

Client: **SGS Trinidad Limited**
 Project: **Various Testing**

Contact: **Romell Sudama**
 Submitter: **Romell Sudama**
 Date Received: **16-Sep-16**

CTL Project No.: **382353**
 CTL Proj. Mgr.: **Xiuping Feng**
 Analyst: **PS, WD, VS, SN, JB, MS**
 Approved: **D. Dhotan**
 Date Analyzed: **21-Sep-16 to 24-Oct-16**
 Date Reported: **25-Oct-16**

ASTM C595-14 : TABLE 3 PHYSICAL REQUIREMENTS

	IL, IP		Test Results
	IS(<70)	IS(≥70)	4305003
	IT(S<70)	IT(S≥70)	Rock Hard Cement (Turkey)
Fineness, specific surface ^A :			
No. 325 sieve, % retained	---	---	2.7
Air permeability test, min. m ² /kg:	---	---	373
Density, g/cm ³ :	---	---	2.99
Autoclave expansion, max. % ^B :	0.80	0.80	---
Autoclave contraction, max. % ^B :	0.20	0.20	0.012
Time of Setting, Vicat test: ^C			
Initial, not less than, min.	45	45	170
Initial, not more than, hours	7	7	
Final, min.	---	---	245
Normal Consistency (wt%)	---	---	26.9
Air content of mortar, max volume %:	12	12	
Strength, compression, min., MPa (psi)			
Mortar flow (%)	110 ± 5	110 ± 5	111
1 day	---	---	12.7
3 days	13.0	---	23.4
7 days	20.0	5.0	27.2
28 days	25.0	11.0	35.7
Water Requirement, max wt% cement:	---	---	47

Special Property Designation Notes

When special properties are required the applicable limits as specified in Table 4 of ASTM C595 for the desired special property apply.

When special properties apply the cement Type as listed in Table 3 will be followed by the appropriate suffix(s) listed below:

- A - air entraining is required
- MS, HS - moderate or high sulfate resistance is required,
- MH, LH - moderate or low heat of hydration is required,
- R - resistance to alkali silica reactive aggregate expansion is required

Cements with greater than 5% limestone are not permitted as MS or HS cements

When multiple special properties are required the strength requirement for special property with the lowest 7 day strength shall apply.

General Notes:

- A: Both amount retained on a 45 micron sieve and the (blaine) air permeability fineness are to be reported on all certificates requested from the manufacturer.
- B: The specimens shall remain firm and hard and show no signs of distortion, cracking, checking, pitting, or disintegration when subjected to the autoclave expansion test.
- C: Time of setting refers to initial setting time in Test Method C191. Test conducted using method B of ASTM C191-08.
The time of setting of cements containing a user-requested accelerating or retarding functional addition need not meet the limits of this table, but shall be stated by the manufacturer.
- D: This report may not be reproduced except in its entirety.

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ASTM C595-14 : TABLE 4 PHYSICAL REQUIREMENTS

Special Property Designation ^A	Physical Requirements for Blended Cements with Special Properties ^G						Test Results	
	A	MS ^B	HS ^B	MH	LH	R ^C	CTL ID: Client ID:	4305003 Rock Hard Cement (Turkey)
Air content of mortar, max volume %:								
min volume %:	16^D							
max volume %:	22^D	12	12	12	12	12		
Density, g/cm ³ :	---	---	---	---	---	---		2.99
Strength, compression, min., MPa (psi) ^E								
Mortar flow (%)	110 ± 5	110 ± 5	110 ± 5	110 ± 5	110 ± 5			111
1 day	---	---	---	---	---	---		12.7 (1840)
3 days	10.4 (1510)	11.0 (1600)	11.0 (1600)	10.4 (1510)	---	13.0 (1890)		23.4 (3390)
7 days	16.0 (2320)	18.0 (2610)	18.0 (2610)	16.0 (2320)	11.0 (1600)	20.0 (2900)		27.2 (3940)
28 days	20.0 (2900)	25.0 (3620)	25.0 (3620)	20.0 (2900)	21.0 (3050)	25.0 (3620)		35.7 (5180)
Water Requirement, max wt% cement:	---	---	---	---	64	---		47
Heat of Hydration								
7 days, max kj/kg (cal/g)	---	---	---	290 (70)	250 (60)	---		
28 days, max kj/kg (cal/g)	---	---	---	330 (80)	290 (70)	---		
Drying Shrinkage, (ASTM C157) max %:	---	---	---	---	0.15	---		
Sulfate Resistance (ASTM C1012)								
expansion at 180 days, max %	---	0.10	0.05^F	---	---	---		
expansion at 1 year, max, %	---	---	0.10^F	---	---	---		
Mortar Expansion (ASTM C227)								
14 days, max %	---	---	---	---	---	0.020		
56 days, (8 week) max %	---	---	---	---	---	0.060		

- A: These requirements apply only if specified and are designated by the appropriate suffixes A, MS, HS, MH, LH, or R as appropriate type designations IL, IP, IS(<70), IT(S<70). The requirements for fineness, autoclave expansion, autoclave contraction and time of setting shall conform to Table 3.
- B: Cements with greater than 5% limestone are not permitted as moderate (MS) or high (HS) sulfate resistance cements.
- C: Compliance with this requirement shall not be required unless the cement shall be used with alkali-silica reactive aggregate.
- D: These air content limits apply to cements with multiple special property requirements when one of those designations is (A).
- E: When multiple special property designations are applied, the set of strength requirements for the special property designation with the lowest 7-day minimum shall apply.
- F: Testing of HS cement, at one year shall not be required when the cement meets the 180-day limit. A HS cement failing the 180-day limit shall not be rejected unless it also fails the one year limit.
- G: The naming convention was simplified in ASTM C595-14. The user is directed to clause 4.2.3 and note 4 of ASTM C595-14.

Client:	SGS Trinidad Limited	CTL Project No.:	382353
Project:	Various Testing	CTL Proj. Mgr.:	Xiuping Feng
Contact:	Romell Sudama	Analyst:	Johnathon Bass
Submitter:	Romell Sudama	Approved:	Scott Nettles
Date Received:	September 16, 2016	Date Analyzed:	September 22, 2016
		Date Reported:	September 22, 2016

REPORT OF CHEMICAL ANALYSIS

Client's Sample ID: Rock Hard Cement (Turkey)
 Material type: Cement-blended
 CTL Sample ID: 4305003

<u>Analyte</u>	<u>Weight %</u>
SiO ₂	27.76
Al ₂ O ₃	8.23
Fe ₂ O ₃	4.50
CaO	49.36
MgO	2.30
SO ₃	2.51
Na ₂ O	0.80
K ₂ O	1.22
TiO ₂	0.62
P ₂ O ₅	0.17
Mn ₂ O ₃	0.09
SrO	0.06
Cr ₂ O ₃	0.02
ZnO	<0.01
BaO	0.04
L.O.I. (950°C) ²	2.07
<u>Total</u>	<u>99.75</u>

T-Alk (Na₂O + 0.658K₂O) 1.60

- Notes:
1. This analysis represents specifically the sample submitted.
 2. Sample results reported on an as received weight basis.
 3. Oxide analysis by X-ray fluorescence spectrometry. Samples fused at 1000°C with Li₂B₄O₇/LiBO₂.
 4. X-Ray Fluorescence oxide analysis meets the precision and accuracy requirements for rapid methods per ASTM C114-13. Most recent re-qualification date is 04-Nov-2017.
 5. Volatile elements may be lost during high temperature ignition and fusion.
 6. This report may not be reproduced except in its entirety.