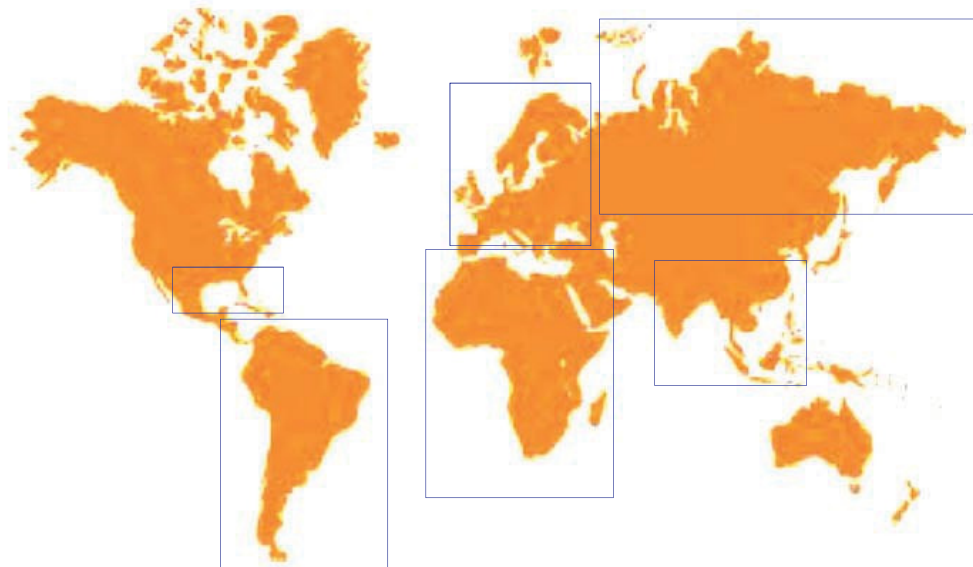




Stabilization and Waterproofing
any type soil in the World

SIMPLIFIED MANUAL OF LABORATORY TESTS

Version Sept 2008



SUMMARY

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No application of the ROCAMIX System can be performed without having first performed, the very simple laboratory tests, planned, to confirm:

- * the proper functioning of the ROCAMIX System with the soil to be treated
- *and demonstrate to the end customer his good choice to use the Rocamix System.

DESCRIPTION OF THE PRINCIPLE OF LABORATORY TESTS

ROCAMIX technology, in general, can be used in many small or medium applications with very few laboratory studies, but they are MANDATORY.

PHASE 1

- **FIRST MANDATORY TESTS ON THE SOIL TO BE TREATED**

- **1** The classification of the soil to be treated
- **2** Atterberg limits of the soil to be treated
- **3** CBR soil tests to be treated

These tests make it possible to know if the soil to be treated enters or not in the foundations of Theorem Rocamix 10 + 10 + 20

The results of PHASE 1 show whether the soil can be treated with no action other than mixing with the Rocamix + Cement

PHASE 2 by following the dosages indicated in the page 5 - RECOMMENDED DOSES TESTS WITH THE ROCAMIX SYSTEM

1st OPTION: The soil to be treated enters the Rocamix 10 + 10 + 20 theorem.

- The following tests are used to verify the action of Rocamix and to certify to the client the Rocamix effect of the treated soil (increase of CBR + reduction of the permeability)
- **4** CBR soil tests with the indicated dosage of Rocamix = 0.40 l / m³ or 0.50l / m³
- + a cement dose of = 7 to 25 kg / m³
- CBR tests performed for immediate results at +7 days (and also for confirmation at +14 and +21 days)
- **5** Capillary ascent tests of the controls during 3, 9, 24, 40, 48, and 120 hours..

Warning! -> The capillary ascension tests will be carried out by measuring the weight of the test pieces according to the time.

