ENVIRONMENTAL ANALYSIS ASSOCIATES, INC.

EXAMPLE REPORT EXCERPTS

Automated Scanning Electron Microscopy / SDD X-ray dust analysis

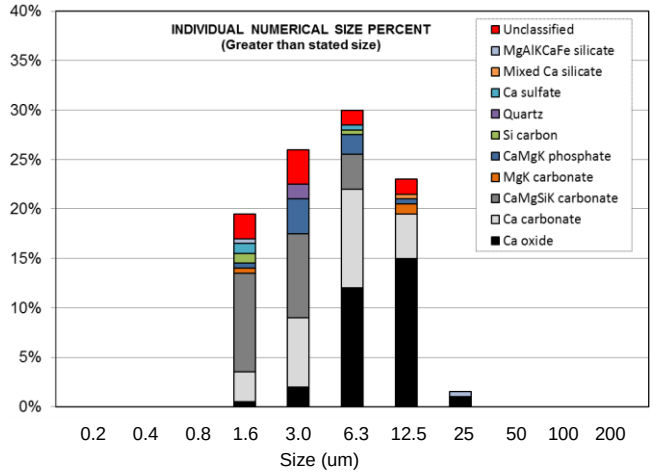
The excerpts on the following pages are from 3 different types of dust analysis reports generated by the new Automated SEM procedure developed by Environmental Analysis. This analysis capability is now located in both the Bay City Michigan, and San Diego California laboratory locations. The particle size/mass distribution, and chemistry of complex airborne and surface dust samples can be simultaneously quantified, and then "classified" into a profile of probable emission sources at an economical price ($250 - $350/sample).

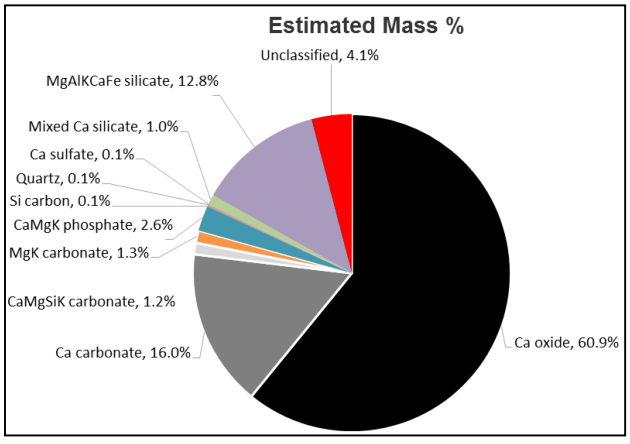
Example Applications :

- **Identification of IAQ dust contamination sources**
- **Wildfire and structure fire particle analysis**
- **Respirable quartz in airborne coal dust**
- **Inhalable / respirable particle size analysis**
- **Monitoring of hospital OR's and clean rooms**
- **Product / dust comparison analysis**

Particle Classification	Particles Counted	Mean size (um)	* Specific Gravity	Numerical %	* Mass Ratio %
Ca oxide	61	13.7	3.00	30.5%	60.9%
Ca carbonate	49	8.3	3.00	24.5%	16.0%
CaMgSiK carbonate	44	4.1	3.00	22.0%	1.2%
MgK carbonate	3	10.2	3.00	1.5%	1.3%
CaMgK phosphate	13	6.6	3.00	6.5%	2.6%
Si carbon	3	5.0	1.50	1.5%	0.1%
Quartz	3	5.7	2.60	1.5%	0.1%
Ca sulfate	3	3.8	3.00	1.5%	0.1%
Mixed Ca silicate	1	16.2	3.00	0.5%	1.0%
MgAlKCaFe silicate	2	20.4	3.00	1.0%	12.8%
Unclassified	18	7.1	2.00	9.0%	4.1%

Wildfire fire ash – Particle classification summary table





For more information contact Daniel Baxter at Environmental Analysis Associates, Inc.

San Diego, California
5290 Soledad Road
San Diego, CA 92109
Bay City, Michigan
306 5th Street, Suite 400
Bay City, MI 48708

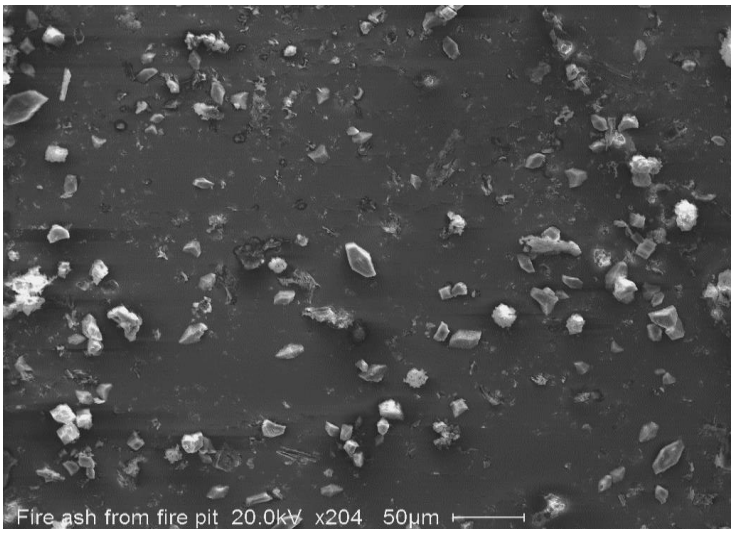
Phone: 858-272-7747
Email: dbaxter@eaalab.com
Website: eaalab.com

