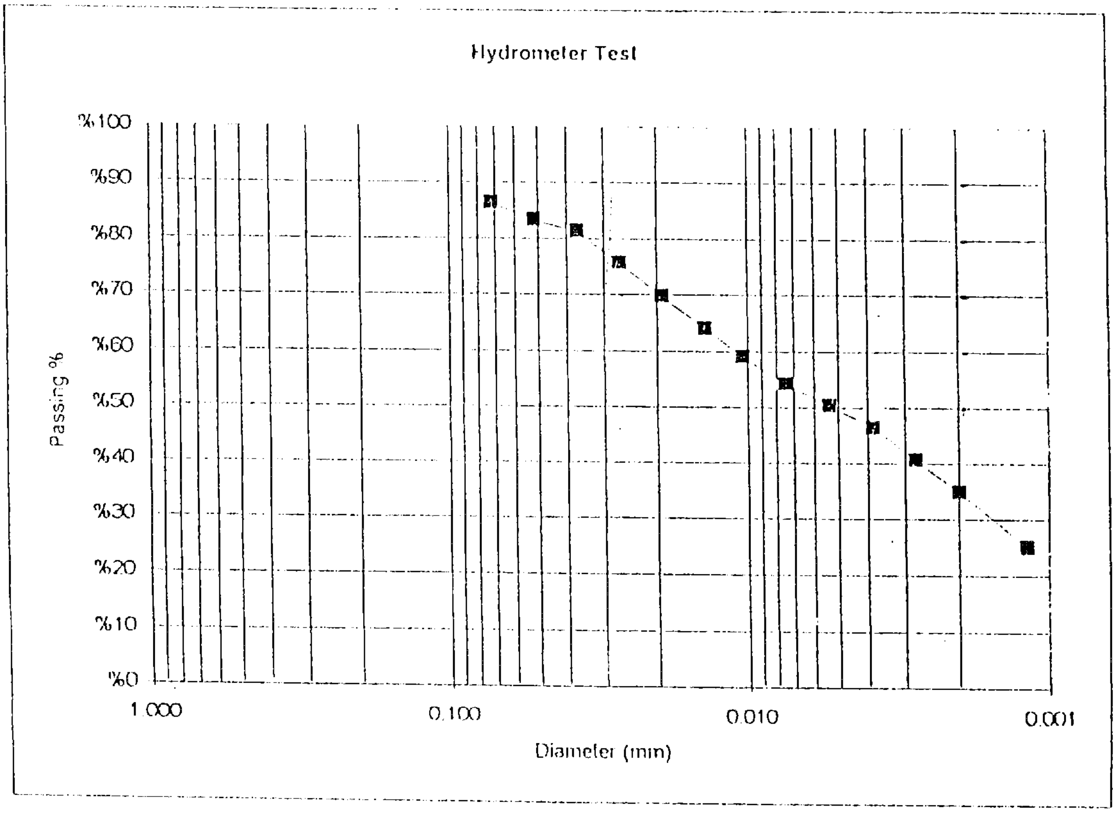
t(min)	Ra	Rc	Rm	Hc	D(mm)	Passing %
0.25	48.00	48.15	49.00	8.48	0.069	%96
0.50	47.00	47.15	48.00	8.64	0.049	%94
1	46.00	46.15	47.00	8.80	0.035	%92
2	44.00	44.15	45.00	9.13	0.025	%88
4	43.00	43.15	44.00	9.29	0.018	%86
8	40.00	40.15	41.00	9.78	0.013	%80
15	38.00	38.15	39.00	10.10	0.010	%76
30	35.00	35.15	36.00	10.59	0.007	%70
60	31.00	31.15	32.00	11.24	0.005	%62
120	27.00	27.15	28.00	11.89	0.004	%54
240	21.00	21.15	22.00	12.86	0.003	%42
480	16.00	16.15	17.00	13.68	0.002	%32
1440	9.00	9.15	10.00	14.81	0.001	%18



HYDROMETER TEST

Project :		Bore No.	B-2(2)
Location :	Mersin	Depth (m) :	9.00-10.50
Date :	20.05.1999	γs (t/m³) :	2.73
Temprature (°C) :	33	Mass of Soil (gr):	50