- 6** PROCTOR (modified) tests for the on-site application

2^d OPTION: The soil to be treated does not enter the Rocamix 10 + 10 + 20 theorem

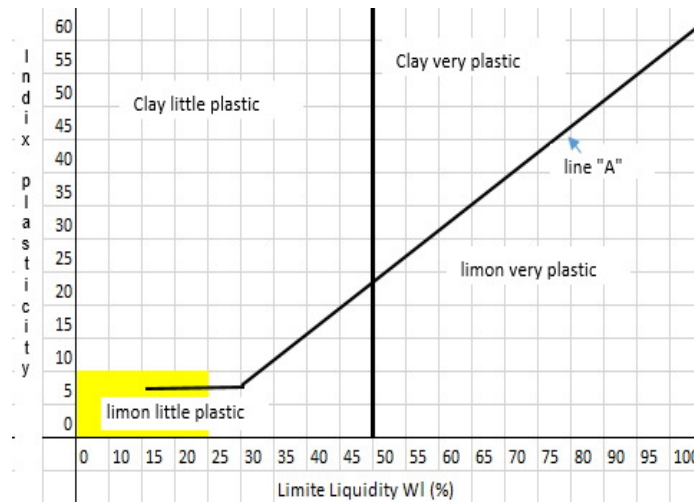
It is necessary to check if this soil contains clay, either by the method of:

- **7** Hydrometric Analysis or Metric Sediment
- **7b** or methylene blue tests

If the clay level is too low, and according to the methodology of the Rocamix tests, one must add a % of clay in the soil to be treated in order to develop a better reaction of the Rocamix product. The % of clay to be added to the soil must begin with 3% of the soil volume.

3th OPTION: The soil to be treated enters the Rocamix 10 + 10 + 20 theorem but the CBR result of the original soil is very low (between 1 and 8)

- **8** Modify the skeleton of the ground by adding crushed stone (8/10) starting with 3% of the volume of the added soil.

THEOREM ROCAMIX 10+10+20**ABACUS OF PLASTICITY**

The deep knowledge of the treatment of the existing soils by Ing. François Lasserre, with the College of Technical Assistance Rocamix, and numerous studies and laboratory tests have enabled the College to determine precisely the scope of "Rocamix effect" in treated soils.

Thus, it was created by Ing. François Lasserre, the **Theorem 10 + 10 + 20**

from these very basic laboratory study data, it is possible to confirm that the soil to be treated will be favorable to "the effects of treatment with Rocamix System"

Particle size - Passage to the 200 sieve (0.075 mm mesh space)

- Minimum 10% of the soil must pass through the sieve 200 and thus indicates that the soil contains sufficient "fine" particles that are sensitive to water and destroy the soils.

These "fine" particles may be silt (but does not respond to treatment) or clay and in this case can be stabilized with treatment of Rocamix system.

This distinction will be made through determining the Index Plasticity (IP) indicated by the Atterberg limits. When **10%** of the particles pass through the sieve 200, this facilitate soil treatment with Rocamix.

Plasticity Index (PI) - Degree of soil plasticity determined by Atterberg limits

- Between zero and 5 -> Soil: NO plastic
- Between 5 and 12 -> Soil: little plastic
- Between 12 and 40 -> Soil. plastic
- Top 40 -> Soil: very plastic

A plasticity index (PI) of at least **10%** facilitate soil treatment.

Liquidity limit (LL) - percentage of water it takes to move from the liquid phase to the solid phase.

- The Index plasticity (IP) is the result of the difference between the Liquidity Limit (LL) and Plasticity Limit (PL), (formula in physics, $WL = IP - WP$). Therefore, the Liquidity Limit (LL) must be a high percentage to allow greater the number percentage de Index Plasticity (PI)

A Liquidity Limit (LL) of at least **20%** will allow number of Index Plasticity (IP) and this will facilitate higher soil treatment.

To summarize these observations, The College has created **Theorem Rocamix 10 + 10 + 20** indicating that all soils containing these features can be treated with Rocamix system. Therefore, all the problems related to soil degradation due to the adverse effects of climate change can be solved by the Rocamix system..

