
Fike

Analytical Technologies, L.L.C.

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SEM-EDS Soot and “What Is It?” Example Report

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Analytical Report

Client: My Company
Project: My Project
Location: Subject Location
Sampled by: Sampler

Laboratory ID: 4089
Order Date: 01/11/2018
Report Date: 01/16/2018
Date Analyzed: 01/15/2018

SEM-EDS Analysis

Analytical – All samples were evaluated with the intent of identifying the predominant types and quantity of particulate, contaminating chemicals, soot, and the reactivity of the particulate together with its potential for imparting hazardous conditions during contact or inhalation. Evaluation was conducted using a JEOL JSM-6610LV Scanning Electron Microscope (SEM) equipped with an Oxford Instruments AZtec system, software version 3.0, using a 20 mm² detector crystal Energy Dispersive X-Ray Spectrometer EDS). Energy calibration data was collected and is presented as 180115 Cu QC. Evaluation of these samples included the determinations of the general nature of the particulate, its potential for acidic/caustic or oxidative/reductive impartation, its potential for electrical conductivity, and the estimated particulate volume fraction of any particle groups including the target soot/char. Particle counting was not performed; particulate fraction was determined based on estimates by two analysts. Particulate fraction was based on estimated particle volume rather than number of particles or estimated weight. Evaluations of particle size and particle size distribution were not performed.

The examination extended over the entire sample and an example field of view is presented for each sample using dot maps and point-and-ID X-ray energy spectra. A dot map is an X-ray energy spectrum of each point in the field of view and is used to highlight particles containing the element(s) presented. Since the substrate (background) is carbonaceous, caution should be used when interpreting the carbon dot map because non-carbonaceous particles will appear as dark areas which can be confused with the dark areas that are caused by the shadow effect. Point-and-ID is presented to provide morphology and X-ray energy spectra for typical particles identified in the sample. The particles selected in point-and-ID are examples but no proportion should be assigned to the citation. Micrographs are backscattered images. The brightness is proportional to the average atomic weight of the atoms contained in the particles. Particles with a high average atomic weight will appear brighter than particles with a low average atomic weight. For example, particles with a high concentration of iron will appear brighter than particles comprised primarily of carbon.

Proportion estimates of particle population are given for the sample and are based on the entire sample, not just the field of view presented in the accompanying micrographs. Proportion estimates are the result of the corroboration of two analysts. Percentages listed total near 100%

but are estimates and hence, the calculated total typically varies between 80 and 100%, the balance being comprised of moieties listed under “Other.”

Management Summary

Four samples were submitted. The chemistry of the particulate was not compared to any reference material.

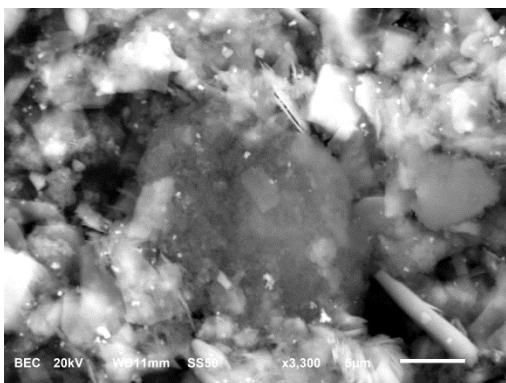
The primary moieties in samples 1-4 are presented in the following table:

Sample Number	Soot	Agglomerate*	PVC Debris	Other**
4089-1	10%	90%	< 5%	Balance
4089-2	15-20%	80%	< 5%	Balance
4089-3	< 5%	40%	< 5%	Balance
4089-4	< 5%	5%	30%	Balance

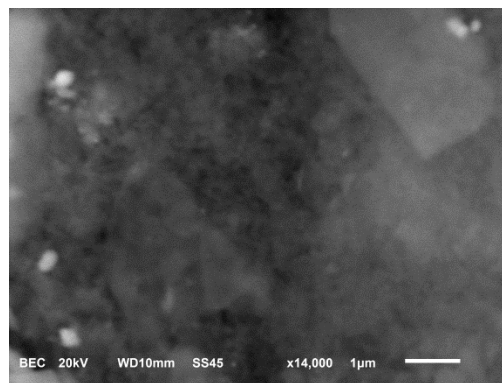
* Magnesiumaluminosilicate contaminated with paint debris.

** See detailed reports below for breakdown of “Other” particulate.

Samples 1 and 2 are very similar and both manifested the presence of soot which had adhered to the surface of other particulate. This was especially prevalent in sample 2. The following micrographs illustrate this phenomenon:



4089-1-3M Soot on Agglomerate



4089-1-4M Close-up of Soot in the Center of Left Hand Micrograph

Therefore, it can be concluded that the particulate in Samples 1 and 2 will appear black on visual observation even though it is only surface soot. This is shown in the right-hand micrograph where the underlying particle is apparent beneath the soot. The soot is carbonaceous and does not appear to present potential hazard other than the potential for electrical conductivity, that being proportional to the quantity of soot present.

The analysis of Sample 3 indicated the presence of leaded paint. This, of course, would not be fire-related but may need to be addressed through additional bulk analysis.