Environmental Analysis Associates, Inc. • 5290 Soledad Road • San Diego, CA 92109 • (858) 272-7747

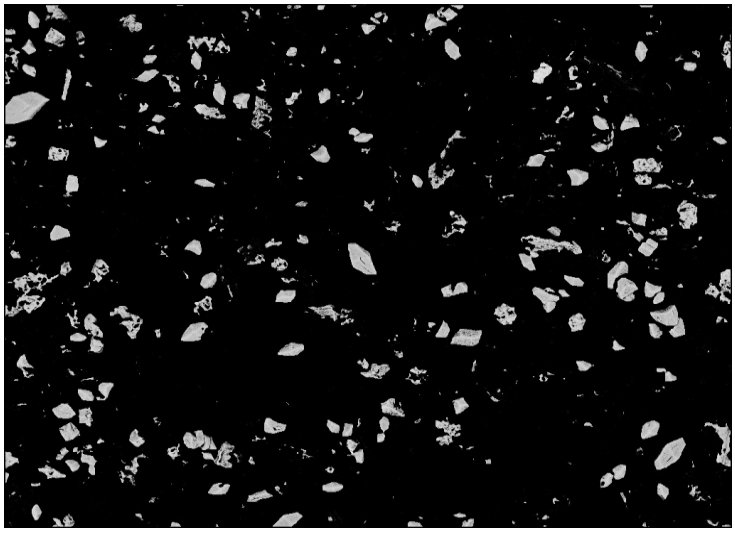
Automated Scanning Electron Microscopy - Dust Analysis Photo Report

Client Name : Research
Contact : Daniel Baxter
Client Project# : Fire pit ash 4-14-15
Client Sample # : 041015-1
Sample Description : Oak fire ash sample from Michigan fire pit
Analysis Method : Automated SEM/EDS

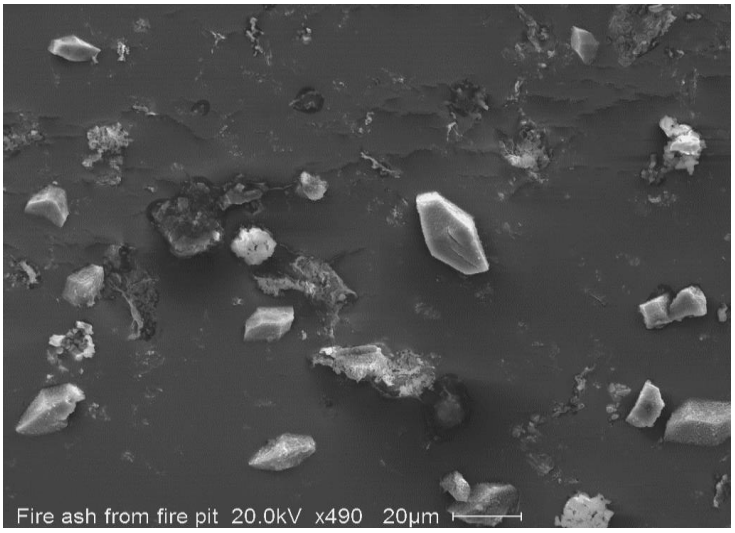
Analysis Date : 8/14/15
EAA Project # : Fire pit
EAA Sample # : Fire ash-1



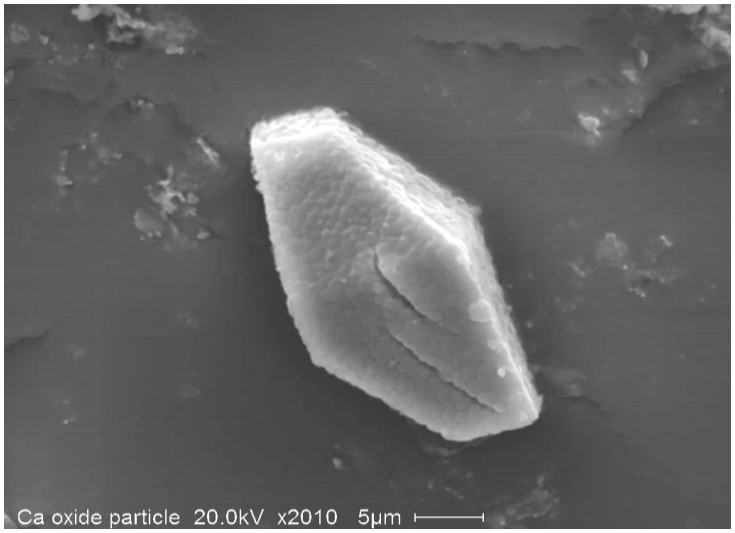
204x - Secondary electron image of analyzed field