SOILS CLASSIFICATION *method* AASHTO and SUCS

RECOMMENDED DOSES

Classification												
AASHTO	A-1		A-2				A-3	A-4	A-5	A-6	A-7	
	A-1a	A-1b	A-2-4	A-2-5	A-2-6	A-2-7					A-7-5	A-7-6
SUCS	GW	GC	SM	SM	SC	SC	SP	ML	MH	CL	CH	CH
Option 1												
Soils conforming to Rocamix Theorem 10 + 10 + 20.												
	<i>no</i>	<i>no</i>	yes*	yes*	yes	yes	<i>no</i>	yes*	yes	yes**	yes**	yes**
Rocamix liter/m3			0,50	0,50	0,50	0,50		0,50	0,60	0,60	0,60	0,60
Cement& kg/m3			7 to 15	7 to 15	7 to 15	7 to 15		15 to 20	15 to 20	15 to 20	20 to 25	20 to 25
Option 2		IT IS ADVISABLE TO ADD TO										
Non compliant soils because the IP (Plasticity Index) <to (8-10) or Methylene Blue result <2.5												
Change the composition of the soil by adding 3% to 10% of previously liquefied clay												
Rocamix liter/m3	0,40	0,40	0,50	0,50				0,50	0,50			
Cement& kg/m3	7	7	7 à 15	7 à 15				10 à 15	15 to 20			
Option 3		IT IS ADVISABLE TO ADD TO										
Soils that contain a sieve 200 (0.075 mm) sieve greater than 85%												
Change the composition of the soil by adding 3% to 10% of crushed stone (8/10 mm)												
Rocamix liter/m3										0,60	0,60	0,60
Cement& kg/m3										15 à 20	20 à 25	20 à 25

yes* Soils can have an IP (Plasticity Index) = 0, or than less < 10, in this case add a % of liquefied clay

yes** these soils can have a passage sieve 200 (0.075mm) of **more than 85%** and in this case it is advisable to improve the composition with a% of crushed stones. **If necessary to increase the CBR**

Cement& The dosage starts at the lowest and depending on the results the choice is frozen. Sometimes for certain soils A5, A6, A7 it is better to mix cement + lime



ROCAMIX has carried out hundreds of laboratory tests with all types of soils. And the application rates of the ROCAMIX System displayed are based on the results of these tests and remain indicative.

THIS CHART OF ASSAYS SHOULD ACT AS A GUIDE BUT CAN NOT BE CONSIDERED AS PETRIFIED FOR THE DOSES POSTED.

Only laboratory tests will be able to fix and certify exact doses to be applied

TESTING IN PICTURES examples

1



The tests **begin by extracting the soil starts to process**. Is about 45/70 kg of soil.

2



The soil sample must be **thoroughly screened**. It must be sieved so that the samples do not contain particles larger than 5 mm.

3



With the soil and sifted dry weigh X **proportions** XXX grams to produce 6 samples.