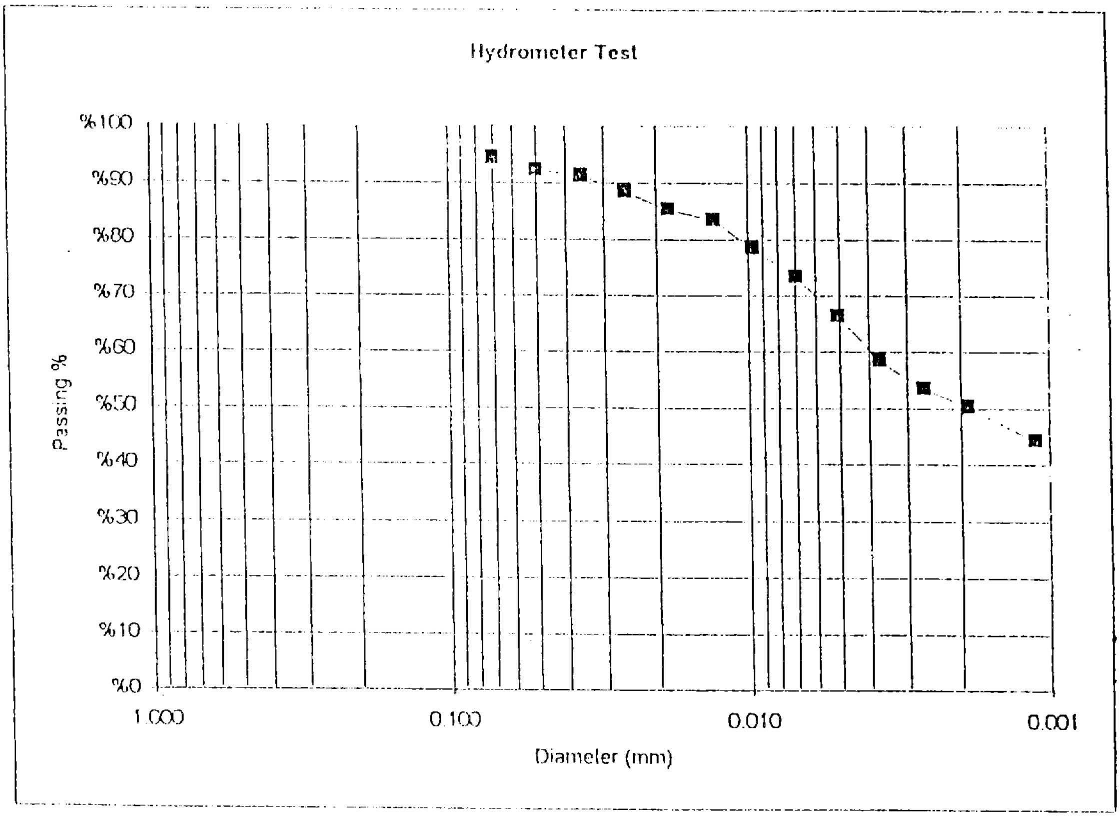
t(min)	Ra	Rc	Rm	Hc	D(mm)	Passing %
0.25	43.50	44.40	44.50	9.09	0.072	%86
0.50	42.00	42.90	43.00	9.33	0.051	%83
1	41.00	41.90	42.00	9.49	0.037	%81
2	38.00	38.90	39.00	9.98	0.027	%75
4	35.00	35.90	36.00	10.47	0.019	%70
8	32.00	32.90	33.00	10.95	0.014	%64
15	29.50	30.40	30.50	11.36	0.010	%59
30	27.00	27.90	28.00	11.77	0.007	%54
60	25.00	25.90	26.00	12.09	0.005	%50
120	23.00	23.90	24.00	12.42	0.004	%46
240	20.00	20.90	21.00	12.90	0.003	%41
480	17.00	17.90	18.00	13.39	0.002	%35
1440	12.00	12.90	13.00	14.20	0.001	%25



HYDROMETER TEST

Project :		Bore No.	B-3(1)
Location :	Mersin	Depth (m) :	7.50-7.75
Date :	20.05.1999	γs (t/m³) :	2.72
Temprature (°C) :	30	Mass of Soil (gr):	50

