



Pyrrhotite & Crumbling Foundations

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

Test Type	Test #	Tests	Purpose	ASTM Designation	Unit Price (\$)	Sample Amount
Aggregates						
Chemical Tests	1A	Total Sulfur by High Temperature Furnace Combustion IR (Leco Method)	Total sulfur from both sulfide and sulfate phases, and any organic sulfur	ASTM D 4239	500	50 grams
	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	
XRD	2A	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	
Physical Tests	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 aggregates in mortar - Aggregate must be received in crushed size finer than No. 4 sieve	ASTM C 1260	1250	500 grams
	4C	Mortar Bar Expansion Test – Length Change Measurements in Water		ASTM C 157	1250	
Petrography	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
Comprehensive Package	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
Comprehensive Package: Petrography, SEM-EDS, XRD, XRF, Chemical (total S), IC	10	Comprehensive investigation, including: <ul style="list-style-type: none"> Detailed Petrography Scanning Electron Microscopy & X-ray Microanalysis Chemical (total sulfur) X-ray Fluorescence X-ray Diffraction Ion Chromatography 	<ul style="list-style-type: none"> 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

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