4

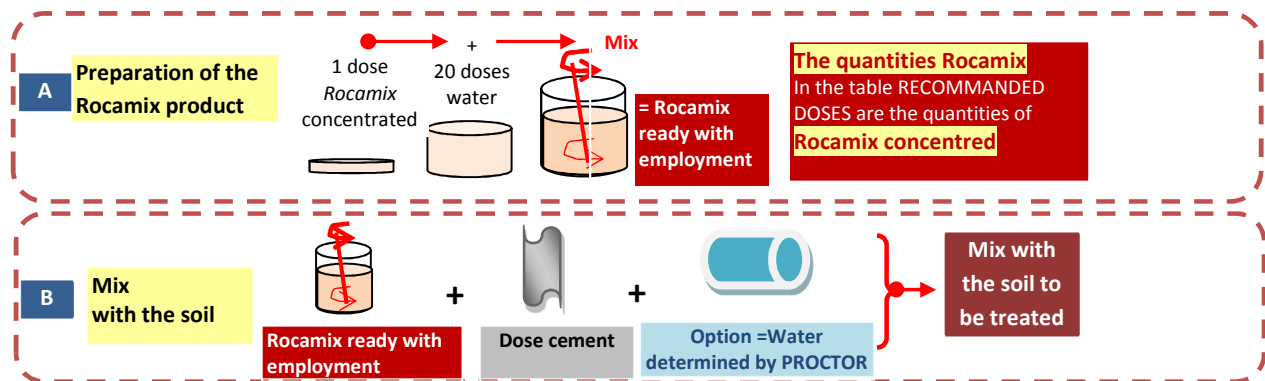


Prepare X samples as follows:

1 without any additive, **natural soil**

X by **adding** the dose of products envisaged according to RECOMMENDED DOSAGES according to the table of CLASSIFICATION

ROCAMIX *concentrated* = 0, 40 liter/m³; 0, 50 liter/m³; 0, 60 liter/m³ CEMENT= 7 to 25 kg/m³)



WARNING! ROCAMIX using very little product with M3, **IMPOSE** that it is mixed with water

DETAILED EXPLANATIONS

With the aim of distributing the ROCAMIX liquid over the entire area with the greatest efficiency, it is obvious that 0.50 liter of ROCAMIX produced liquid) mixed with 1 m³ of soil will never reach all the particles of the soil to be treated. For that, it is obligatory to add a sufficient dose of WATER so that all the particles are reached. But we must also take into account the natural moisture of the soil and the influence that this addition can have on the Proctor data.

For example: with a soil that has an A5 classification the dose per M3 of Rocamix is 0.50 L Rocamix concentrate and if we consider an additive of 20 liters of water per m³ the calculation in % of water supplement is 1500 kg / average weight of a soil divided by 20 liters (20 kg) = 1.3% water addition, which will enter the calculation of the addition of water to reach the Proctor data.

Thus, when the site is realized, and when the treatment is carried out on a thickness of 15 cm, the minimum of ROCAMIX diluted by the water added 20 liters / m³ x 0.15 = **3.0 liters per M2**.

Compliant and demonstrated to tests carried out on scarified ground for a construction site experience in Mexico City (September 2006)


In the case of soils saturated with water, it is therefore not possible to add an overdose of WATER, since this no longer corresponds to the PROCTOR parameters previously established by the laboratory tests, it is necessary:

- The sun and the air dry the soil in a natural way
- Or create artificial conditions (for example, absorbing moisture from the soil by lime treatment) to reduce this moisture

5

THE DOCUMENTS SUMMARY OF THE TESTS TO BE SENT TO ROCAMIXMail labo@rocamix.comSheets available pre-established on www.rocamix.com/documentos.phpBelow = *Example document completed*

PRESENTATION MODEL



RESUMEN of labor tests

made according to the ROCAMIX instructions www.rocamix.com/documentos.php
fill each TEST PERFORMED for the DIFFERENT TYPES OF SOIL

MANDATORY Fill the pages 1 and 2

Write in the green boxes **PAGE 1**

Date	March 20, 2016		
Place	Tests laboratory University CUJAE La Havane		

1	PARTICLE SIZE ANALYSIS OF SOIL		
	Sieve nº	10	40
	Aperture	2,00	0,425
	% retained	61,5%	74,5%
	% que passing	38,5%	25,5%
		GRAVELS	SANDS
			FINES

2	CLASSIFICATION OF SOIL		
	Type	AASHTO	SUCS
		A-2-5	SM
			<i>other</i>

3	% ORGANIC		
	%	0%	

4	NATURE MOISTURE CONTENT		
	%	19%	

5	DENSITY		
		1,95	
	gr/cm3	1,95%	

6	MODIFIED PROCTOR		
	% optimum moisture required for compacting	12%	

7	ATTERBERG LIMITS		
	Liquid Limit(LL)	39,90%	
	Plastic Limit (LP)	38,80%	
	Indices	11,10%	

FOR THE WARRANTY OF A REACTION BETWEEN THE SOIL and Rocamix, The FEATURES SOIL MUST MEET THE CONDITIONS OF **THE ROCAMIX TEOREM 10+10+20**