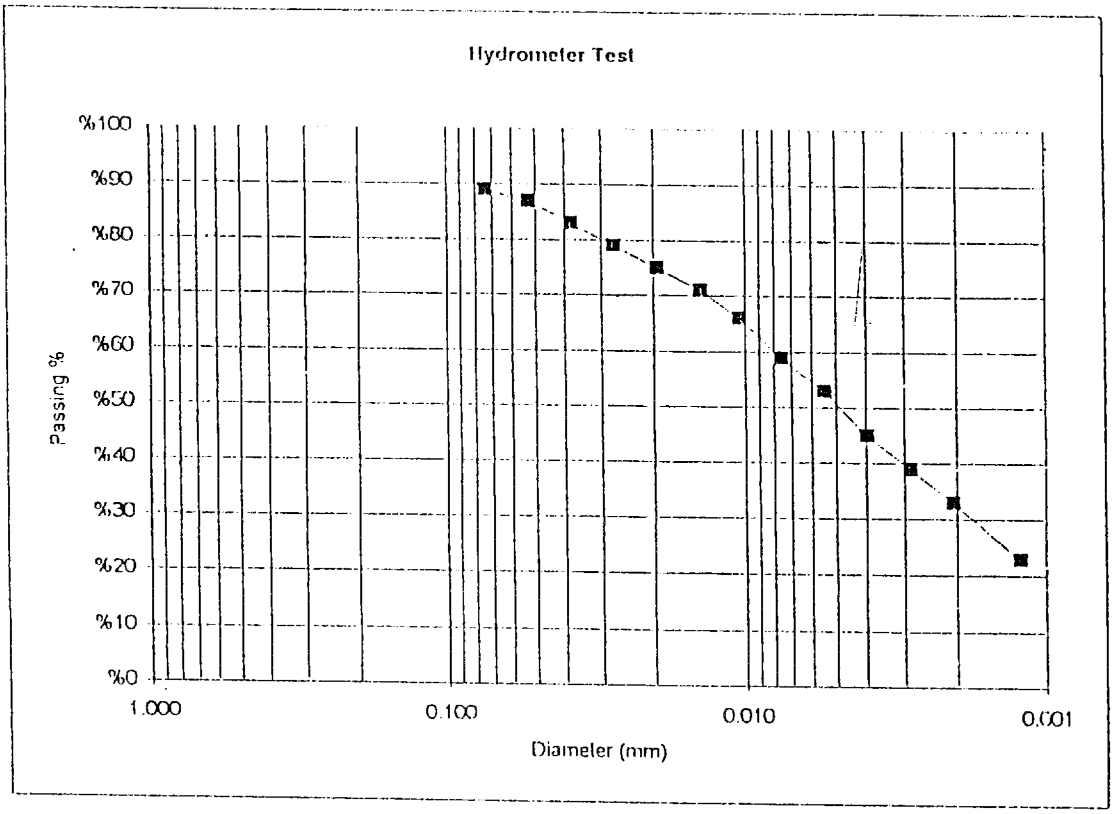
t(min)	Ra	Rc	Rm	Hc	D(mm)	Passing %
0.25	47.00	47.15	48.00	8.64	0.070	%94
0.50	46.00	46.15	47.00	8.80	0.050	%92
1	45.50	45.65	46.50	8.88	0.035	%91
2	44.00	44.15	45.00	9.13	0.025	%88
4	42.50	42.65	43.50	9.37	0.018	%85
8	41.50	41.65	42.50	9.53	0.013	%83
15	39.00	39.15	40.00	9.94	0.010	%78
30	36.50	36.65	37.50	10.34	0.007	%73
60	33.00	33.15	34.00	10.91	0.005	%66
120	29.00	29.15	30.00	11.56	0.004	%58
240	26.50	26.65	27.50	11.97	0.003	%53
480	25.00	25.15	26.00	12.21	0.002	%50
1440	22.00	22.15	23.00	12.70	0.001	%44



