SPECIAL METALS
A PCC COMPANY

December 11, 2024

By Email and U.S. Mail

Mr. Michael Egnor, PE
Air Toxics Coordinator
West Virginia Department of Environmental Protection
Division of Air Quality
601 57th Street SE
Charleston, WV 25304

Re: Follow-Up to September 2024 Meeting

Dear Mike,

Special Metals' Huntington Alloys is committed to maintaining the health of our employees and neighbors. As we discussed in our last meeting, we were concerned when you brought to our attention that a recent EPA screening risk assessment suggested that dust emissions from our electric arc furnace might be posing an elevated cancer risk.

To reiterate, the screening risk assessment was fundamentally flawed because it assumed that 100% of our electric arc furnace dust was nickel subsulfide, a pollutant associated with nickel refining operations, and that these emissions were 100% bioavailable. Huntington Alloys has not engaged in nickel refining at the site for many decades. In all of that time, Huntington Alloys has produced nickel alloys which would be expected to generate, at most, trace amounts of nickel subsulfide. Nickel alloys are considered non-carcinogenic and have low bioavailability. By estimating cancer risk as if our emissions were 100% nickel subsulfide and 100% bioavailable, EPA dramatically overestimated the potential for that risk.

Given our commitment to the community, we wanted to quantitatively document the flawed basis for EPA's screening assessment. During our meeting on September 20, we described that we had engaged outside consultants to evaluate the dust emitted by our electric arc furnaces to determine the fraction, if any, of the arc furnace dust that is nickel subsulfide and to demonstrate the large percentage of alloy and non-metallic particles in our dust. We also discussed our parallel effort to perform a bioaccessibility analysis of the arc furnace dust. The results of these efforts are detailed in the two attached reports from our consultant, ToxStrategies.

As you will see from the two reports, our arc furnace dust largely consists of metal alloy and non-metal particles, and was determined to have only trace (<0.02% by weight) amounts of nickel particles in a sulfidic form. Consistent with this result, the bioaccessibility analysis identified that the bioaccessibility of nickel in the arc furnace dust is low (13.5%). Based on the results of these technical analyses, it is clear that the EPA screening risk assessment over-estimated risk associated with our facility by several orders of magnitude and that the cancer risk posed by our operations is de minimis.

During our September meeting and subsequent correspondence with you, we agreed to table discussion of whether ambient monitoring was necessary or appropriate until we had the results from these analyses. Now that these data are available and demonstrate the absence of carcinogenic forms of nickel, we do not believe that there is any reasonable basis for justifying the considerable time, expense and resources associated with ambient nickel monitoring. Even if ambient nickel monitoring was conducted, any detected nickel concentrations would be dominated by the non-carcinogenic nickel in alloy form. As the monitor and associated analyses are incapable of discriminating between alloy and non-alloy particles, ambient nickel monitoring would provide no meaningful data relevant to estimating cancer risk.

Huntington Alloys has invested considerable resources into analyzing its electric arc furnace dust constituents and bioavailability. These efforts produced quantitative analyses demonstrating that the cancer risk posed by our electric arc furnaces is de minimis. Huntington Alloys respectfully asserts that ambient nickel monitoring by WV DEP is not justified at this time given the results of the analyses that we have conducted.

We appreciate being able to work with you to put to rest any concerns that Huntington Alloys could present an elevated cancer risk to our community. Based on the highly technical work that we engaged independent experts to complete at your request and with your oversight, we believe that we have demonstrated that Huntington Alloys does not present an elevated cancer risk to the community.

Please let me know if you have any questions after reviewing the attached reports.

Sincerely,

Tom Bell

Tom Bell
Environmental Manager
Special Metals – HBE

cc: Andy Dale (General Manager)

ToxStrategies

Innovative solutions
Sound science

December 11, 2024

Mr. Tom Bell
Environmental Manager, HBE
Huntington Alloys Corp.
3200 Riverside Drive
Huntington, WV 25705

SUBJECT: Evaluation of potential nickel subsulfide in Special Metals Huntington Alloys facility Electric Arc Furnace (EAF) emissions

Dear Mr. Bell:

In response to a request from the West Virginia Department of Environmental Protection (WVDEP), ToxStrategies has collaborated with the RJ Lee Group (RJ Lee) to evaluate the potential presence of nickel subsulfide in emissions from the Electric Arc Furnace (EAF) at Special Metals Huntington Alloys (Huntington Alloys). Our analysis of the findings is provided herein, and the RJ Lee report is provided as Attachment A.

