Ministry of Transport, Road & Bridges

National Highway Authority

Laboratories Directorate

Date 30.3.2010

To: Consolid Developing Treading Enterprises

Att: Mutasim Izeldin Haroun

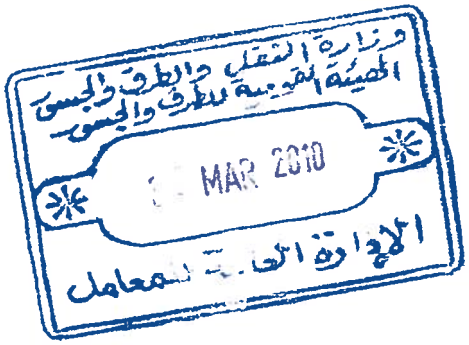
Dear Sirs,

Subject: Conclusion and Comments for Test Results and Procedure for Construction

Reference your letter dated 07.02.2010; please find attached the laboratories results of the soil stabilization materials provided to us namely Consolid444 (liquid) and Solidray (powder).

Thanks.

Dr. Abubaker Mohamed Ali
Laboratories General Directorates



Procedure for Construction Process on Site by using CONSOLID system

1. Trial section specified in the range of 300m to be open for the traffic
2. The amount of materials to be mixed should be determined as follows:
3. Length of Trail Section X Width X Thickness X C.F (The results of calculation attached)
4. The amount of additives should be specified (in dry and liquid form) according to the type of the material.
5. The required amount to be mixed should be put in a truck equipped with tank with a mixer to avoid sedimentation of stabilized material.
6. The mixing and spreading of materials and additives should be executed perfectly to avoid cutting or filling (cut or fill) or remixing as well; to avoid this event a finisher equipped with sensor should be used.
7. Curing of the finished product should be provided for 4 days with continuous control.
8. Field density should be conducted immediately after full compaction
9. To follow the test results of stabilized material and its durability on site, the following tests should be carried out:
10. DCP (Dynamic Core Pentrometer for every 50m should be conducted.
11. Benklman Beam Deflection every 50m for assessment of layer thickness tolerance under the effect of load.
12. Plate Bearing Test can also be used to determine the strength characteristics.
13. Rutting test on site also required on uncovered road structure.
14. Establishment of correlation relationship for test results to compare the comparative value of durability for every period of test results on site and ultimately to be compared with the lab tests.
15. The equipment and devices for site tests should be calibrated and checked based on international standards references (AASHTO, ASTM, BS).

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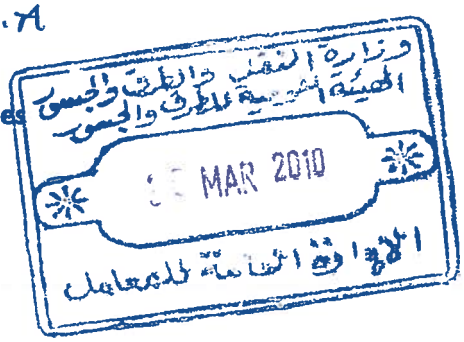

Conclusion and Comments

Soil stabilization materials namely CONSOLID 444 (liquid) and SOLIDRAY (powder) were tested to prove that, with this stabilization material it is possible to improve the resistance of these soils and thus to use them as subbase and base course materials.

The selected soils for the tests both with significant limitations for use in road construction (see attached report), their preliminary characteristics shows that they can not even provide the minimum prerequisites for use in the subbase course when we concentrated on 50% clay with 50 % sand which the economical option when we compare with other trail mix (70% sand +30 % clay because the clay is more available than the sand).

The operational technique used is as follow, the product CONSOLID 444(liquid) is added to the water and the product SOLIDRAY (powder) to the soil. First CONSOLID 444 is added to the water with ratio of (0.4 CC of CONSOLID for one kg of soil), it is important to note that the quantity of product CONSOLID 444 to be added is in depended of the quantity of water need to be added as Optimum Moisture Content (OMC), it is depended only on the weight of the soil used. The product SOLIDRAY (powder) is added to the soil and mixed-in until a homogenous distribution is achieved, followed by the addition of the required OMC (water mixed with CONSOLID).

The addition of the CONSOLID system results in a great improvement of the water resistance for both soils tested. After a 4 days immersion the CBR values have improved significantly and the plasticity has also been considerably reduced.

Occasionally there are no adequate materials available in the neighborhood for the subgrade or the subbase, in such cases the use of this additive for the improvement of the soil can be of great advantage in economical terms by saving the importation and transport of the materials from quarry. Furthermore, the stabilization of the soil resulting in a higher resistance of the subgrade enables reductions of the layer thickness and consequently much more economical structures.

It can be advised to use the CONSOLID system on a field trail for a road to analysis the actual field possibilities with respect to the resistance values, durability and evaluate in the present case the economical advantages of the application (condition of field trail is below). Also, the system can be analyzed for other applications, for example soil blocks on the basis of clayey materials for the construction of houses.

Cost benefit analysis and recommendation should be conducted. We recommend using the additive for base course only and additive with sand to be used for embankment and subbase to cut down the cost effect when stabilization is conducted with dry and liquid additives.

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السادة / أعمال كونسليد المتطورة التجارية

Lab No.	Description	Sieve Analysis % Passing Sieve Size (mm)									Atterberg Limits		Classification		Modified Compaction		Soaked CBR AT		
		25	19	12	9.5	4.75	2	0.425	0.15	0.075	LL	PI	AASHTO	Unified	MDD	OMC	90%	95%	98%
		1"	3/4"	1/2"	3/8"	No. 4	No. 10	No. 40	No.100	No. 200	%	%			gm/cm3	%	MDD		
43	50% of clay Soil from EL Gazera with 50 % of sand	100	98.5	98	98	96.4	91.9	64.1	50.4	46.6	24	8	A-4	SC	1.891	12.3	1	1	2
	50% of clay Soil from EL Gazera with 50 % of sand with additives			100	98.9	97.6	93.2	62.8	45.6	41.3	N.L	N.P	A-4	SM			27	37	43
44	30% of clay Soil from EL Gazera with 70 % of sand			100	99	98.0	92.2	52.5	34.3	29.9	N.L	N.P	A-2-4	SM	1.997	12.5	6	7	7
	30% of clay Soil from EL Gazera with 70 % of sand with additives			100	98.8	97.2	91.3	50.1	30.5	25.7	N.L	N.P	A-2-4	SM			57	90	100
46	50% of clay Soil from Upper Nile State with 50 % of sand				100	98.6	93.9	52.3	23.7	19.0	N.L	N.P	A-2-4	SM	1.990	9.4	4	8	9
	50% of clay Soil from Upper Nile State with 50 % of sand with additives			100	99.7	99.0	96.1	75.7	57.8	54.9	N.L	N.P	A-2-4	ML	1.979	10.2	62	100	100
45	30% of clay Soil from Upper Nile State with 70 % of sand				100	98.4	90.9	44.7	18.7	15.1	N.L	N.P	A-1-b	SM	1.987	9.5	13	28	41
	30% of clay Soil from Upper Nile State with 70 % of sand with additives				100.0	97.7	90.7	48.2	19.0	14.2	N.L	N.P	A-1-b	SM	2.003	9.4	71	100	100

Notes:-

Additives are:-

1- 0.4 cc of Consolid 444 /kg of Soil

2- 20 gm of Solidray Powder /kg of Soil

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رئيس قسم التربة
13 MAR 2016
الإدارة العامة للمعامل