204x - Backscatter image of analyzed field



Calcium "oxide" crystals - 490x



Calcium "oxide" crystals - 2010x

Environmental Analysis Associates, Inc. • 5290 Soledad Road • San Diego, CA 92109 • (858) 272-7747

Automated Scanning Electron Microscopy - Dust Analysis Report

Summary Page

Client Name : Research
Contact : Daniel Baxter
Client Project# : Fire pit ash 4-14-15
Client Sample # : 041015-1
Sample Description : Oak fire ash sample from Michigan fire pit
Analysis Method : Automated SEM/EDS
Analysis Magnifcation : 204
Min. size threshold (um) : 2.0
Max. size threshold (um) : 100

Analysis Date : 8/14/15
EAA Project # : Fire pit
EAA Sample # : Fire ash-1
Fields Counted : 2
Field area cted (mm^2) : 0.095
Particles / mm^2 : 2103
Scale (µm/div.) : 1
Total particles counted : 200

SUMMARY CONCLUSIONS

The fire ash was fully "decarbonized" at high temperature and is primarily composed of Calcium oxide / hydroxide, and Calcium carbonate and Magnesium, Potassium (K) salts. Minor amounts of Calicum/Magnesium silicates and phosphous (P) oxides are also present. The Calcium oxide / oxalate crystals are the most common indicator particles for wood "ash".

Particle Classification	Particles Counted	Mean size (um)	* Specific Gravity	Numerical %	* Mass Ratio %
Carbon H	1	8.3	1.50	0.5%	0.1%
M carbon	9	4.0	1.50	4.5%	0.2%
Ca oxide	61	13.7	2.00	30.5%	59.7%
Ca carbonate	53	8.2	2.00	26.5%	16.6%
CaMgSiK carbonate	46	4.2	2.00	23.0%	1.4%
MgK carbonate	3	10.2	2.00	1.5%	1.2%
CaMgK phosphate	13	6.6	2.00	6.5%	2.5%
Quartz	4	7.9	2.00	2.0%	0.8%
Ca sulfate	3	3.8	2.00	1.5%	0.1%
Mixed Ca silicate	1	16.2	2.00	0.5%	1.0%
MgAlKCaFe silicate	2	20.4	2.00	1.0%	12.5%
Unclassified	4	10.8	2.00	2.0%	3.8%

** Mass ratios are based on the average particle size & theoretical specific gravity. If the specific gravity is unknown and not "carbonaceous", it will automatically be assigned a density value of 2.0*
"Unclassified" particles fall outside of the established chi square rule fit criteria

Analysis Method : Automated EDAX Genesis X-ray particle analysis software integrated with a data libraries developed by Environmental Analysis

Analyst : Daniel M. Baxter

Date : 8/14/15

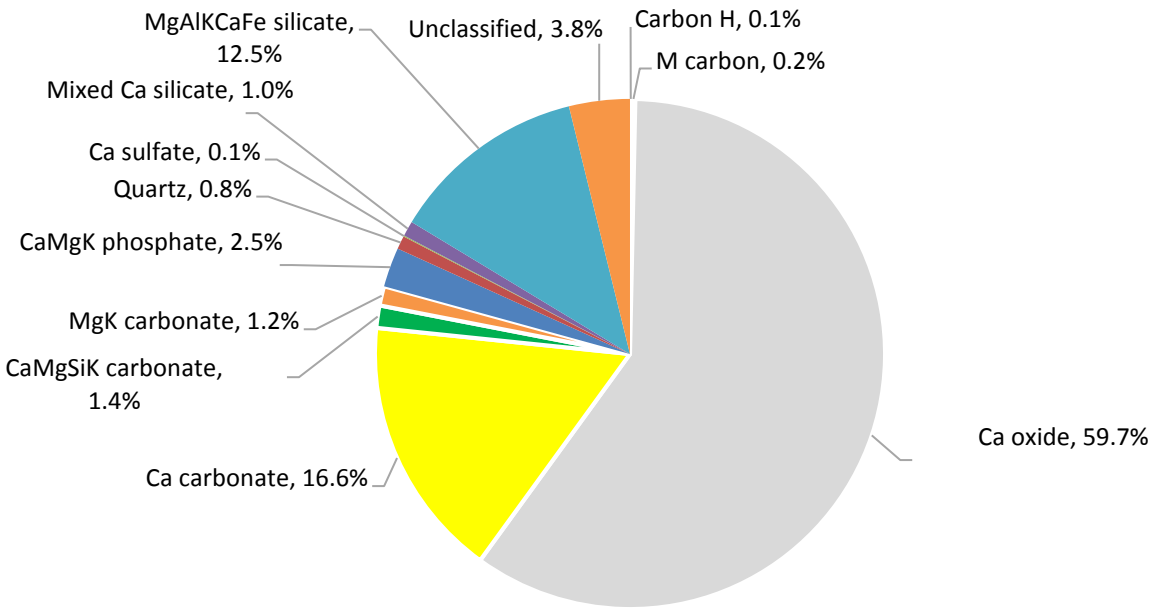
Environmental Analysis Associates, Inc. • 5290 Soledad Road • San Diego, CA 92109 • (858) 272-7747