Background

Nickel is an element that exists in many chemical and physical forms. While some forms have been shown in animal studies to cause lung cancer when inhaled, and among workers exposed during the process of refining sulfidic ores, other forms, such as nickel in alloys, demonstrate no carcinogenic potential.[1] Complexities in the physical and chemical properties of nickel compounds and their metallic forms affect their bioavailability in the lung and their carcinogenic potential.[2, 3] The forms of nickel emitted by Huntington Alloy's operations had not previously been studied, but nickel emissions from Huntington Alloy's operations are expected to exist primarily in alloy form, consistent with the alloys produced

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[1] ATSDR. 2005. Toxicological profile for nickel. US Department of Health and Human Services Public Health Service Agency for Toxic Substances and Disease Registry, Division of Toxicology/Toxicology Information Branch, Atlanta, Georgia.

[2] ECHA (European Chemicals Agency) 2018. Annex 1 Background Document in support of the Committee for Risk Assessment (RAC) for the evaluation of limit values for nickel and its compounds in the workplace. ECHA/RAC/A-77-0-0000001412-86-189/F. March 9.

[3] Goodman JE, Prueitt RP, Thakali S, Oller AR. 2011. The nickel ion bioavailability model of the carcinogenic potential of nickel-containing substances in the lung. Crit Rev Toxicol 41(2):142–174.

by this facility's operations. These nickel forms are typically not associated with increased cancer risk in worker or animal studies, because they are not bioavailable.[1]

The US Environmental Protection Agency (EPA) has developed cancer potency measures for use in risk assessment for only two forms of nickel: nickel refinery dust and nickel subsulfide.[4] The inhalation unit risk (IUR) for nickel refinery dust was developed from studies of workers historically involved in nickel refining, and the fraction of nickel subsulfide in nickel refinery dust reported in these studies ranged from 31% to 59%.[4] The nickel subsulfide IUR is two times that of nickel refinery dust, based on the assumption that nickel refinery dust is one-half nickel subsulfide. Therefore, quantitative cancer risk assessments for nickel rely entirely on data for nickel in the subsulfide form. For this reason, understanding whether nickel subsulfide exists in Huntington Alloy's emissions is particularly important.

Nickel subsulfide's ability to cause lung cancer is related to the efficient absorption of crystalline nickel subsulfide into epithelial lung cells through a process called endocytosis.[2,3] Once inside the cell, nickel subsulfide dissolves, and, at high exposures, efficiently delivers nickel ions to the cell's nucleus, thereby increasing cancer risk. Other forms of nickel, including amorphous nickel sulfide and freely soluble forms of nickel, which are taken up by ion transport channels, or endocytosed to a lesser extent, are not absorbed efficiently, and pose far less, if any, cancer hazard. Nickel in alloy form does not dissolve in lung fluids and is not readily taken into lung cells which restricts absorption and the potential for carcinogenicity. These factors are important considerations for risk assessment and for this evaluation because the specific chemical form of nickel—even the specific form of sulfidic nickel—determines whether free nickel ions can reach the target cell nucleus and cause cancer.

Scope of Work

Nickel subsulfide is typically associated with the refining of nickel from sulfidic ores, a process that Huntington Alloys does not conduct. To research the forms of nickel emitted from Huntington Alloy's EAF, which is considered the only potential source of nickel subsulfide at the facility, ToxStrategies contacted the RJ Lee Group in Monroeville, PA to speciate elements in the dust representative of the EAF emissions and to determine if nickel subsulfide may exist in EAF emissions. The EAF emissions are collected in two independent baghouses (MS-1-C1 and MS-1-C2) that significantly reduce emissions to air. Emissions from both baghouses blend together and are vented through a single stack. The

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[4] https://iris.epa.gov/AdvancedSearch/?keyword=nickel, EPA 1987 Nickel refinery dust
https://iris.epa.gov/static/pdfs/0272_summary.pdf, Nickel subsulfide
https://iris.epa.gov/static/pdfs/0273_summary.pdf, Nickel carbonyl (also considered carcinogenic by USEPA, but a unit risk value has not been developed).

material collected in the baghouses for the EAF are expected to be representative of the EAF's airborne nickel emissions.