HYDROMETER TEST

Project :		**Bore No.**	**B-3(2)**
Location :	Mersin	**Depth (m) :**	9.00-9.20
Date :	20.05.1999	**γs (t/m³) :**	2.74
Temprature (°C) :	27	**Mass of Soil (gr):**	50

t(min)	Ra	Rc	Rm	He	D(mm)	Passing %
0.25	45.00	44.40	46.00	9.09	0.074	%89
0.50	44.00	43.40	45.00	9.25	0.052	%87
1	42.00	41.40	43.00	9.57	0.038	%83
2	40.00	39.40	41.00	9.90	0.027	%79
4	38.00	37.40	39.00	10.22	0.020	%75
8	36.00	35.40	37.00	10.55	0.014	%71
15	33.50	32.90	34.50	10.95	0.010	%66
30	30.00	29.40	31.00	11.52	0.008	%59
60	27.00	26.40	28.00	12.01	0.005	%53
120	23.00	22.40	24.00	12.66	0.004	%45
240	20.00	19.40	21.00	13.15	0.003	%39
480	17.00	16.40	18.00	13.64	0.002	%33
1440	12.00	11.40	13.00	14.45	0.001	%23



ATTERBERG LIMITS

Project :

Location : Mersin

Bore No. : **B-1(1)**

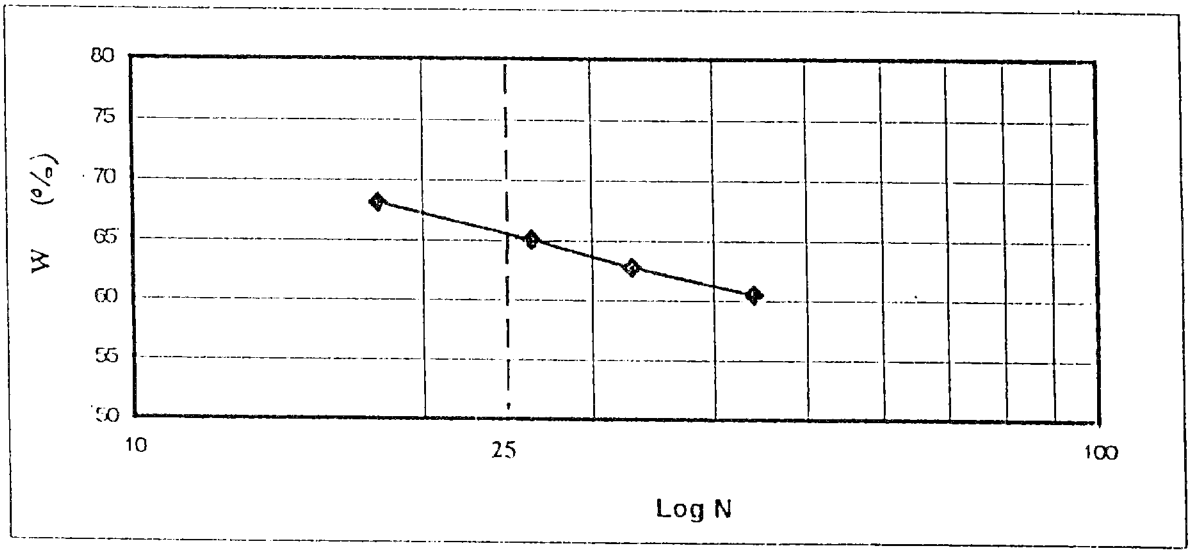
Depth (m) : 7.50-7.95

LIQUID LIMIT

Can No	31	21	15	27
No. of Drops (N)	44	33	26	18
Can + Wet Soil (gr)	46.64	61.13	49.19	60.47
Can + Dry Soil (gr)	40.96	53.99	42.77	52.38
Mass of Can (gr)	31.56	42.61	32.94	39.83
Water Content (%)	60	63	65	68

PLASTIC LIMIT

Can No	6	19
Can + Wet Soil (gr)	43.49	48.98
Can + Dry Soil (gr)	41.10	46.59
Mass of Can (gr)	33.67	38.98
Water Content (%)	32	31



w_L(%)	w_P(%)	I_P(%)
65.0	32	33

W_L = Liquid Limit

W_P = Plastic Limit

I_P = Plastisite Index

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01.06.1999

ATTERBERG LIMITS

Project :

Location : Mersin

Bore No. : B-1(2)