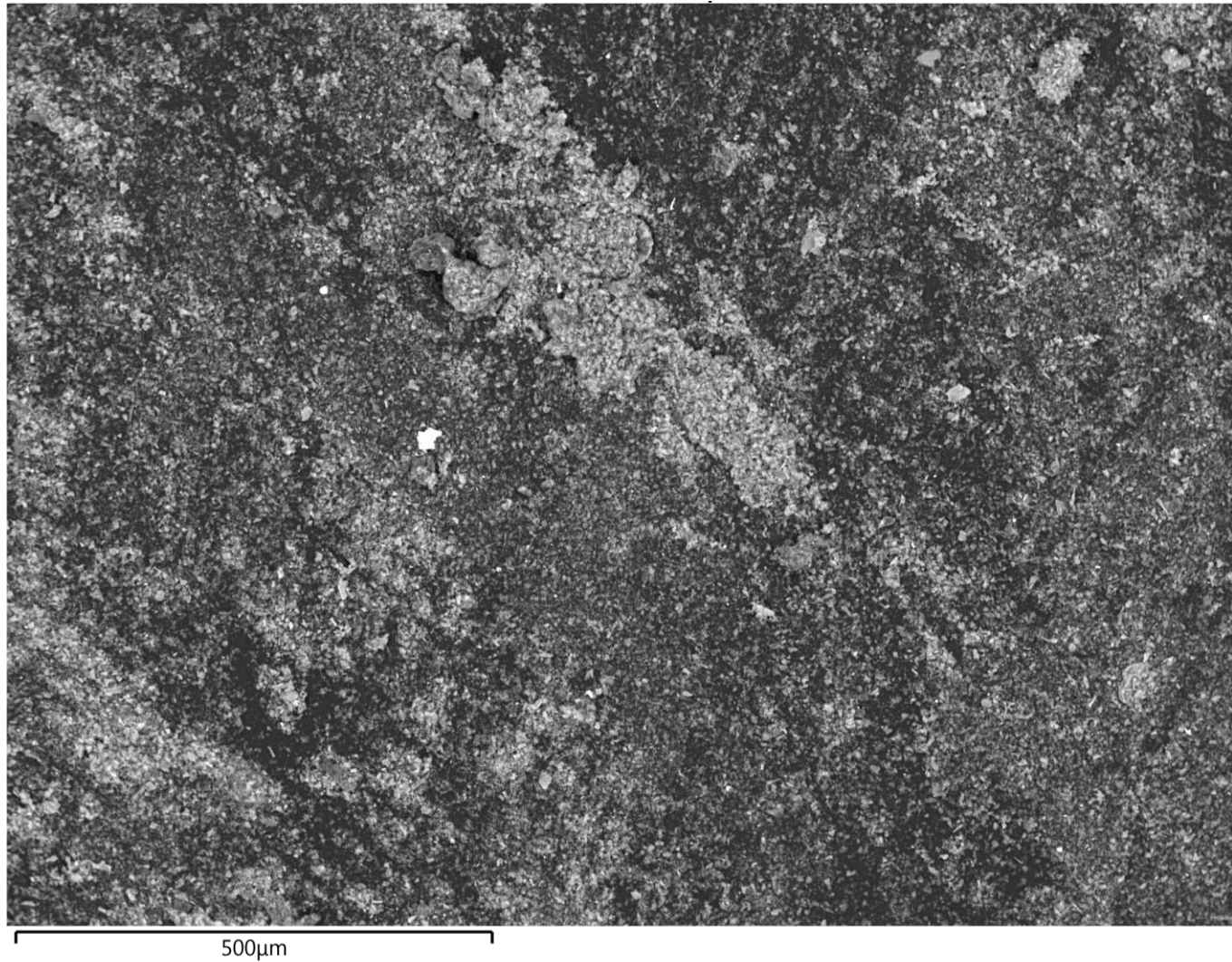
Detailed reports of the samples follow:

Data Sheet (this explains all of the images and X-ray energy spectra that follow)