For this study, three dust samples from the EAF baghouse dust collectors were sent to RJ Lee for analysis by computer-controlled scanning electron microscopy (CCSEM) and energy-dispersive x-ray spectroscopy (EDS). These techniques allow the individual elements in individual dust particles to be identified relatively rapidly. Three thousand particles were analyzed from each sample for a total of 9,000 EAF dust particles analyzed.[5] RJ Lee grouped particles by composition according to a set of rules developed for this project, with the specific purposes of (1) identifying any particles consistent with nickel subsulfide, and (2) identifying and grouping other forms of nickel. RJ Lee also analyzed a reference sample of nickel subsulfide, purchased from a chemical laboratory supplier, for comparison with the baghouse results as a reference standard. RJ Lee's report is provided as Attachment A.

RJ Lee started by identifying particles composed of nickel, sulfur, and oxygen, consistent with the nickel subsulfide reference material. This analysis, however, cannot identify the specific form of sulfur and nickel. For example, a particle with nickel, sulfur, and oxygen (considering that oxygen may be identified because it is in the sample matrix) could be nickel sulfide, nickel sulfate, or nickel subsulfide. The specific chemical form is not observable using this technique. The technique also cannot differentiate amorphous nickel sulfide from crystalline nickel subsulfide, the form of greatest concern. Therefore, particles identified through this technique as consistent with nickel subsulfide may not be in the carcinogenic form of nickel subsulfide, and thus, the presence of nickel subsulfide may be overestimated in this analysis.

Results

Particles with elements other than nickel and sulfur will not have the physical chemical properties of nickel subsulfide, and thus the analysis focused on discrete, particles containing mostly or entirely nickel and sulfur, and potentially including oxygen associated with the sample matrix. Of the 9,000 particles analyzed by RJ Lee, approximately 40%[6] were in the form of metal alloys (nickel, chromium, copper, iron, or molybdenum-rich, or at least 50% of combined alloy metals). The remaining particles were determined to be

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[5] For each sample, 1,000 particles were analyzed at each of three magnifications (3,000 particles per sample). Analyzing 1,000 particles and in some cases 100s of particles results in a stable understanding of major and minor elements. (National Exposure Research Laboratory. 2002. Guidelines for the Application of SEM/EDX Analytical Techniques to Particulate Matter Samples. September. And Mamane Y. et al., 2001. Evaluation of computer-controlled scanning electron microscopy applied to an ambient urban aerosol sample. Aerosol Science and Technology. 34: 97-107.)

[6] Sample 3190016 was 39.6% Cr-rich, Cu-rich, Fe-rich, Mo-rich, Ni-rich or other metallic particles, consistent with metallic or alloy particles. Similarly, samples 3190017 and 3190018 were 36.7% and 46.4% metallic or alloy particles.

non-metallic as they were comprised of less than 50% metallic elements and primarily consisted of elements commonly found in the earth's crust including calcium, silicon, magnesium and aluminum. In each of the three samples, these non-metallic particles were most commonly identified.

Of the 9,000 particles analyzed by RJ Lee, three (3) particles were identified as particles considered "consistent with nickel subsulfide."[7] RJ Lee's report includes Tables A1–A3, which present the total mass of each group of particles analyzed. The total mass of the three particles considered consistent with nickel subsulfide (0.25 nanograms per square millimeter [ng/mm^2]) is <0.02% of the total sample mass evaluated (1289 ng/mm^2). The three particles considered consistent with nickel subsulfide were also relatively large, with diameters of 5.3[8], 8.5, and 12.6 μm, with the largest being non-respirable (particles with a diameter greater than 10 μm [$>PM_{10}$]).

Conclusion

In summary, using sophisticated techniques that allow elements to be identified at the particle level found that less than 0.02% of the mass of particles (at most 3 of 9,000) in the emitted EAF emissions may be in a form consistent with nickel subsulfide, and approximately 40% are in alloy form, a form that has consistently been shown to pose no cancer risk among workers[1] and is considered non-carcinogenic by the National Toxicology Program.[9] Thus, cancer risk estimates based on nickel in the subsulfide form, such as that from EPA's AirToxScreen program, significantly overestimate the cancer risk, if any, associated with emissions from Huntington Alloys' EAF. It is our considered opinion that, based on the results of the current evaluation, in assessing cancer risk from emissions of EAF dust, no more than 0.02% of the emissions should be considered nickel subsulfide, and that assumption has a considerable conservativeness factor as a significant mass fraction of what was detected was too large to be respirable.