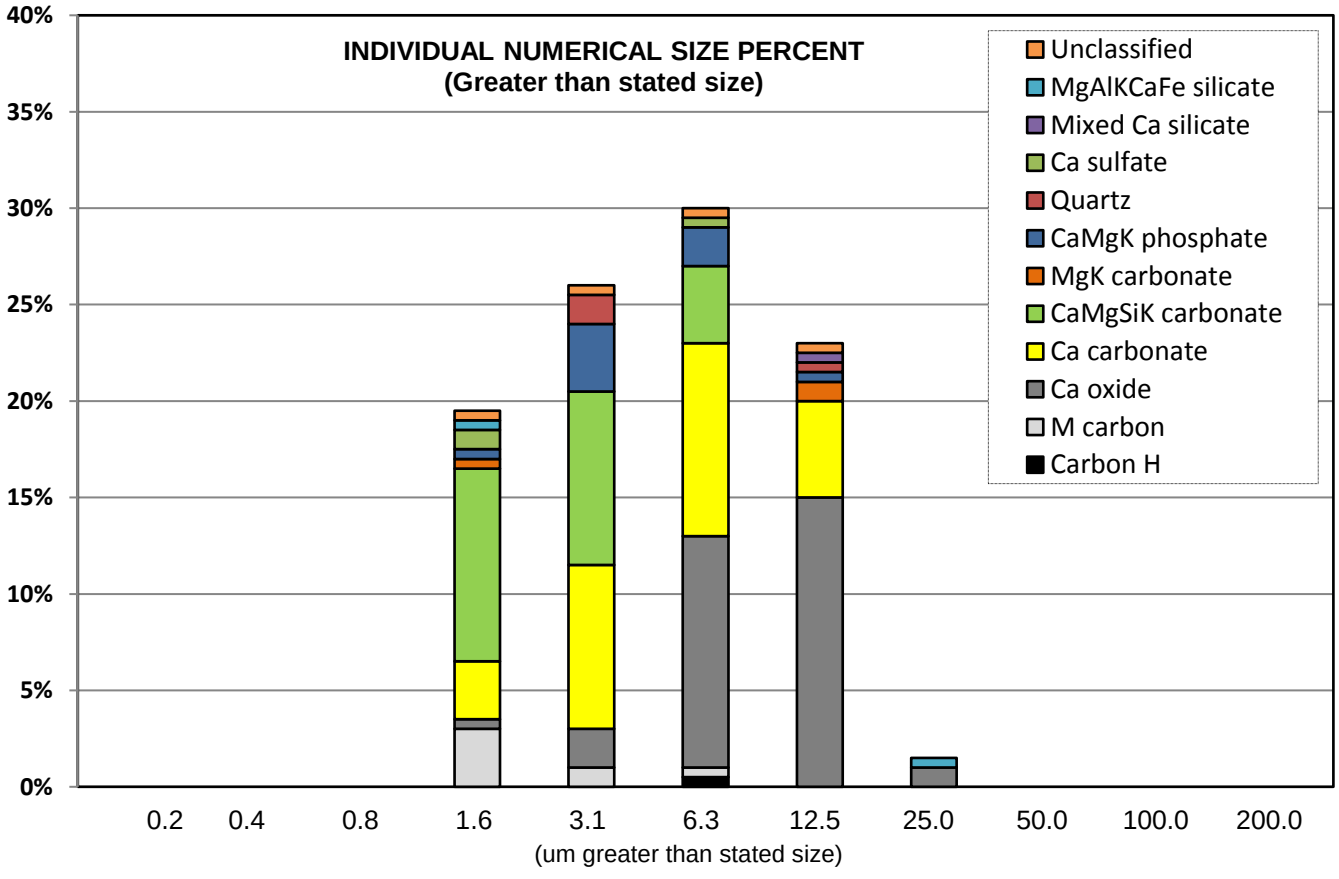
Automated Scanning Electron Microscopy -Grapical Report - Mass & Size Distribution

Client Name : Research
Contact : Daniel Baxter
Client Project# : Fire pit ash 4-14-15
Client Sample # : 041015-1
Sample Description : Oak fire ash sample from Michigan fire pit
Analysis Method : Automated SEM/EDS