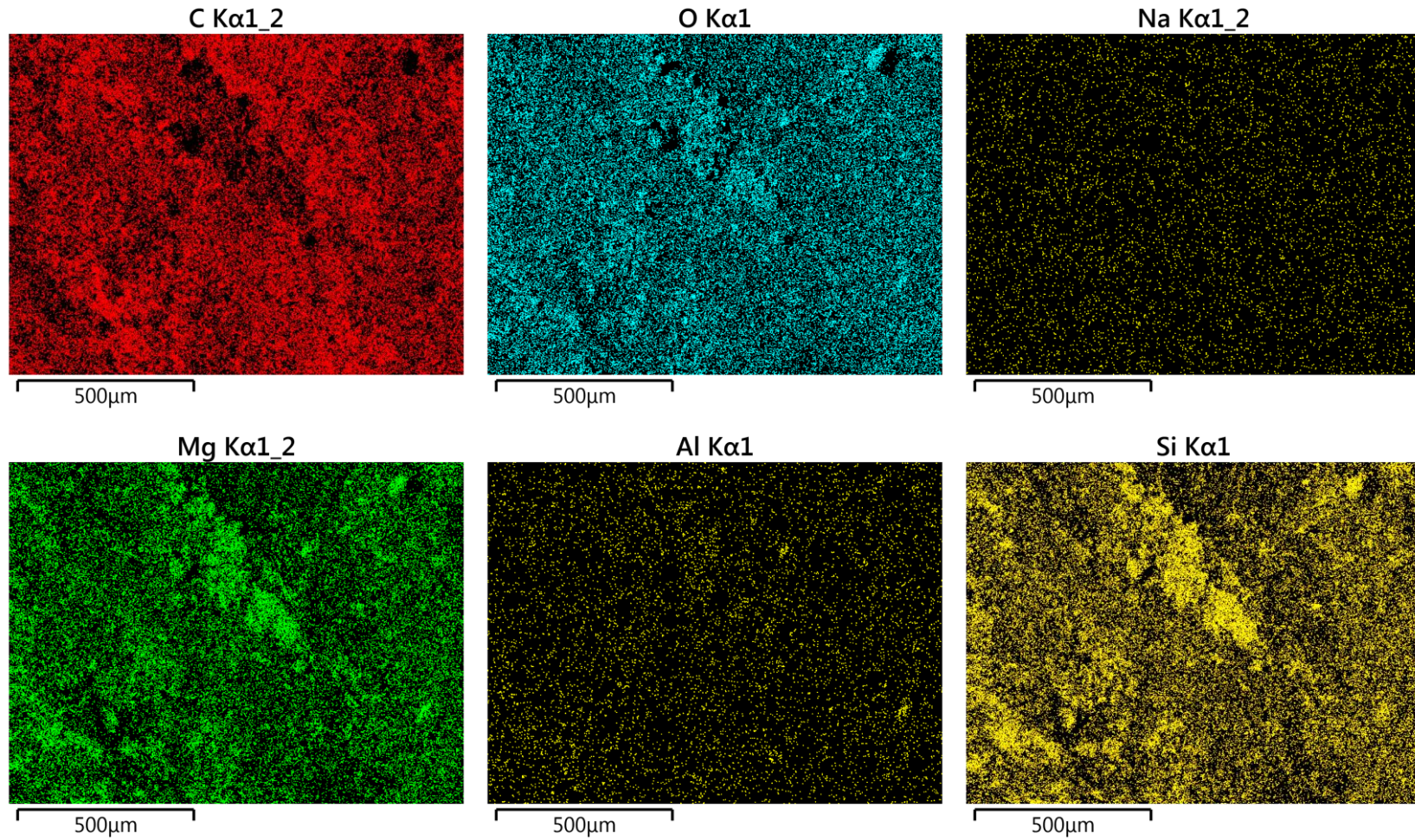
COC:	4089	Sample No.:	1
Date Received:	01/11/2018	Cu Reference #:	180115 Cu QC
Date Sampled:	01/11/2018	Date Analyzed:	01/15/2018
Sample Name:	Rack Below Origin		
Loading:	Heavy		
General Comments:	Note: brush marks and mechanical damage to some portions of the sample; field of view was adjusted to 100X due to small particle size.		
General Image:	4089-1-1M	Dot Map:	4089-1 Dot Map
Point and ID:	4089-1 Point and ID		
Spectrum Number:			
12	Magnesiumaluminosilicate contaminated with paint debris (Defined as "agglomerate" below)		
13	Steel debris (note that some of the steel particles manifested Ni which indicates that the steel debris has multiple sources, one of which is nickel-based stainless steel)		
14	Unagglomerated magnesiumsilicate		
15	Agglomerate		
16	Soot-coated agglomerate		
Other Micrographs:			
4089-1-2M, 2X	Spectrum 12 above (note that the debris surrounding the object particle is heavily contaminated with soot)		
4089-1-3M, 3X	Heavily soot-coated agglomerate		
4089-1-4M, 4X	Soot coating; note the high carbon content with lower agglomerate response; note that some low level of chlorine contamination exists in the soot indicating that some portion of the soot may have originated from PVC combustion		
Other Comments:	Note that a slight level of copper contamination exists throughout the entire sample (see dot map)		
Loading Summary:			
Soot	10% (almost all is adhered to the outside of agglomerate particles)		
Agglomerate	90%		
Nuisance Dust	Included in the agglomerate		
All Fiber Types	< 5%		
Other	Steel and SS debris; barium sulfate paint debris		
Nature:			
Oxidative/Reductive	No	High pH	No
Low pH	No	Conductive	Possibly depending upon the conductivity of the soot coating

Data sheets from samples 2-4 have been eliminated for brevity.

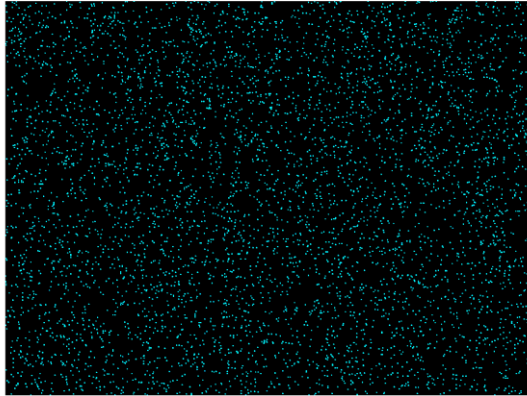
4089-1 General image used for Dot Map following