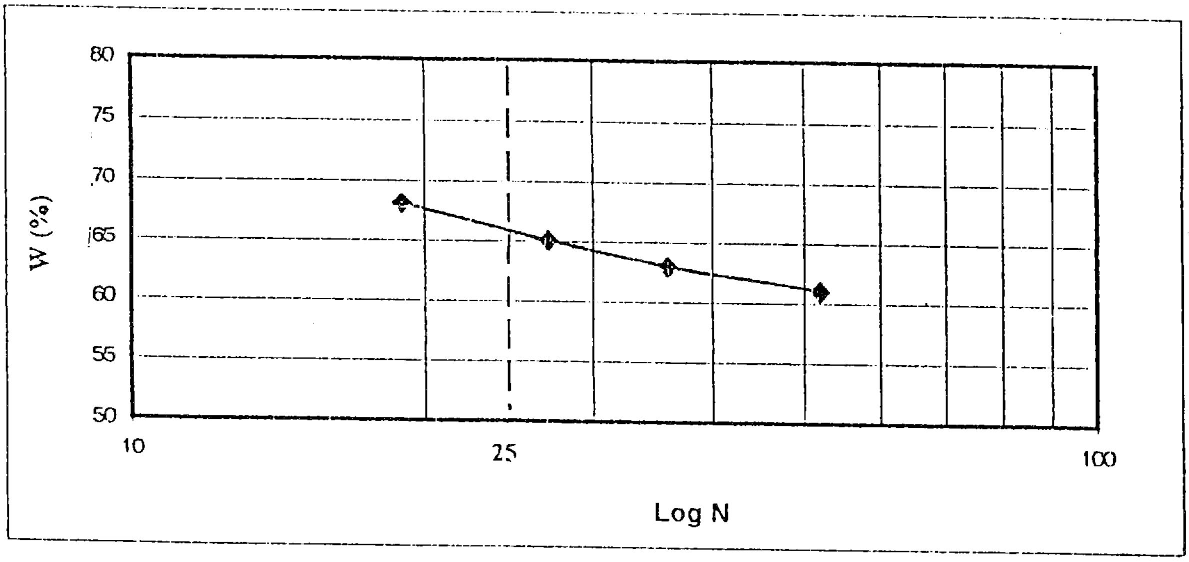
Depth (m) : 12.00-12.20

LIQUID LIMIT

Can No	15	49	47	17
No. of Drops (N)	52	36	27	19
Can + Wet Soil (gr)	44.80	48.60	49.65	55.50
Can + Dry Soil (gr)	40.31	43.02	43.43	48.53
Mass of Can (gr)	32.94	34.14	34.17	38.07
Water Content (%)	61	63	65	68

PLASTIC LIMIT

Can No	44	9
Can + Wet Soil (gr)	48.03	45.03
Can + Dry Soil (gr)	44.90	42.40
Mass of Can (gr)	34.45	33.76
Water Content (%)	30	30



w_L(%)	w_P(%)	I_P(%)
66.0	30	36

W_L = Liquid Limit

W_P = Plastic Limit

I_P = Plastisite Index

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ATTERBERG LIMITS

Project :

Location : Mersin

Bore No. : B-2(1)