Sea Indices de plasticity (IP) = 10 + passage to the sieve 200 = 10 + limit de liquid (LL) = 20

THE RESULTS FOR this soil IP = Sieve 200 = LL =
Remember of the Theorem 10 10 20

In case the ground studied not fulfilled the conditions of **Theorem Rocamix 10 + 20 + 20**, IT IS **MANDATORY** to perform additional laboratory tests (page 4 = capillary rise) or mix the soil with clay with a% defining (3 to 7%).

The results will be sent by the laboratory to labo@rocamix.com

If the level (%) of clay in the soil exists but with little%, it is necessary to verify the reaction that is to say to follow the tests of laboratory 8 (CBR) and 9 (capillary ascension)

If the level (%) of clay is too weak, and according to the Rocamix methodology, it is necessary add a% clay in the soil to be treated, to get to develop a better reaction with the Rocamix product. It is necessary to add clay beginning with 3% of the weight of the soil

Complementary tests with the new specimens are performed (CBR + Capillary Ascending)

8 TESTS CBR *Californian Bearing Ratio*

Test conditions

The test pieces are made according to the different dosages of **ROCAMIX + CEMENT**

The CBR is the result of the compaction of 56 strokes with optimum humidity of the test pieces.

The first tests are carried out with a pre-established cement dose of 20kg / m3.

DOSIS	Cement	20kg/m3		20kg/m3		20kg/m3	
DOSIS	Rocamix	0,5liter/m3	% reported	0,5liter/m3	% reported	0,5liter/m3	% reported
natural soil	immersion	piece1	natural soil	piece 2	natural soil	piece 3	natural soil
CBR							
47,00%	0 day	0,0	0%	0,0	0%	0,0	0%
	7 days	57,2	22%	58,7	25%	0,0	0%
<i>Immediately transmit the first results to 7 days in the water</i>							
	14 day	58,6	25%	60,1	28%	0,0	0%
	21 days	59,1	26%	61,5	31%	0,0	0%

WARNING! In the case of a soil initially with a very weak CBR, it is necessary to change its mineral skeleton adding to that dream a small percentage (%) of gravel crushed size 3/8 starting with a percentage of 3%.

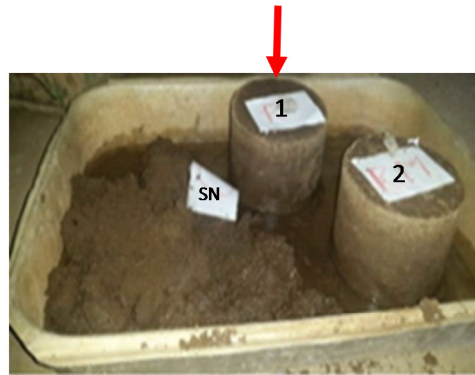
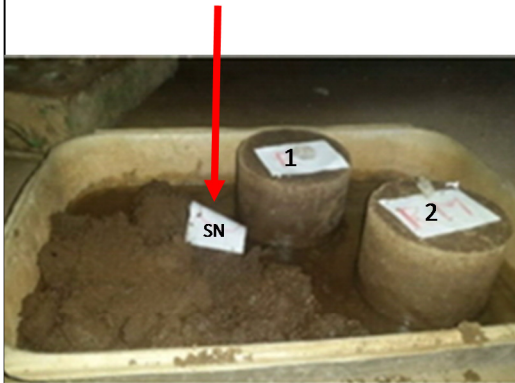
COMPLEMENTARY ESSAYS REQUIRED