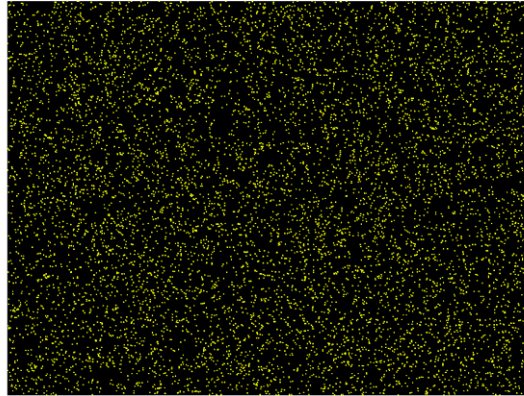
Dot Maps from image above for 4089-1



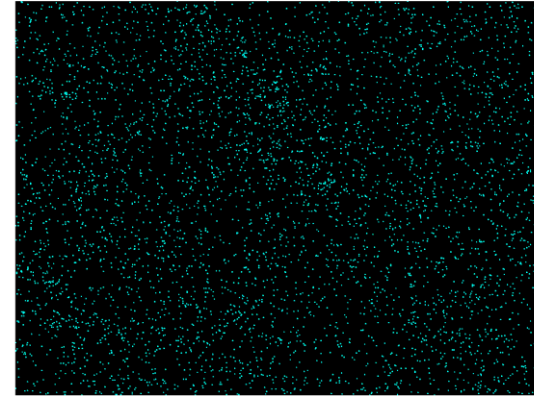
P K α 1



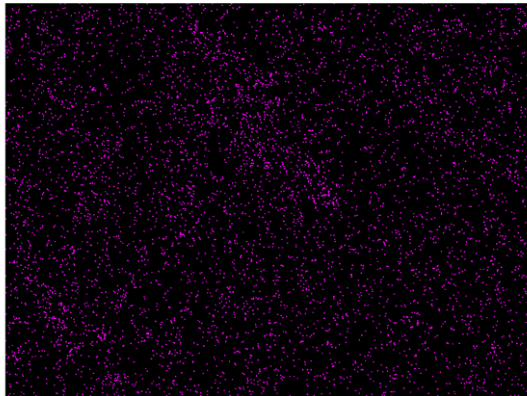
S K α 1



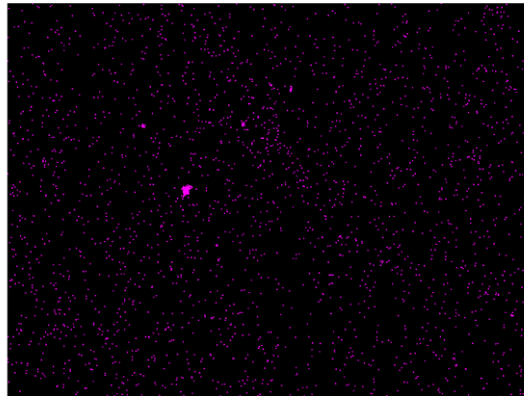
