



# The Monarch Cement Company

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## Certified Mill Test Report - Type I

Production Period: July 1- July 31, 2017

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.

### PHYSICAL

|                                       | Reported | Spec Limit |                                  | Reported | Spec Limit |
|---------------------------------------|----------|------------|----------------------------------|----------|------------|
| 325 Sieve, % Passing                  | 97.7     | -          | Air Content of Mortar (volume %) | 8.0      | 12.0 max   |
| Blaine fineness, specific surface     |          |            | Autoclave Expansion (%)          | -0.033   | 0.80 max   |
| Air Permeability (cm <sup>2</sup> /g) | 3680     | 2600 min   | Compressive Strength (psi)       |          |            |
| Time of Setting, Gilmore test:        |          |            | 1 Day                            | 2298     | -          |
| Initial (hrs:min)                     | 2:30     | 60 min     | 3 Days                           | 3473     | 1740 min   |
| Final (hrs:min)                       | 3:25     | 600 max    | 7 Days                           | 4388     | 2760 min   |

### CHEMICAL

|   | Reported | Spec Limit |  | Reported | Spec Limit |
|---|----------|------------|--|----------|------------|
| SiO <sub>2</sub> - Silicon dioxide (%)              | 21.15    | -          | Loss on ignition (%)                   | 1.45     | 3.0 max    |
| Fe <sub>2</sub> O <sub>3</sub> - Ferric oxide (%)   | 2.79     | 6.0 max    | Insoluble residue (%)                  | 0.22     | 1.50 max   |
| Al <sub>2</sub> O <sub>3</sub> - Aluminum oxide (%) | 4.29     | 6.0 max    | Free lime (%)                          | 1.34     | -          |
| CaO - Calcium oxide (%)                             | 63.77    | -          | Na <sub>2</sub> O - Sodium oxide (%)   | 0.17     | -          |
| MgO - Magnesium oxide (%)                           | 1.34     | 6.0 max    | K <sub>2</sub> O - Potassium oxide (%) | 0.54     | -          |
| SO <sub>3</sub> - Sulphur trioxide (%)              | 2.84     | 3.0 max    | Equivalent Alkalies (%)                | 0.53     | 0.60 max   |
|   |          |            | Inorganic Processing Addition (%)      | 2.10     | 5.0 max    |

### POTENTIAL CALCULATED COMPOUNDS

|   |      |       |
|---|------|-------|
| C <sub>3</sub> S - Tricalcium silicate (%)          | 58.0 | -     |
| C <sub>2</sub> S - Dicalcium silicate (%)           | 16.9 | -     |
| C <sub>3</sub> A - Tricalcium aluminate (%)         | 6.6  | 8 max |
| C <sub>4</sub> AF - Tetracalcium aluminoferrite (%) | 8.5  | -     |

### INORGANIC PROCESS ADDITON (C150)

|   |      |
|---|------|
| Process Dust (%)                                    | 2.10 |
| SiO <sub>2</sub> - Silicon dioxide (%)              | 10.3 |
| Fe <sub>2</sub> O <sub>3</sub> - Ferric oxide (%)   | 2.16 |
| Al <sub>2</sub> O <sub>3</sub> - Aluminum oxide (%) | 4.23 |
| CaO - Calcium oxide (%)                             | 43.8 |
| SO <sub>3</sub> - Sulphur trioxide (%)              | 0.46 |

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 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: 8/17/2017

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 Quality Control Supervisor