9		CAPILLARY ASCENSION					% ascension
HOURS	0	3	9	24	48	120	
	initial weight	weight on toggle					120 h
natural soil	4660	4750	5050	0	0	0	100,00%
difference		90	300	0	0	0	
Piece 1	4501	4505	4530	4550	4555	4570	1,53%
difference		4	25	20	5	15	
Piece 2	4455	4465	4495	4500	4502	4522	1,50%
difference		10	30	5	2	20	
Piece 3	0	0	0	0	0	0	0,00%
difference		0	0	0	0	0	

9a PHOTOS OF THE CAPILLARY ASCENSION TEST Add photos

Natural Soil=after 120 horas de immersion Piece 1 = after 120 horas de immersion

↑ Position on the green boxes and go to the EXCEL menu at the top of the page - click on INSERT / IMAGES and paste the saved photo with dimensions 220 x 240 pixels



Piece 2 = after 120 horas de immersion

Piece 3 = after 120 horas de immersion

↑ Position on the green boxes and go to the EXCEL menu at the top of the page - click on INSERT / IMAGES and paste the saved photo with dimensions 220 x 240 pixels



6

PREUVES D'IMPERMÉABILISATION

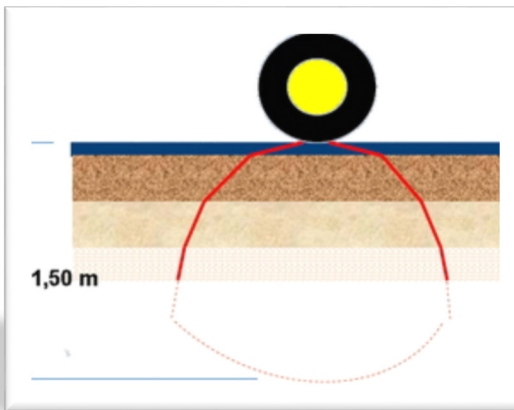
GEOLOGIA NC-325 CORTANTE DIRECTO
 Lab 5 NC-155 ENSAYO SIN COHESION Y SIN DRENAJE
 TITULO: ENSAYOS CORTANTE
 OBJETIVOS: CONOCER LA MANIPULACION DE LOS DISTINTOS EQUIPOS PARA HACER EL CORTANTE DIRECTO Y ENSAYOS TRIAXIALES

$$\tau_f = c + \sigma \tan \phi$$
 C-32. NOTAS: 2
 5.1 CORTANTE DIRECTO
 a) PREPARACION DE LA MUESTRA
 b) MONTAJE DE LA MUESTRA EN EL EQUIPO
 FUERZA TANG. σ_m



2014/2015 = 1 year in the water – University CUJAE La Havana





Example of use thick ROCAMIX Technology

Several years of using the technology used to present the concepts of using thick ROCAMIX, depending on their future use. However, a specific study for each application is required because the treatment depends on thickness of the **<classification soil>** and **<the future use of the work>**

Country Road. Secondary Street. Path. Bottom deposit of junk.	Soil treated with Rocamix Technology. → Nature soil → <i>Check the stability</i>		Thickness of treatment 15 /20 cm	Recommending then cover with a primer reinforced irrigation area or city with a very thin layer of asphalt
Water reserve. Lakes. Channels.	Soil treated with Rocamix Technology. → Add LIME		Thickness of treatment 15 cm	
Roads. Railway. Mine entrance. Highway.	Soil treated with Rocamix Technology. → Nature soil → <i>Check the stability</i>		Thickness of treatment 20 to 30 cm	
Taxiway. Platforms	Soil treated with Rocamix Technology. → Nature soil → <i>Check the stability</i>		Thickness of treatment 40 cm	



The sheets "SUMMARY OF ROCAMIX TESTS" must be transmitted **immediately after the completion** of the laboratory tests to labo@rocamix.com
 Available pre-established sheets at www.rocamix.com/documentos.php