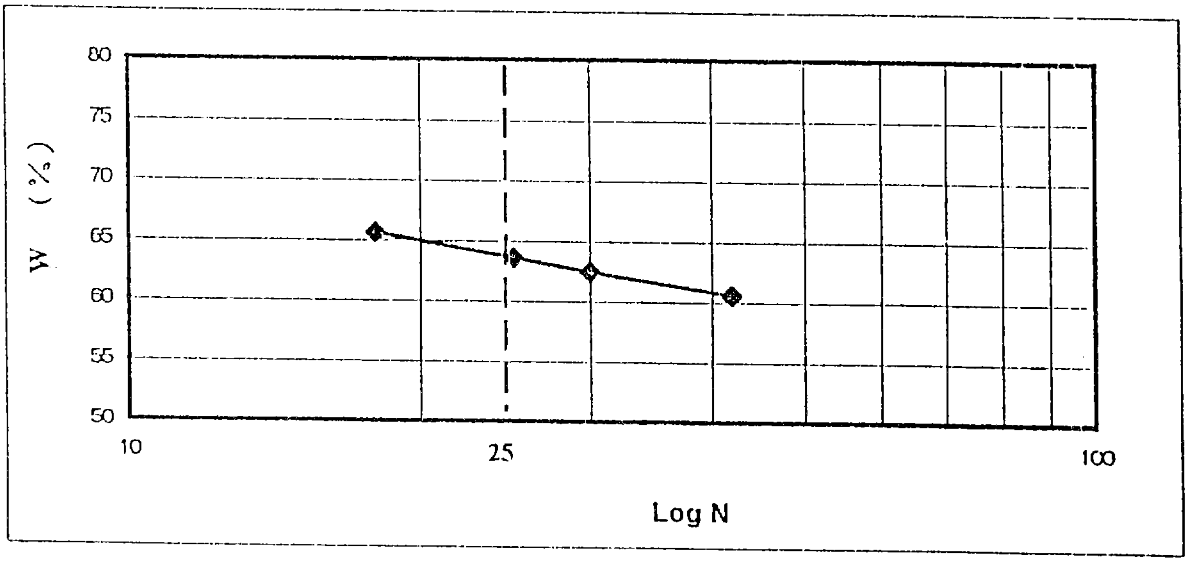
Depth (m) : 4.50-6.00

LIQUID LIMIT

Can No	5	39	28	29
No. of Drops (N)	42	30	25	18
Can + Wet Soil (gr)	51.88	43.67	46.22	48.47
Can + Dry Soil (gr)	47.05	38.92	40.97	41.77
Mass of Can (gr)	39.07	31.30	32.71	31.55
Water Content (%)	61	62	64	66

PLASTIC LIMIT

Can No	36	35
Can + Wet Soil (gr)	43.47	45.62
Can + Dry Soil (gr)	41.88	43.66
Mass of Can (gr)	32.26	32.87
Water Content (%)	17	18



w_L(%)	w_P(%)	I_P(%)
64.0	17	47

W_L = Liquid Limit

W_P = Plastic Limit

I_P = Plastisite Index

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ATTERBERG LIMITS

Project :

Location : Mersin

Bore No. : B-2(2)

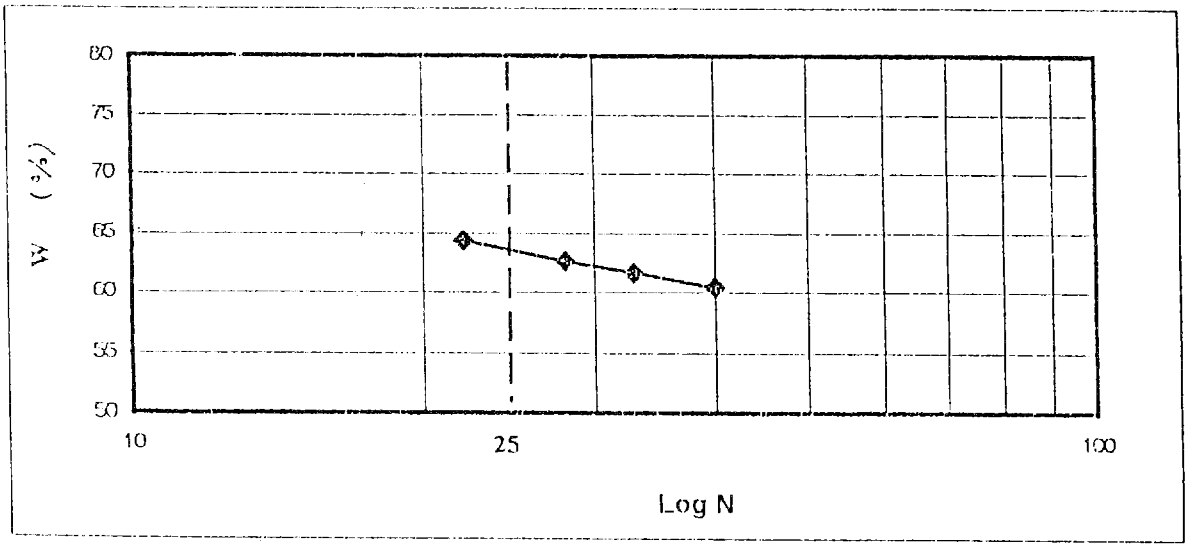
Depth (m) : 9.00-10.50

LIQUID LIMIT

Can No	9	32	49	25
No. of Drops (N)	40	33	28	22
Can + Wet Soil (gr)	43.48	41.87	42.86	52.59
Can + Dry Soil (gr)	39.82	37.53	39.51	47.39
Mass of Can (gr)	33.76	30.48	34.14	39.30
Water Content (%)	60	62	63	64