Ca K α 1



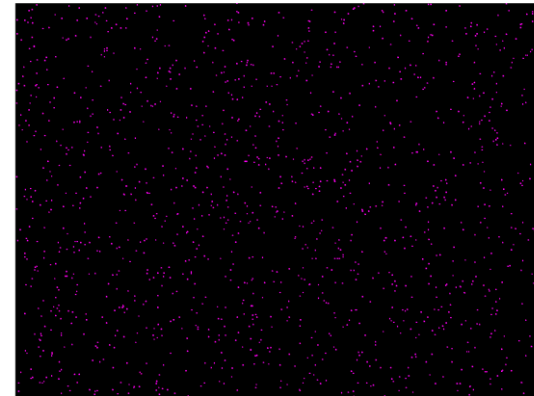
Ti K α 1



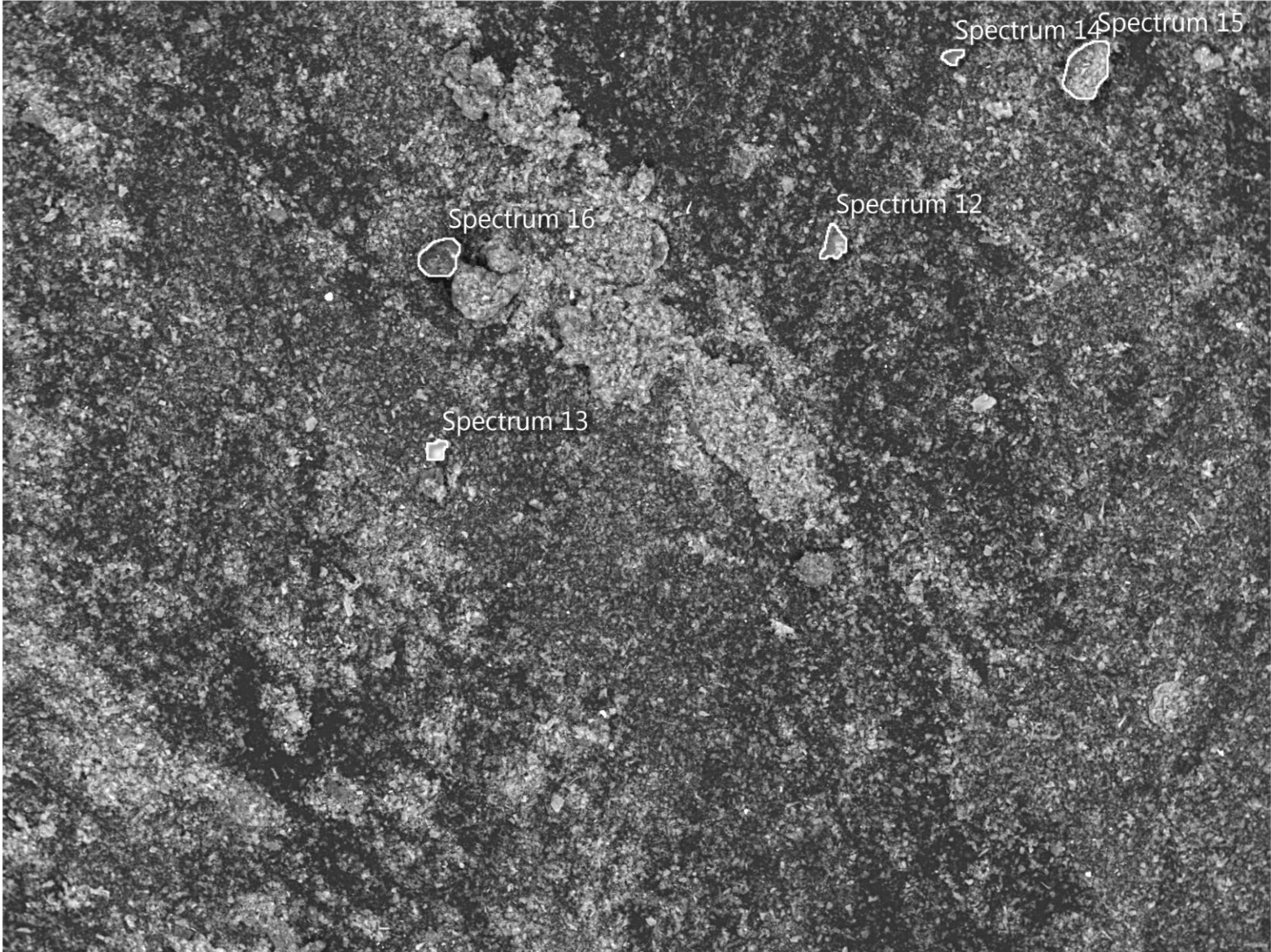
Fe K α 1



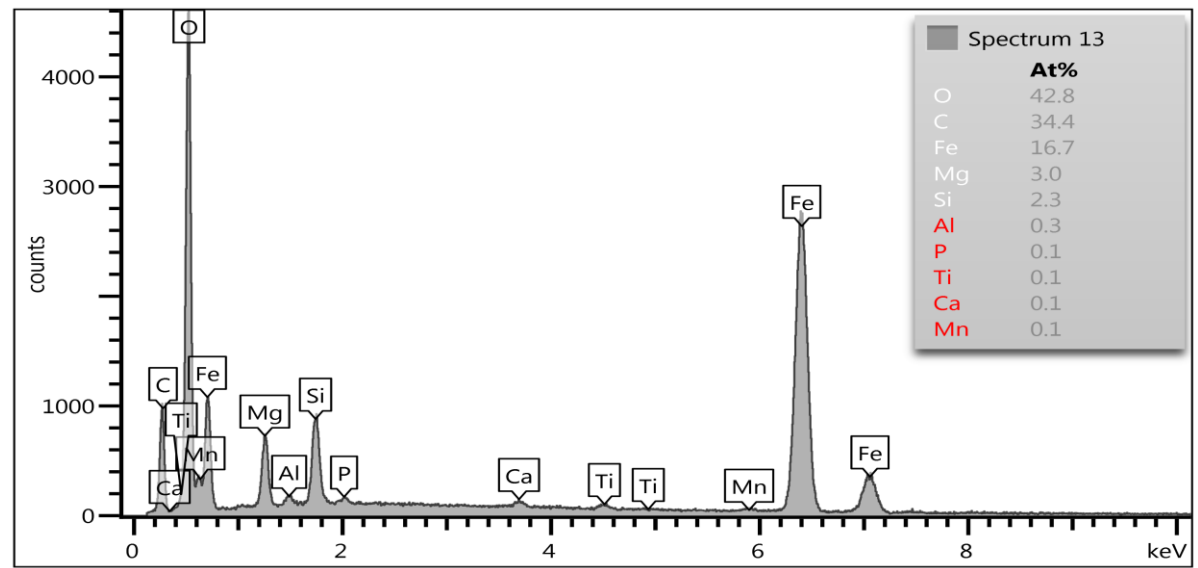
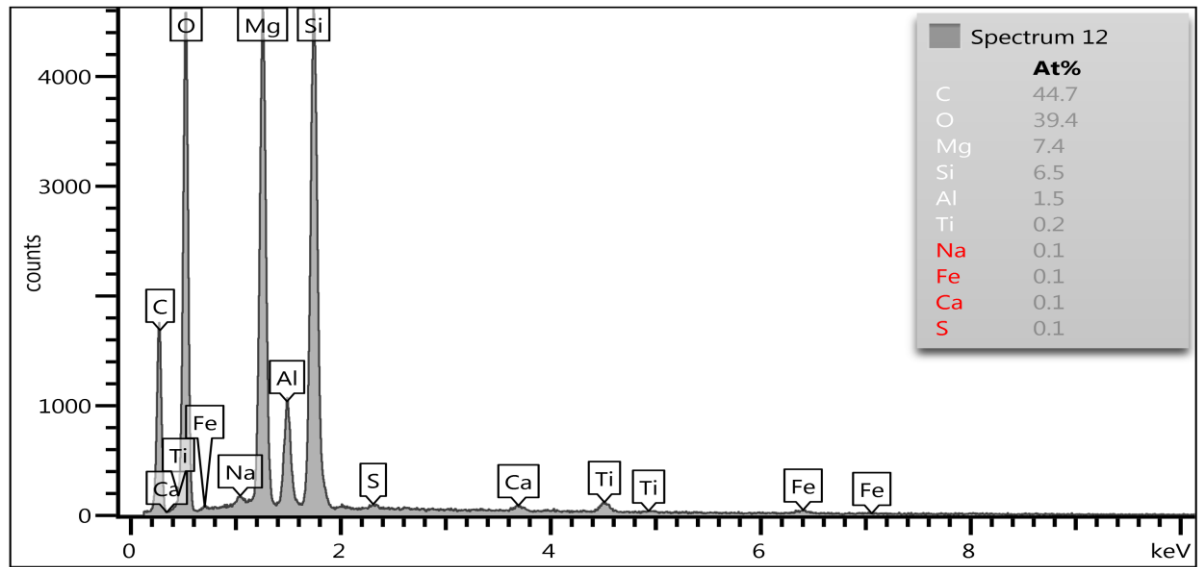
Cu K α 1

