

Construction Materials Consultants, Inc.

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Pyrrhotite & Crumbling Foundations

Fee Schedule for Testing of Aggregates, and Cores from Existing Concrete Foundations

Toot #	Toota	Purposs	ASTM	Unit Price	Sample
1651#	1 6515	i uipose	Designation	(\$)	Amount
<u>Aggregates</u>					
1A	Total Sulfur by High Temperature Furnace Combustion IR (Leco Method)	Total sulfur from both sulfide and sulfate phases, and any organic	ASTM D 4239	500	
1B	Total Sulfur (as SO ₃) by ED-XRF		ASTM C 114	350	
1C	Sulfide (S ²⁻) and Sulfate (S ⁶⁺) Sulfur Speciation by WD-XRF	Amount of sulfide (reduced) and sulfate (oxidized) phases	ASTM E 1621	1000	
1D	Sulfide content from total sulfur (from combustion) minus sulfate and organic sulfur (from gravimetry) - Sample is separated into 3 portions – (i) one used for total sulfur from IR combustion, (ii) another for HCl digestion to remove sulfate, then combustion to get sulfide and organic sulfur, then (iii) 3 rd to digest in HCl + HNO ₃ to remove sulfate and sulfide, then combusted to get organic sulfur. Individual sulfide, sulfate, or organic S contents are then calculated.		Modified EPA method (Sobek et al. 1978; Jennings et al. 2000)	1500	50 grams
	Sulfide mineralogy in aggregate by XRD (Qualitative ICDD-Jade Search/Match)	Detection of various iron sulfide phases and oxidation products	ASTM C 1365	500	
2B	Sulfide mineralogy in aggregate by XRD (Quantitative – Rietveld Analysis)		ASTM C 1365	1000	
3	Detection of pyrrhotite (and magnetite) in aggregate by magnetic separation	Qualitative estimation of potential presence of pyrrhotite (and magnetite) in aggregate from magnetic properties	Non-standard Test	350	
4A	Accelerated oxidation test of pulverized aggregate from chemical analysis of filtrates by ion chromatography (IC)	Amount of sulfate released from oxidation of iron sulfide minerals in aggregate	ASTM D 4327	750	100 grams
4B	Mortar Bar Expansion Tests – Accelerated Method	Potential expansion of Iron sulfide bearing	ASTM C 1260	1250	500 grams
4C	Mortar Bar Expansion Test – Length Change Measurements in Water	aggregates in mortar - Aggregate must be received in crushed size finer than No. 4 sieve	ASTM C 157	1250	
5	Micro-XRF on Drilled cores from quarry	Detection of depths at which sulfide minerals are present	-	2000	Drilled core
6	Petrographic Examinations of drilled rock cores from quarry		ASTM C 295, ASTM D 2113	1750	
7	Petrographic Examinations of crushed stone aggregate from quarry	Detection of aggregate type, and potentially deleterious constituents including presence/absence/types of sulfide minerals	ASTM C 295	1750	5 pounds
8	Total Sulfur – XRD – Petrography	Comprehensive package of three most relevant short-term tests for initial screening of aggregates		2500	5 pounds
Cores from Existing Foundations Petrography 9 Optical microscopy of concrete core • Detection of pyrrhotite distress ASTM C 856 1500 4-in. ø core					
9	Optical microscopy of concrete core	Detection of pyrrhotite distress	ASTM C 856	1500	4-in. ø core
10	 Comprehensive investigation, including: Detailed Petrography Scanning Electron Microscopy & X-ray Microanalysis Chemical (total sulfur) X-ray Fluorescence X-ray Diffraction Ion Chromatography 	Detection of Pyrrhotite and Pyrite in Existing Foundations Amount of Iron Sulfide Minerals Concrete Composition, Condition & Quality Mechanisms and Extent of Deterioration Service Life Assessment	ASTM C 856, ASTM C 1723, ASTM C 114, ASTM D 4239, ASTM D 4327	2500	4-in. diameter core drilled from over cracked foundation
	1B 1C 1D 2A 2B 3 4A 4B 4C 5 6 7 8	Total Sulfur by High Temperature Furnace Combustion IR (Leco Method) 1B Total Sulfur (as SO ₃) by ED-XRF 1C Sulfide (S ²) and Sulfate (S ⁶⁺) Sulfur Speciation by WD-XRF Sulfide content from total sulfur (from consulfur (from gravimetry) - Sample is separatotal sulfur from IR combustion, (ii) another then combustion to get sulfide and organi + HNO ₃ to remove sulfate and sulfide, the Individual sulfide, sulfate, or organic S confunction (Qualitative ICDD-Jade Search/Match) 2B Sulfide mineralogy in aggregate by XRD (Quantitative – Rietveld Analysis) 3 Detection of pyrrhotite (and magnetite) in aggregate by magnetic separation 4A Accelerated oxidation test of pulverized aggregate from chemical analysis of filtrates by ion chromatography (IC) 4B Mortar Bar Expansion Tests – Accelerated Method 4C Mortar Bar Expansion Test – Length Change Measurements in Water 5 Micro-XRF on Drilled cores from quarry 6 Petrographic Examinations of drilled rock cores from quarry 7 Petrographic Examinations of crushed stone aggregate from quarry 8 Total Sulfur – XRD – Petrography 8 Total Sulfur – XRD – Petrography 9 Optical microscopy of concrete core Comprehensive investigation, including: • Detailed Petrography • Scanning Electron Microscopy & X-ray Microanalysis • Chemical (total sulfur) • X-ray Fluorescence • X-ray Diffraction	Aggregates 1A Total Sulfur by High Temperature Furnace Combustion IR (Leco Method) 1B Total Sulfur (as SO.) by ED.XRF 1C Sulfide (S°) and Sulfate (S°) Sulfur Sulfur (from combustion) minus sulfate and organic sulfur (from gravimetry) - Sample is separated into 3 portions – (i) one used for total sulfur (from gravimetry) - Sample is separated into 3 portions – (i) one used for total sulfur (from gravimetry) - Sample is separated into 3 portions – (i) one used for total sulfur (from gravimetry) - Sample is separated into 3 portions – (ii) one used for total sulfur from IR combustion, (ii) another for HCI digestion to remove sulfate, then combusted to get organic sulfur. 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Note: Prices are for standard 3-4 weeks TAT (except Test #4C, which runs for 3 to 6 months). We also offer expedite 3-5 business day report for Tests #1A, 1B, 2A, and 2B for double price. Our prices are based on our extensive experience on the subject, our in-house state-of-the-art laboratory facilities that can be seen in our website under various laboratories, and our extent of research and publications on this topic, which can be downloaded from the case studies and publication pages in our website