

Technical Bulletin

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Producing Sulfate Resistant Concrete with Whitemud^{MK}

Whitemud^{MK} Metakaolin is a manufactured pozzolan meeting ASTM C 618 and AASHTO M 295 Class N requirements.

Whitemud^{MK} has been tested in combination with cements containing up to 10% C₃A and meets all the requirements in ASTM C 618, ASTM C 1157 and ASTM C 595 for use in high sulfate exposure conditions.

In addition, Whitemud^{MK} can be used in combination with cements meeting ASTM C 150, C 1157 or C 595 for the production of sulfate resistant concrete provided the additional requirements in the ACI 318 building code are met.

When using Whitemud^{MK}, it is the responsibility of the concrete producer to ensure that all the relevant specifications are met. The requirements for sulfate resistance (exposure class S) are contained in ACI 318-08 Chapter 4. In addition, the concrete must meet all local codes and specifications concerning concrete designed to resist sulfate attack or other specified exposure conditions.

Cementitious Materials for Sulfate Resistant Concrete

In table 4.3.1 of ACI 318 the concrete properties and the cementitious material types for exposure class S are defined with the added note that “*Alternative combinations of cementitious materials to those listed in Table 4.3.1 shall be permitted when tested for sulfate resistance and meeting the criteria in [Table] 4.5.1*”

Table 4.5.1 from ACI 318 is summarized below and Table 1 shows the performance of Whitemud^{MK} in the performance tests.

Exposure Class	Maximum expansion when tested using ASTM C1012		
	At 6 months	At 12 months	At 18 Months
S1	0.10 percent		
S2	0.05 percent	0.10 percent*	
S3			0.10 percent

*The 12-month limit applies only when the expansion exceeds the 6 month limit

Table 1 shows the requirements and results of testing performed at the University of Toronto with Whitemud^{MK}. The test results are also shown in graphical form as Appendix I. The C₃A of the cement tested in combination with Whitemud^{MK} was 10.4%

Table 1 – ACI 318 Performance Requirements and Whitemud^{MK} Performance

Exposure Class	Max. allowed Expansion at 6 Months (ASTM C1012), %	Max. allowed Expansion at 12 Months (ASTM C1012), %	Max. allowed Expansion at 18 Months (ASTM C1012), %	Expansion with Whitemud^{MK} used at 10% cement replacement (18 Months)	Expansion with Whitemud^{MK} used at 15% cement replacement (18 Months)
S1	0.10			0.08 %	0.04 %
S2	0.05	0.10			
S3			0.10		

These test results show that a cementing material combination using a minimum of 10% Whitemud^{MK} in combination with cements of 10% C₃A or less, performs equivalent to or better than that required by ACI 318.

When Whitemud^{MK} is used in ternary cementitious combinations with other pozzolans such as slag and fly ash, additional protection against sulfate attack can be achieved.

Appendix I
Mortar Bar Expansion - ASTM C-1012 (Testing Performed by the University of Toronto)