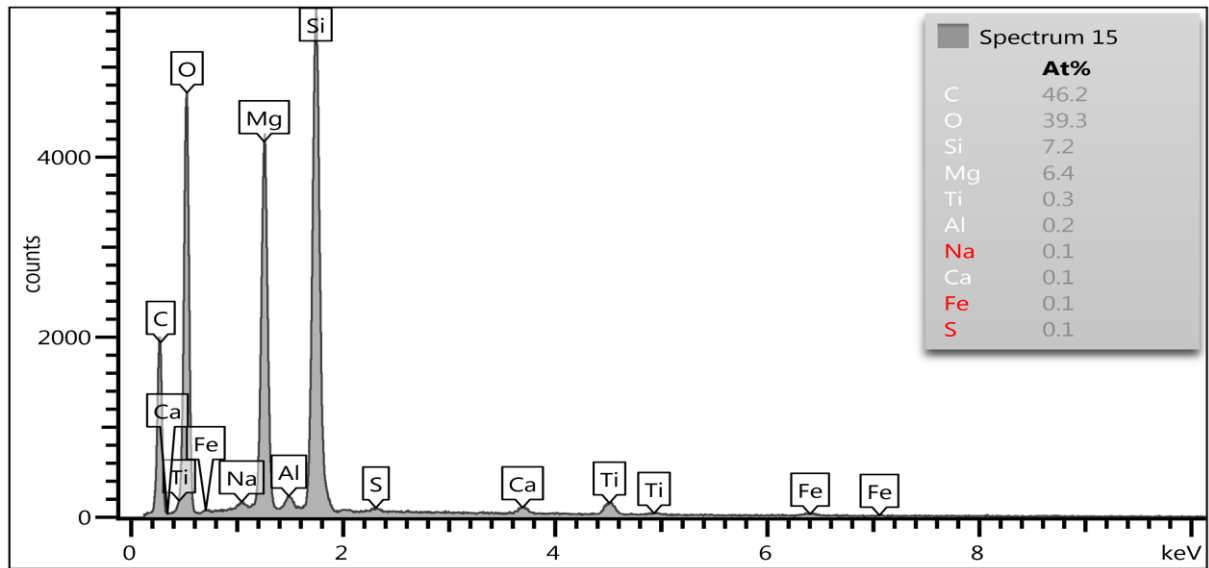
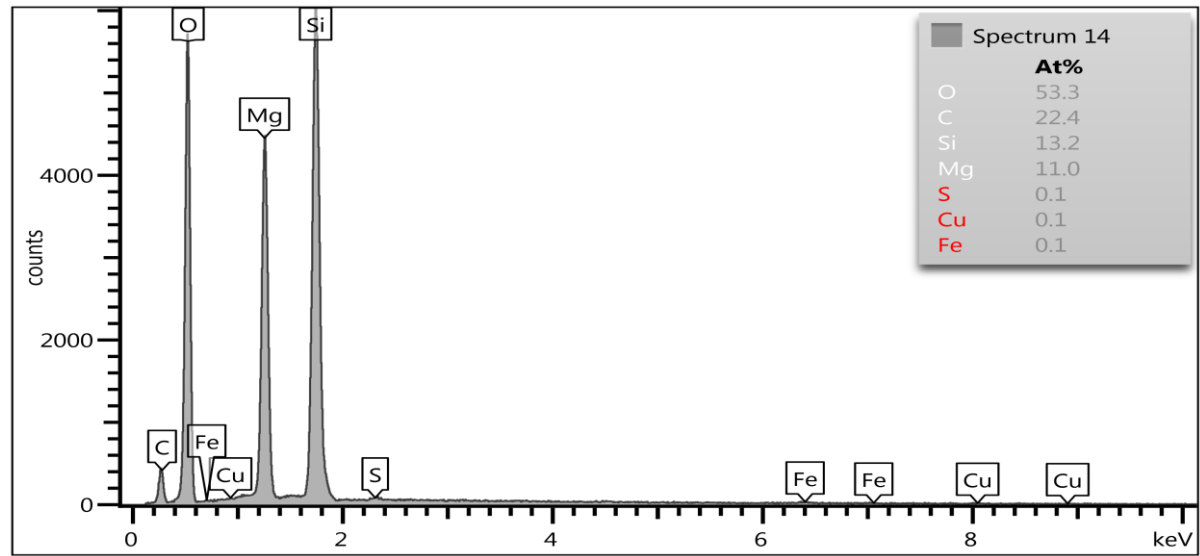


