

The Monarch Cement Company

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Certified Mill Test Report - Type I/II

Production Period: May 1, 2018 through May 31, 2018

The following is based on average test data during the production period. The data is typical of cement produced at The Monarch Cement Company, Humboldt, KS. Individual shipments may vary.

325 Sieve, % Passing 92.6 - Air Content of Mortar (volume %) 8.3			CAL	PHYSIC		
Autoclave Expansion (%) 0.011	Spec Limit	Reported		Spec Limit	Reported	
Air Permeability (cm²/g) 3470 2600 min Compressive Strength (psi)	12.0 max	8.3	Air Content of Mortar (volume %)	-	92.6	325 Sieve, % Passing
Time of Setting, Gilmore test:	0.80 max	0.011	Autoclave Expansion (%)			Blaine fineness, specific surface
Time of Setting, Gilmore test:				2600 min	3470	Air Permeability (cm²/g)
Initial (hrs:min) 2:35 60 min 3 Days 3352 Final (hrs:min) 3:40 600 max 7 Days 4237 CHEMICAL Reported Spec Limit Reported SiO2 - Silicon dioxide (%) 21.37 - Loss on ignition (%) 1.45 Fe2O3 - Ferric oxide (%) 2.88 6.0 max Insoluble residue (%) 0.36 Al2O3 - Aluminum oxide (%) 4.39 6.0 max Free lime (%) 1.50 CaO - Calcium oxide (%) 65.61 - Na2O - Sodium oxide (%) 0.20 MgO - Magnesium oxide (%) 1.41 6.0 max K2O - Potassium oxide (%) 0.54 SO3 - Sulphur trioxide (%) 2.86 3.0 max Equivalent Alkalies (%) 0.54 Inorganic Processing Addition (%) 2.10 POTENTIAL CALCULATED COMPOUNDS INORGANIC PROCESS ADDITON (C150) C3S - Tricalcium silicate (%) 62.9 - Process Dust (%) 2.10 C2S - Dicalcium silicate (%) 13.8 - SiO2 - Silicon dioxide (%) 10.3 C3A - Tricalcium aluminate (%) 6.8 8 max Fe2O3 - Ferric oxide (%) 2.16			Compressive Strength (psi)			
Final (hrs:min) 3:40 600 max 7 Days 4237 CHEMICAL CHEMICAL Reported Spec Limit Reported SiO2 - Silicon dioxide (%) 21.37 - Loss on ignition (%) 1.45 Fe2O3 - Ferric oxide (%) 2.88 6.0 max Insoluble residue (%) 0.36 Aluminum oxide (%) 4.39 6.0 max Free lime (%) 1.50 CaO - Calcium oxide (%) 1.50 Na ₂ O - Sodium oxide (%) 0.20 MgO - Magnesium oxide (%) 1.41 6.0 max K ₂ O - Potassium oxide (%) 0.54 SO ₃ - Sulphur trioxide (%) 2.86 3.0 max Equivalent Alkalies (%) 0.54 POTENTIAL CALCULATED COMPOUNDS INORGANIC PROCESS ADDITON (C150) C ₃ S - Tricalcium silicate (%) 1.38 <t< td=""><td>-</td><td>2145</td><td>1 Day</td><td></td><td></td><td>Time of Setting, Gilmore test:</td></t<>	-	2145	1 Day			Time of Setting, Gilmore test:
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	1740 min	3352	3 Days	60 min	2:35	Initial (hrs:min)
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	2760 min	4237	7 Days	600 max	3:40	Final (hrs:min)
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$			CAL	СНЕМІ		
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	Spec Limit	Reported		Spec Limit	Reported	
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	3.0 max	1.45	Loss on ignition (%)	-	21.37	SiO ₂ - Silicon dioxide (%)
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	1.50 max	0.36	Insoluble residue (%)	6.0 max	2.88	Fe ₂ O ₃ - Ferric oxide (%)
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	-	1.50	Free lime (%)	6.0 max	4.39	Al ₂ O ₃ - Aluminum oxide (%)
SO $_3$ - Sulphur trioxide (%) 2.86 3.0 max Equivalent Alkalies (%) 0.54 Inorganic Processing Addition (%) 2.10 POTENTIAL CALCULATED COMPOUNDS INORGANIC PROCESS ADDITON (C150) C $_3$ S - Tricalcium silicate (%) 62.9 - Process Dust (%) 2.10 C $_2$ S - Dicalcium silicate (%) 13.8 - SiO $_2$ - Silicon dioxide (%) 10.3 C $_3$ A - Tricalcium aluminate (%) 6.8 8 max Fe $_2$ O $_3$ - Ferric oxide (%) 2.16	-	0.20	Na ₂ O - Sodium oxide (%)	-	65.61	CaO - Calcium oxide (%)
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	-	0.54	K ₂ O - Potassium oxide (%)	6.0 max	1.41	MgO - Magnesium oxide (%)
POTENTIAL CALCULATED COMPOUNDSINORGANIC PROCESS ADDITON (C150) C_3S - Tricalcium silicate (%)62.9-Process Dust (%)2.10 C_2S - Dicalcium silicate (%)13.8- SiO_2 - Silicon dioxide (%)10.3 C_3A - Tricalcium aluminate (%)6.88 max Fe_2O_3 - Ferric oxide (%)2.16	0.60 max	0.54	Equivalent Alkalies (%)	3.0 max	2.86	SO ₃ - Sulphur trioxide (%)
C ₃ S - Tricalcium silicate (%) 62.9 - Process Dust (%) 2.10 C ₂ S - Dicalcium silicate (%) 13.8 - SiO ₂ - Silicon dioxide (%) 10.3 C ₃ A - Tricalcium aluminate (%) 6.8 8 max Fe_2O_3 - Ferric oxide (%) 2.16	5.0 max	2.10	Inorganic Processing Addition (%)			
C_2S - Dicalcium silicate (%) 13.8 - SiO_2 - Silicon dioxide (%) 10.3 C_3A - Tricalcium aluminate (%) 6.8 8 max Fe_2O_3 - Ferric oxide (%) 2.16		(150)	CALCULATED COMPOUNDS INORGANIC PROCESS ADDITON (C			
C ₃ A - Tricalcium aluminate (%) 6.8 8 max Fe ₂ O ₃ - Ferric oxide (%) 2.16		2.10	Process Dust (%)	-	62.9	C ₃ S - Tricalcium silicate (%)
		10.3	SiO ₂ - Silicon dioxide (%)	-	13.8	C ₂ S - Dicalcium silicate (%)
		2.16	Fe ₂ O ₃ - Ferric oxide (%)	8 max	6.8	C ₃ A - Tricalcium aluminate (%)
O_4AF - Tetracalcium aluminolemite (76) 6.0 - $A_1_2O_3$ - Aluminum Oxide (76) 4.23		4.23	Al ₂ O ₃ - Aluminum oxide (%)	-	8.8	C ₄ AF - Tetracalcium aluminoferrite (%)
CaO - Calcium oxide (%) 43.8		43.8	CaO - Calcium oxide (%)			
SO ₃ - Sulphur trioxide (%) 0.46		0.46	SO ₃ - Sulphur trioxide (%)			

The cement in this shipment meets standard requirements in the current specifications of the Federal Government and the American Society for Testing and Materials for Type I and for Type II Portland Cement. All tests conform to AASHTO M-85 and ASTM Test Methods: Chemical C-114, Blaine C-204, Soundness C-151, Gillmore C-266, Compressive Strength C-109, Air Content C-185, C-465 and C-150.

Date: 6/18/2018

Sean D. Bowman Quality Control Supervisor