Analysis Date : 8/14/15
EAA Project # : Fire pit
EAA Sample # : Fire ash-1

Estimated Mass %



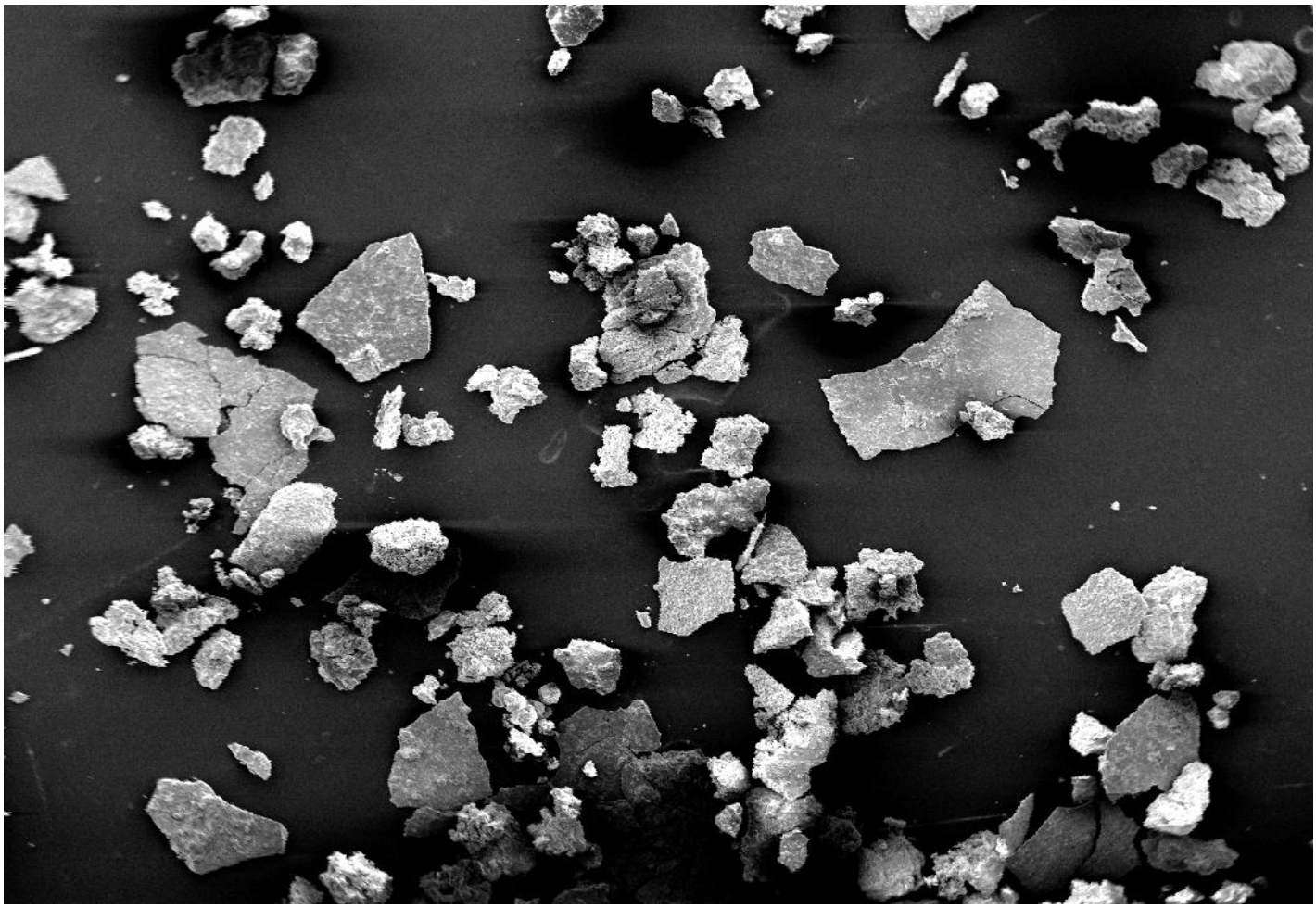


Environmental Analysis Associates, Inc. • 5290 Soledad Road • San Diego, CA 92109 • (858) 272-7747

Automated Scanning Electron Microscopy - Dust Analysis Photo Report

Client Name : ABC Environmental
Contact : Mr. John Doe
Client Project# : 14-1000
Client Sample # : 110314-1
Sample Description : "Trace" white powder in HVAC system duct
Analysis Method : Automated SEM/EDS

Analysis Date : 8/14/15
EAA Project # : 14-0495
EAA Sample # : 1000-1



Field 1 107x - Flake-like corrosion particles

Environmental Analysis Associates, Inc. • 5290 Soledad Road • San Diego, CA 92109 • (858) 272-7747