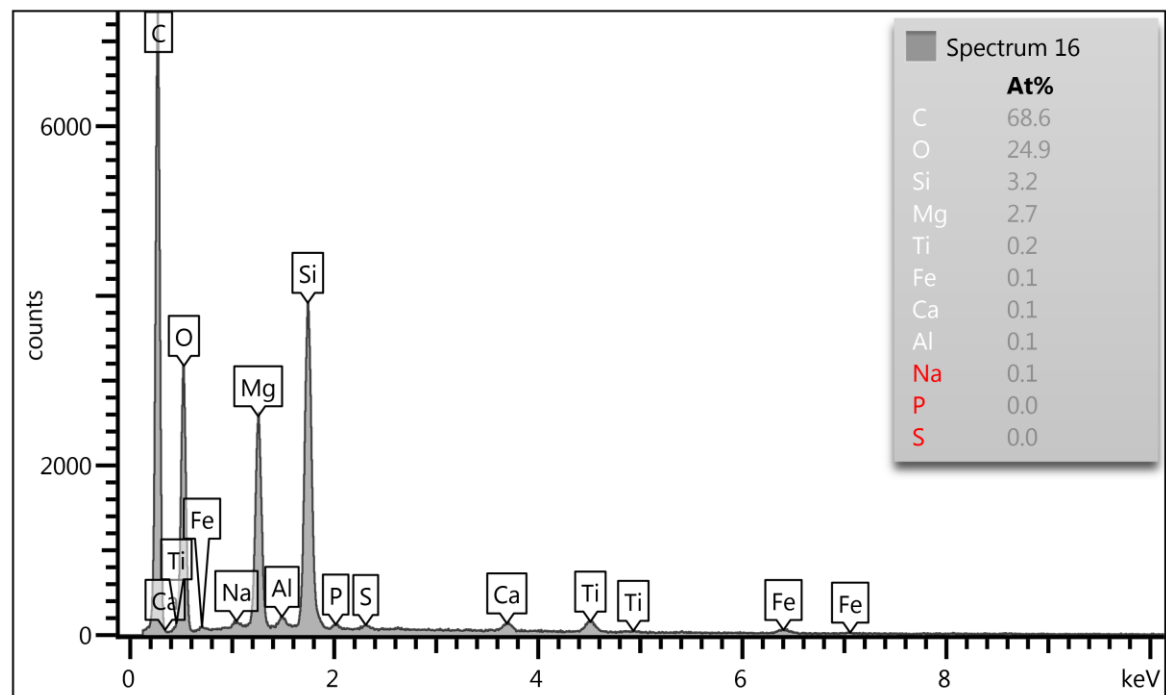
4089-1 Point & ID

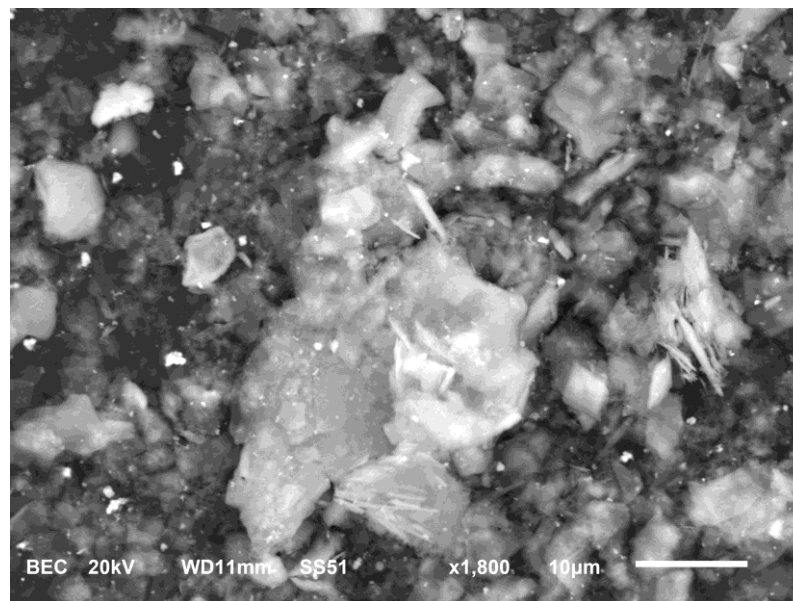


500µm

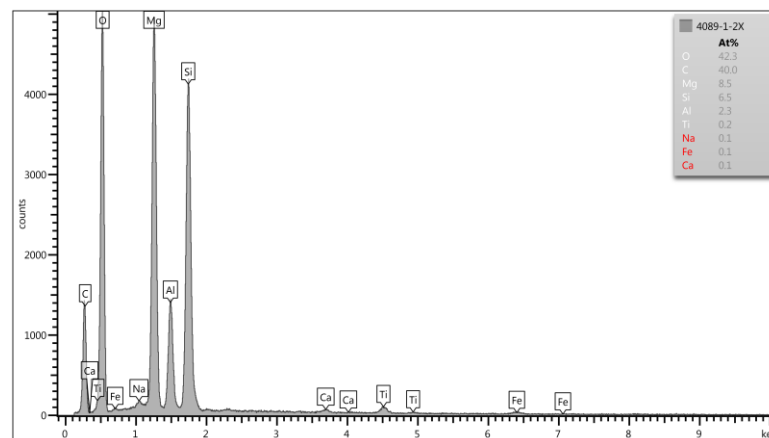




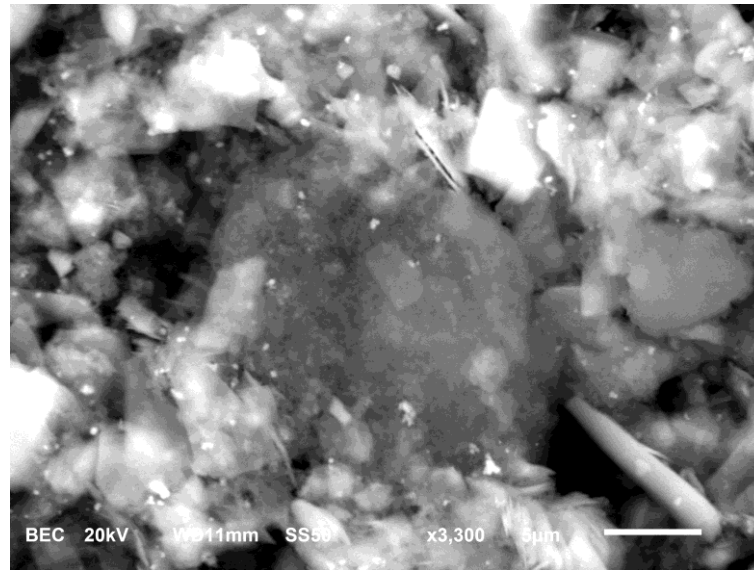




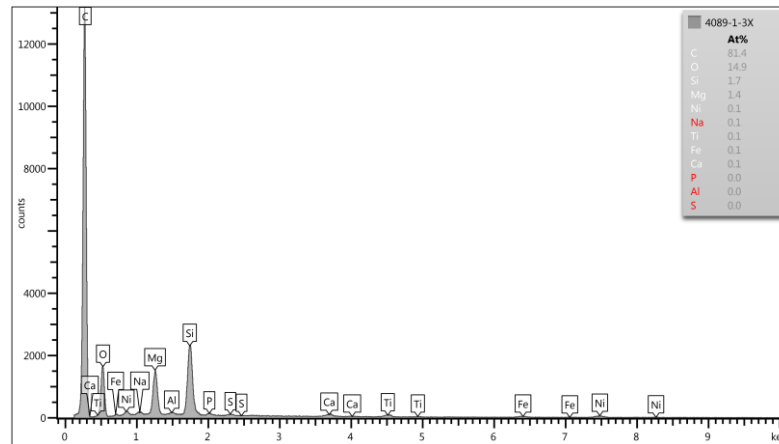
4089-1-2M



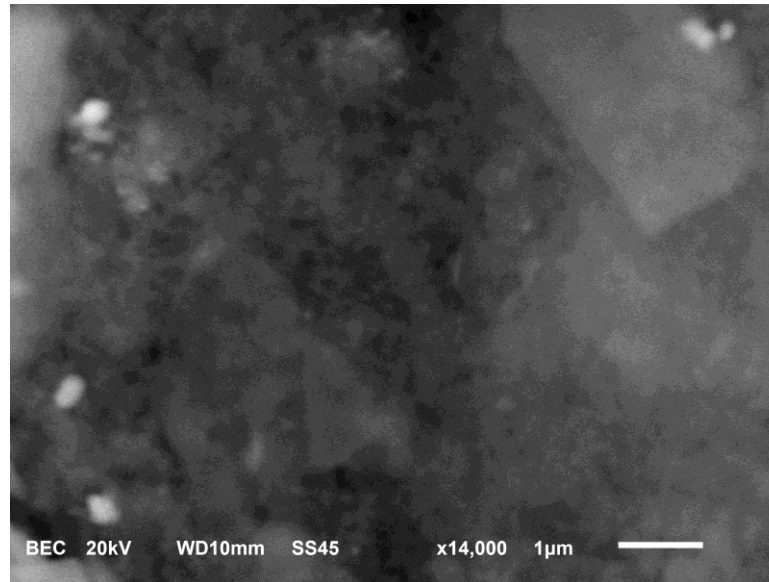
4089-1-2X



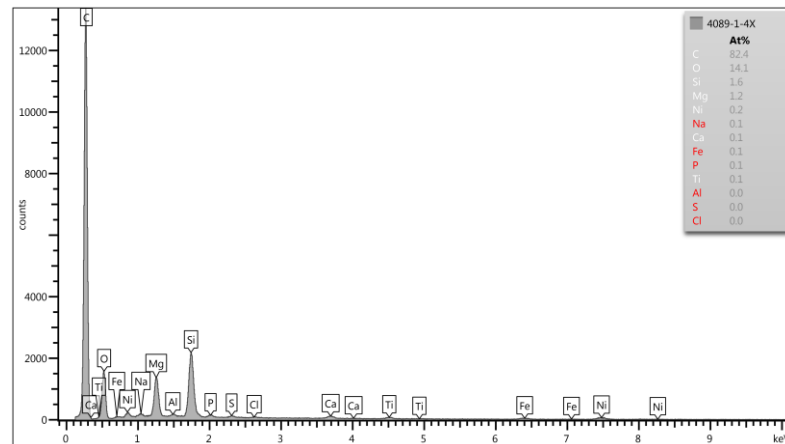
4089-1-3M



4089-1-3X



4089-1-4M



4089-1-4X

Analysis/Service	Description	Price
AirSurvey	TDT air sample; GC-MS determination of 60 compounds quantitatively and 500+ compounds semiquantitatively	\$385 stand-alone \$305 as add-on or post facto
IAQ Summary	TDT air sample; TVOC and TMVOC (post facto analysis is available for SmokeScan and AirSurvey)	\$160 stand-alone \$80 as add-on or post facto
Compound Specific	TDT air sample; determination of specific compound(s) specified by the submitter	\$145 + \$15 per compound
TMVOC	Total Mold Volatile Organic Compounds	\$80 as add-on or post facto
FUI	Aged Feline Urine – Index	\$160 stand-alone \$80 as add-on or post facto
SmokeScan	Active and stale tobacco smoke – Index	\$160 stand-alone \$80 as add-on or post facto
FireScan	Residual odors from fires - Index	\$160 stand-alone \$80 as add-on or post facto
SPFScan	Thermal degradation VOCs from improperly installed Spray Polyurethane Foam (SPF); does not detect properly installed SPF – Index	\$160 stand-alone \$80 as add-on or post facto
