

December 16, 2004

Shamrock Mining and Metals  
 3301 North University Avenue  
 Second Floor  
 Provo, Utah 84604

Attention: Mr. Al McKee

Subject: Potential Alkali Reactivity Testing, Modified ASTM C 1260  
 Reactive Aggregates and Cement, Your Natural Pozzolan  
 Project No.: CT12645

Dear Mr. McKee:

This report presents results of modified potential reactivity testing (mortar bar method), performed using local sand and cement and your natural pozzolan that we received on October 25, 2004. The purpose of this testing was to determine the effectiveness of your pozzolan in mitigating alkali-silica reactivity (ASR) when used with reactive aggregates.

Two mixes were proportioned, prepared and tested in general conformance with ASTM C 1260, "Potential Alkali Reactivity of Aggregates (Mortar Bar Method)." The control mix contained portland cement and a local reactive aggregate (Gunnison stream sand), and the test mixture was modified to replace 30% of the portland cement with your natural pozzolan. The 14-day expansion for the control mixture was 0.12%, and the mix containing the natural pozzolan expanded 0.04%. Test results are presented in Tables 1 and 2.

The test method defines the potential of an aggregate for deleterious expansion as follows:

<u>Test Expansion</u>	<u>Classification</u>	<u>Potential for Deleterious ASR</u>
< 0.10%	Innocuous	Low
> 0.10% to < 0.20%	Inconclusive	Not Predictable
> 0.20%	Deleterious	High

Based on these results, the natural pozzolan reduced the expansion due to ASR by 68%. It has excellent potential to mitigate ASR with most reactive aggregates. If you have any questions regarding this report, please feel free to contact us.

Very truly yours,

CTL | Thompson Materials Engineers, Inc.



Orville R. Werner II, P.E.  
 Principal

ORW:hh

Enclosures

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Table 1



**POTENTIAL ALKALI REACTIVITY OF AGGREGATES, (MORTAR-BAR METHOD)**  
**ASTM C 1260**

**Client:** Shamrock Mining & Metals  
**Project:** Potential Alkali Reactivity Testing  
**Job No.:** CT12645

**Cast Date:** October 27, 2004

**Standard**

**Modified**

Aggregate: Gunnison Sand  
Cement: Dacotah Type I/II

Cement:  
Fly Ash:  
Coarse Agg:  
Fine Agg:  
Lithium Admix: (none)

**Cement Alkalis** (Total Alkalis as Na<sub>2</sub>O): 0.53%  
**Required Cementitious Content:** 440 g  
**Aggregate/Cement Ratio:** 990 g/440 g  
**Water/Cement Ratio:** 0.47

Sample I.D.	Initial (24 hr)	Zero (48 hr)	3 Day Reading	% Change	7 Day Reading	% Change	10 Day Reading	% Change	14 Day Reading	% Change
Date	10/28/04	10/29/04	11/01/04		11/05/04		11/08/04		11/12/04	
1	0.1480	0.1533	0.1568	0.035	0.1587	0.054	0.1630	0.097	0.1682	0.149
2	0.0816	0.0889	0.0902	0.013	0.0923	0.034	0.0960	0.071	0.1000	0.111
3	0.1631	0.1708	0.1718	0.010	0.1741	0.033	0.1775	0.067	0.1813	0.105
<b>Average</b>				<b>0.02</b>		<b>0.04</b>		<b>0.08</b>		<b>0.12</b>