Automated Scanning Electron Microscopy - Dust Analysis Report

Summary Page

Client Name :	ABC Environmental	Analysis Date :	8/14/15
Contact :	Mr. John Doe	EAA Project # :	14-0495
Client Project# :	14-1000	EAA Sample # :	1000-1
Client Sample # :	110314-1		
Sample Description :	"Trace" white powder in HVAC system duct	Fields Counted :	1
Analysis Method :	Automated SEM/EDS	Field area cted (mm^2) :	0.127
Analysis Magnifcation :	107	Particles / mm^2 :	315
Min. size threshold (um) :	3.0	Scale (µm/div.) :	1
Max. size threshold (um) :	1000	Total particles counted :	40

SUMMARY CONCLUSIONS

Sample is composed of a mixture of aluminum oxide and mixed aluminum, iron, and zinc corrosion oxide particles. These particles also contain low concentrations of chlorine / chlorides.

The dust is consistent with corrosion of the ducting and "galvanized" duct coatings.

Carbon H = Particle with greater than 60% carbon

Particle Classification	Particles Counted	Mean size (um)	* Specific Gravity	Numerical %	* Mass Ratio %
Carbon H	3	58.4	1.00	7.5%	2.9%
Al oxide	27	49.0	1.00	67.5%	61.1%
Zn oxide	2	50.9	1.00	5.0%	2.1%
M AlFeZn oxide	8	42.5	2.00	20.0%	33.9%
Unclassified					

** Mass ratios are based on the average particle size & theoretical specific gravity. If the specific gravity is unknown and not "carbonaceous", it will automatically be assigned a density value of 2.0*
"Unclassified" particles fall outside of the established chi square rule fit criteria

Analysis Method : Automated EDAX Genesis X-ray particle analysis software integrated with a data libraries developed by Environmental Analysis

Analyst : Daniel M. Baxter Date : 8/14/15

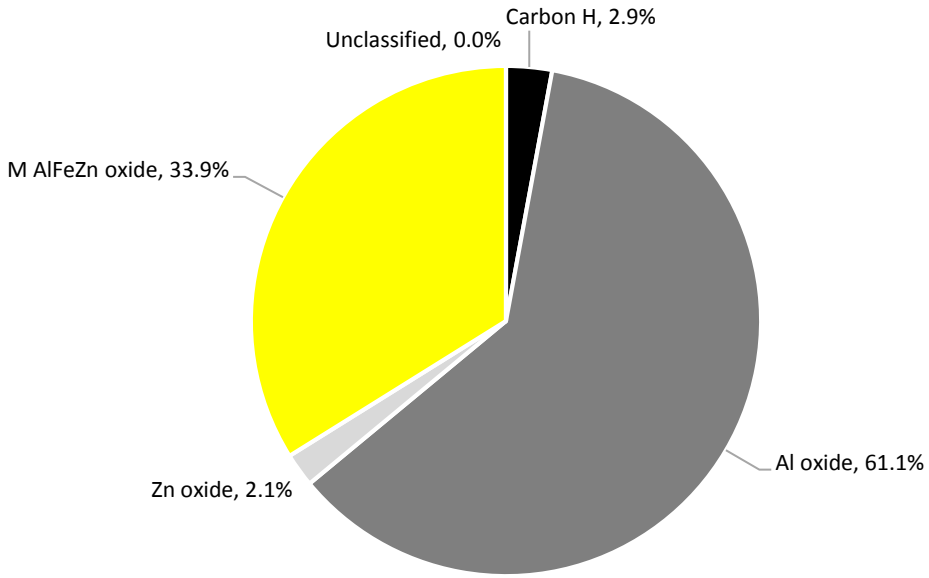
Environmental Analysis Associates, Inc. • 5290 Soledad Road • San Diego, CA 92109 • (858) 272-7747