Material Off Gas	Performed at the off gas conditions specified by the submitter. Sample prep includes 1-hr incubation time.	\$50 Sample Prep Analysis costs same as above
Consulting relating to above analyses	Consultation on project planning and data interpretation (see below for consulting charges related to work outside of this scope)	No charge
Sampling Media	Trimatrix thermal desorption tube (refunded upon return for analysis)	\$30
Particle Evaluation		
SEM-EDX	Scanning Electron Microscope – Energy Dispersive X-Ray Spectrometer analysis of particulate or other samples amenable to SEM scrutiny	Call for Quote
Legal and Custom Work		
Consulting, Non-Legal Work	Consulting beyond that normally provided in support of analytical reports; includes meeting with end clients, report writing/review, and on site visitation	\$170/hr plus expenses
Consulting, Legal Work	Assistance in legal report writing, in-depth data evaluation, meeting with end users; assistance in legal work including testimony, depositions, writing legal documents, and consultation with attorneys	\$270/hr plus expenses
Custom Analytical Work	Lab-scale process simulation; custom analytical setup and testing; design of custom monitoring protocol	Call for Quote

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Rush turnaround multipliers: same day evenings and weekends 4X; same day working hours 3X; 24 hr 2X; 48 hr 1.75X

Prices are effective February, 2018. Prices are subject to change without notice.