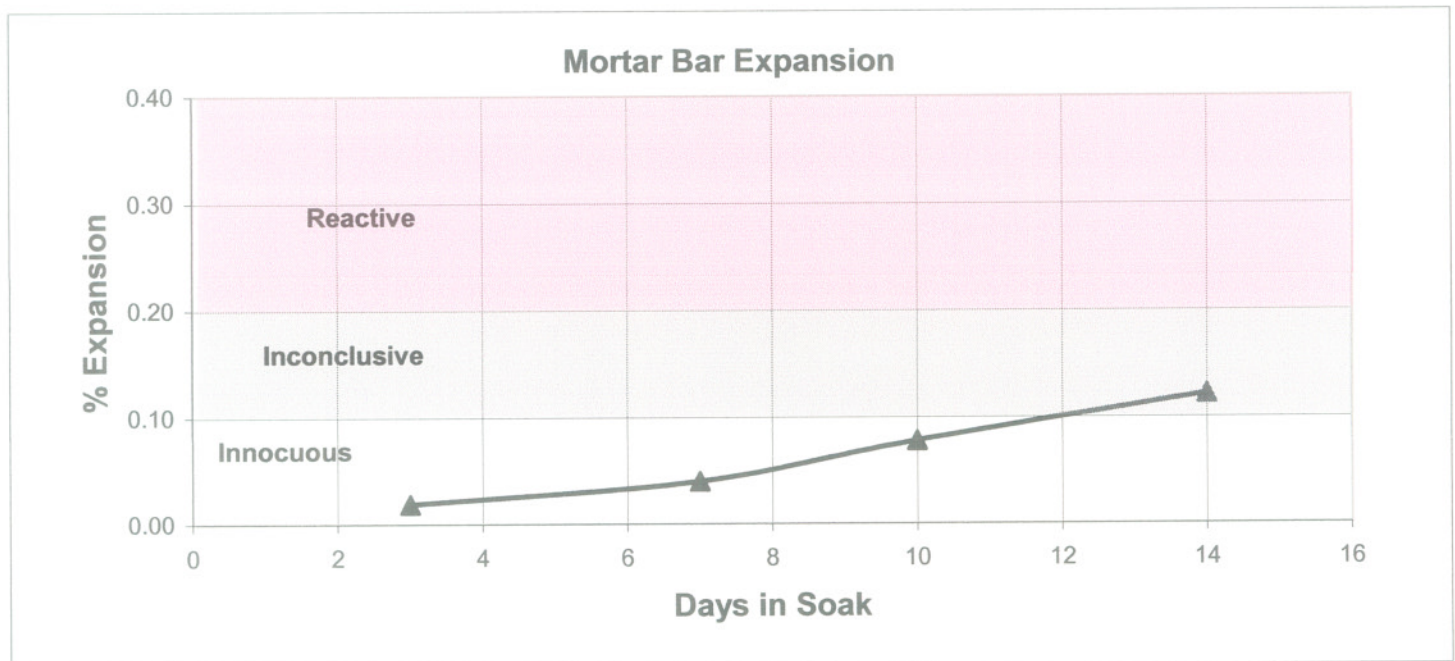


Table 2



**POTENTIAL ALKALI REACTIVITY OF AGGREGATES, (MORTAR-BAR METHOD)**  
**ASTM C 1260**

**Client:** Shamrock Mining & Metals  
**Project:** Potential Alkali Reactivity Testing  
**Job No.:** CT12645

**Cast Date:** October 27, 2004

**Standard**

**Modified**

Aggregate:  
Cement:

Cement: Dakota Type I/II  
Pozzolan: Shamrock Mnatural Pozzolan  
  
Fine Agg: Gunnison Sand  
Lithium Admix: (none)

**Cement Alkalis** (Total Alkalis as Na<sub>2</sub>O): 0.53%

**Required Cementitious Content:** 440 g (30% Natural Pozzolan)

**Aggregate/Cementitious Ratio:** 990 g/440 g

**Water/Cementitious Ratio:** 0.47

Sample I.D.	Initial (24 hr)	Zero (48 hr)	3 Day Reading	% Change	7 Day Reading	% Change	10 Day Reading	% Change	14 Day Reading	% Change
Date	10/28/04	10/29/04	11/01/04		11/05/04		11/08/04		11/12/04	
1	0.1957	0.2025	0.2035	0.010	0.2036	0.011	0.2048	0.023	0.2062	0.037
2	0.2333	0.2404	0.2415	0.011	0.2415	0.011	0.2427	0.023	0.2440	0.036
3	0.2043	0.2115	0.2126	0.011	0.2127	0.012	0.2140	0.025	0.2154	0.039
<b>Average</b>				<b>0.01</b>		<b>0.01</b>		<b>0.02</b>		<b>0.04</b>