PLASTIC LIMIT

Can No	31	15
Can + Wet Soil (gr)	39.58	48.14
Can + Dry Soil (gr)	37.60	44.40
Mass of Can (gr)	31.56	32.94
Water Content (%)	33	33



$w_L(\%)$	$w_P(\%)$	$I_P(\%)$
64.0	33	31

W_L = Liquid Limit

W_P = Plastic Limit

I_P = Plastisite Index

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ATTERBERG LIMITS

Project :

Location : Mersin

Bore No. : B-3(1)

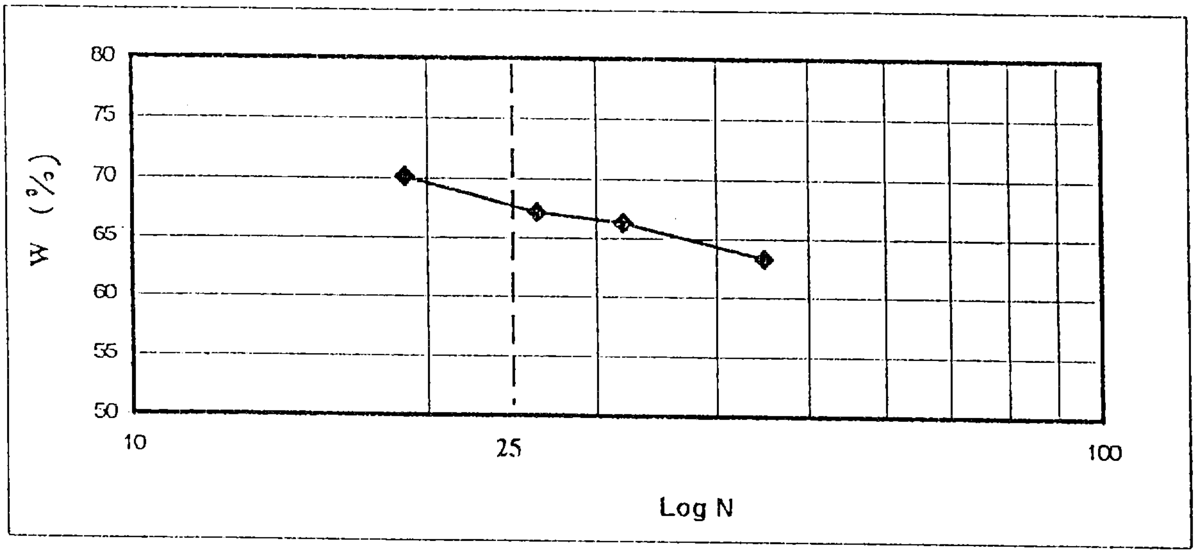
Depth (m) : 7.50-7.75

LIQUID LIMIT

Can No	47	41	21	6
No. of Drops (N)	45	32	26	19
Can + Wet Soil (gr)	46.59	44.65	52.97	44.40
Can + Dry Soil (gr)	41.78	39.88	48.81	39.98
Mass of Can (gr)	34.17	32.68	42.61	33.67
Water Content (%)	63	66	67	70

PLASTIC LIMIT

Can No	17	27
Can + Wet Soil (gr)	45.18	47.42
Can + Dry Soil (gr)	43.24	45.33
Mass of Can (gr)	38.07	39.83
Water Content (%)	38	38



$w_L(\%)$	$w_P(\%)$	$I_P(\%)$
68.0	38	30

W_L = Liquid Limit

W_P = Plastic Limit

I_P = Plastisite Index

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01.06.1999

ATTERBERG LIMITS

Project :

Bore No. : B-3(2)