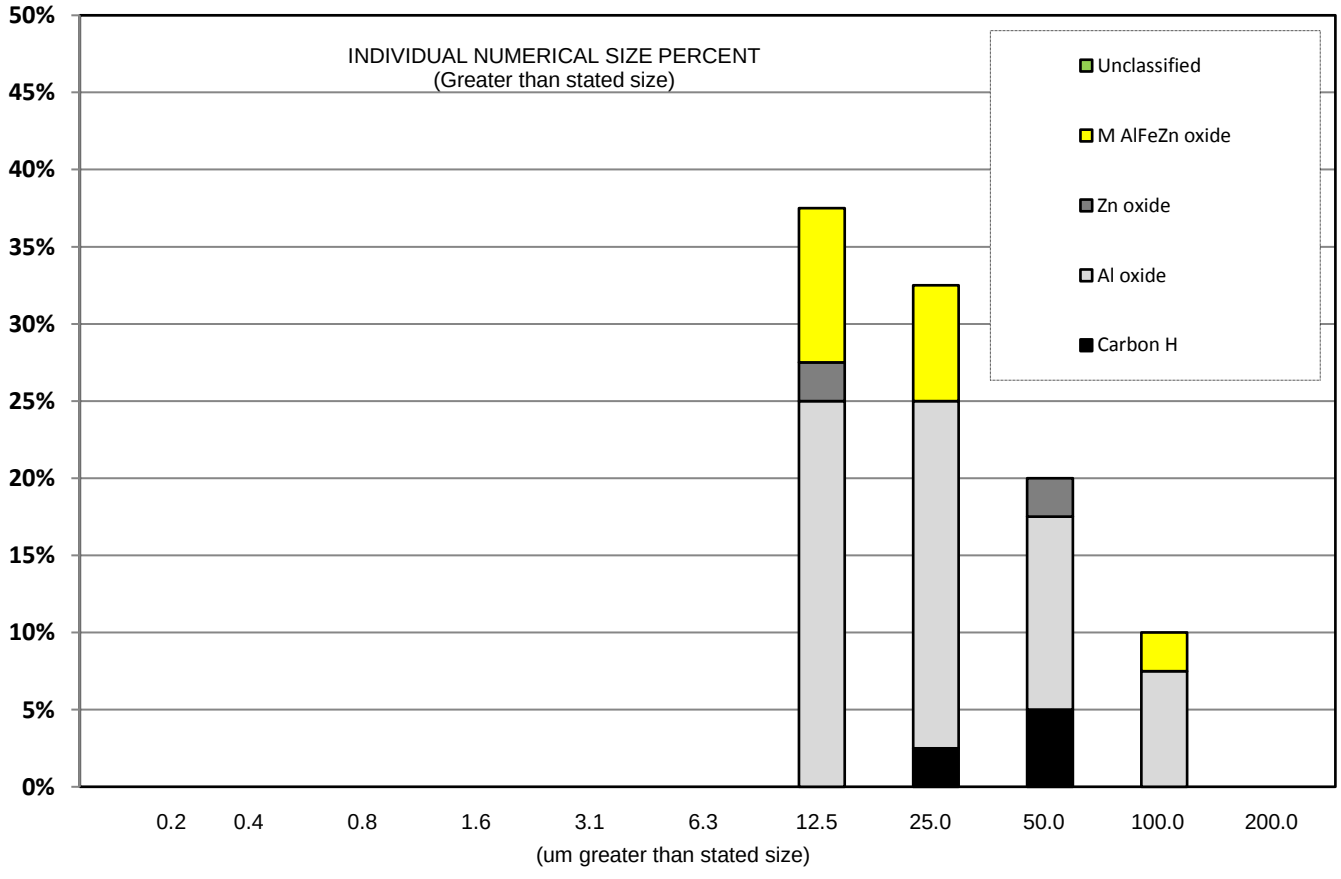
Automated Scanning Electron Microscopy -Grapical Report - Mass & Size Distribution

Client Name : ABC Environmental
Contact : Mr. John Doe
Client Project# : 14-1000
Client Sample # : 110314-1
Sample Description : "Trace" white powder in HVAC system duct
Analysis Method : Automated SEM/EDS

Analysis Date : 8/14/15
EAA Project # : 14-0495
EAA Sample # : 1000-1

Estimated Mass %





Environmental Analysis Associates, Inc. • 5290 Soledad Road • San Diego, CA 92109 • (858) 272-7747

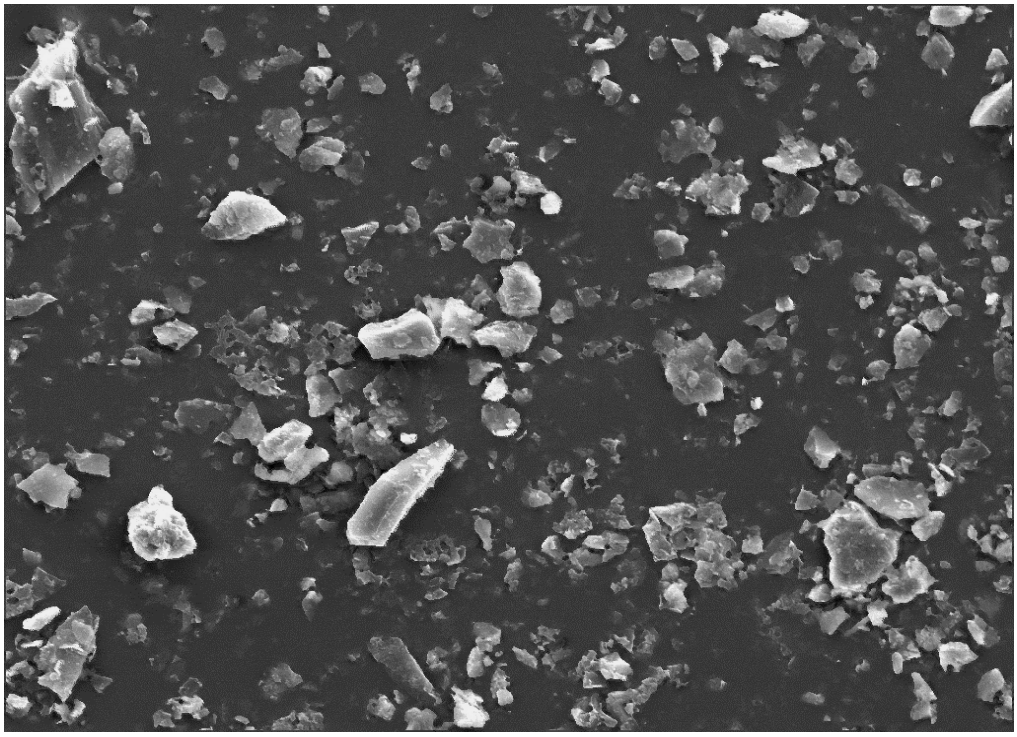
Automated Scanning Electron Microscopy - Dust Analysis Photo Report