Location : Mersin

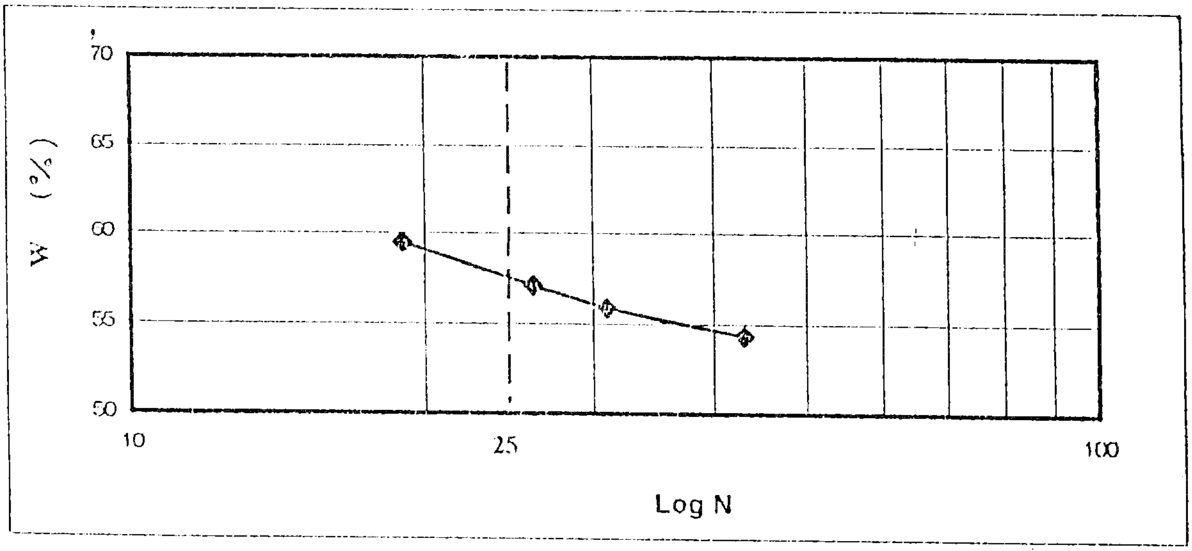
Depth (m) : 9.00-9.20

LIQUID LIMIT

Can No	5	39	28	29
No. of Drops (N)	43	31	26	19
Can + Wet Soil (gr)	52.88	44.67	47.22	49.47
Can + Dry Soil (gr)	48.02	39.88	41.95	42.79
Mass of Can (gr)	39.07	31.30	32.71	31.55
Water Content (%)	54	56	57	59

PLASTIC LIMIT

Can No	36	35
Can + Wet Soil (gr)	42.47	44.62
Can + Dry Soil (gr)	40.80	42.65
Mass of Can (gr)	32.26	32.87
Water Content (%)	20	20



W_L(%)	W_P(%)	I_P(%)
58.0	20	38

W_L = Liquid Limit

W_P = Plastic Limit

I_P = Plastisite Index

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Table 7 BULK DENSITY

Bore No.	Can+Soil (gr)	Volume (cm^3)	$\gamma_n(t/m^3)$
P1	1553	940.00	1.65
P2	1680.00	940.00	1.79
P3	1615.10	940.00	1.72

Table 8 SPECIFIC GRAVITY

Bore No.	M2	M1	M3	$\gamma_s(t/m^3)$
P1	625.19	100.00	688.50	2.73
P2	624.00	50.03	655.70	2.73
P3	625.19	100.00	688.24	2.71

M1 : Mass of soil (gr)
M2 : Mass of bottle+water(gr)
M3 : Mass of bottle+soil+water

Table 9 WATER CONTENT

Bore No.	Mass of Can (gr)	Can+Wet Soil (gr)	Can + Dry Soil (gr)	Water Content (%)
P1	73.7	334.2	311.1	10
P2	65.7	342.5	308	14
P3	69.4	317.8	264.8	27

Table 10 A Summary of Index Properties of Fill Materials

Location: Fill Material-Mersin

Sample No.	γn (t/m³)	γs (t/m³)	W (%)	Soil Type
P1	1.65	2.73	10.0	CH
P2	1.79	2.73	14.0	CH
P3	1.72	2.71	27.0	CH