Client Name : Research
Contact : Dan Baxter
Client Project# : Mining rock
Client Sample # : Coal mine-1
Sample Description : Air sample - During operations
Analysis Method : Simulated 25mm PC filter analysis

Analysis Date : 7/22/15
EAA Project # : Research
EAA Sample # : 1000-1

Coal mine-1
Field 1
Magnification (X) 497

Coal mine-1
Field 2
Magnification (X) 497



Environmental Analysis Associates, Inc. • 5290 Soledad Road • San Diego, CA 92109 • (858) 272-7747

Scanning Electron Microscopy Air Sample - Summary Report

Filter / Impaction Air Sample

Client Name : Research
Contact : Dan Baxter
Client Project# : Mining rock
Client Sample # : Coal mine-1
Sample Description : Air sample - During operations
Filter media / size / type : Simulated 25mm PC filter analysis
Analysis Magnifcation : 497
Scale (µm/div.) : 1
Total particles counted : 342
Sample volume (m^3) : 2.400
Min./Max. size range (um) : 3 / 165

Analysis Date : 7/22/15
EAA Project # : Research
EAA Sample # : 1000-1
Fields / passes counted : 2
Field area counted (mm^2) : 0.069
Collection area (mm^2) : 398.2
% of sample counted : 0.02%
Particles / mm^2 : 4965
Particles / sample : 1976892
Estimated Particles / m^3 : 823705

SUMMARY CONCLUSIONS - Major Constituents

Simulated air sample output using the bulk analysis of the Rom rock.
Sample is primarily highly carbonaceous (Carbon H >30%), mixed Alumino-silicate minerals (Al silicate >50%), Quartz (~2%). Minor amounts of Calcium carbonate (Ca carbonate) and Magnesium Calcium Carbonate (MgCa carbonate) present.

Minor Constituents:

Particle Classification	# Cted	Mean (um)	Num. %	*Calc Mass %	*Spec Grav	Part. / Sample	Part / m^3	*Calc Mass ug/m^3	** Mean Mass ug/m^3
Carbon H	91	8.5	26.6%	22.6%	1.50	526015	219173	444.7	105.6
AlSi carbon	29	11.1	8.5%	19.1%	1.50	167631	69846	376.8	74.1
Ca carbonate	2	11.2	0.6%	0.9%	3.00	11561	4817	17.5	10.6
MgCa carbonate	1	5.9	0.3%	0.0%	3.00	5780	2408	0.8	0.8
Al silicate	106	8.8	31.0%	29.6%	2.00	612721	255300	583.1	183.0
AlK silicate	34	8.8	9.9%	6.6%	2.00	196533	81889	129.2	58.8
M silicate	42	10.4	12.3%	15.9%	2.00	242776	101157	313.9	118.6
Quartz	29	5.8	8.5%	1.9%	2.60	167631	69846	37.8	19.0
Unclassified	8	13.6	2.3%	3.4%	2.00	46243	19268	66.8	50.8
TOTALS	342					1976892	823705	1971	621

** The calculated mass/m^3 is based on the sum total of each particle volume & theoretical specific gravity.*
*The ** Mean Mass is calculated using the Mean particle size for each category. Both calculations* should be used as the likely range of estmated particle mass concentrations.

Analysis Method : Automated EDAX Genesis X-ray particle analysis

Analyst : Daniel M. Baxter Date : 7/22/15

Environmental Analysis Associates, Inc. • 5290 Soledad Road • San Diego, CA 92109 • (858) 272-7747

Automated Scanning Electron Microscopy -Grapical Report - Mass & Size Distribution

Client Name : Research
Contact : Dan Baxter
Client Project# : Mining rock
Client Sample # : Coal mine-1
Sample Description : Air sample - During operations
Analysis Method : Simulated 25mm PC filter analysis

Analysis Date : 7/22/15
EAA Project # : Research
EAA Sample # : 1000-1

Estimated Mass %