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[7] RJ Lee's report refers to nickel subsulfide as NiS, but the chemical formula is Ni_3S_2, and the technique cannot distinguish Ni_3S_2 from other particles containing only nickel and sulfur as explained above.

[8] The diameter of this particle including a small agglomerated portion was 7.6 μm, as shown in Table A1, but the primary portion of the particle considered consistent with NiS was 5.3 μm as discussed in the RJ Lee report text.

[9] NTP (National Toxicology Program). 2021. Report on Carcinogens, 15th Edition. Research Triangle Park, NC: U.S. Department of Health and Human Services, Public Health Service. https://ntp.niehs.nih.gov/go/roc15.

Thank you for the opportunity to work on this project. Let us know if you have any questions.

Sincerely,

Deborah Proctor

Deborah Proctor
Managing Principal Scientist

Attachment A

ATTACHMENT A

RJ Lee Group Report

RJ Lee Group

RJ Lee Group Project No. LLH408127

November 20, 2024

Mr. Tom Bell
Environmental Manager, HBE
Huntington Alloys Corp.
3200 Riverside Drive
Huntington, WV 25705

This report summarizes results of computer-controlled scanning electron microscopy (CCSEM) coupled with energy dispersive x-ray spectroscopy (EDS) analyses performed on 3 "bag house" samples received on August 23, 2024 and on a chemical standard reference material. The samples analyzed are listed in Table 1 below, along with the corresponding RJ Lee Group sample number. The purpose of the analyses was to assess the general particle compositions of the samples and specifically test for the presence of particles consistent with nickel subsulfide (Ni_3S_2 or NiS for short). The CCSEM/EDS method provides size and elemental composition data and an SEM image for each particle analyzed. The particles are grouped by similar compositions and the frequency of particle class recorded.

A total of 3,000 particles were characterized during the CCSEM/EDS analysis for each of the three submitted samples and 300 particles of a nickel subsulfide reference material standard. Each CCSEM analysis was programmed to characterize 1,000 particles at three different magnifications. The CCSEM/EDS analyses identified five particles that were considered to include "Possible NiS" composition. These five particles were then further analyzed by manual SEM/EDS. Three of these particles were considered "consistent with the NiS standard". The samples did contain other particles with nickel and trace levels of sulfur, but these were not considered consistent with discrete nickel subsulfide particles due to the trace amounts of sulfur along with other accompanying elements. Discrete particles are considered individually separate and distinct particles as displayed in supplemental Figure A1.

The as-received material for analysis consisted of bulk samples contained in glass jars. A sample of nickel subsulfide was also obtained from Aldrich (Ni_3S_2, Aldrich number 343226-25G, Lot # MKC88884). A representative sub-sample of each sample and of the standard was suspended in a carrier fluid and deposited onto polycarbonate filters. A portion of each filter was excised and fixed onto a half inch diameter pin mount using colloidal graphite. The surface was given a coating of carbon by evaporative deposition to provide an electrical path to ground to prevent charging while under the electron beam.

Table 1 – Identification and description of the samples

Client Sample Identification	Sample Description	RJLG Sample Number
A-SMC-EAF-DUST	Electrical ARC Furnace Dust Composite of #4 and #5 BAG Houses	3190016
B-SMC-EAF-DUST	Electrical ARC Furnace Dust Composite of #4 and #5 BAG Houses	3190017
C-SMC-EAF-DUST	Electrical ARC Furnace Dust Composite of #4 and #5 BAG Houses	3190018
	Nickel subsulfide standard	3190019

SEM Analysis

The samples were analyzed by computer-controlled scanning electron microscopy techniques following the general SEM procedures described in the literature, including Casuccio et al., (1983), Kennedy et al., (1996), Kennedy et al. (2002).

Instrument Set-Up

The samples were analyzed by automated CCSEM/EDS for size and elemental composition using a Tescan Mira SEM with an accelerating voltage of 30 keV. A multi-detector imaging mode was set to image at 85% backscattered electron and 15% secondary electron signal. In this imaging mode, particles are bright on a dark background, and heavier elements correspond to brighter particles. The analysis was conducted at three magnifications for particle size ranges indicated in Table 2 where size is represented by the average particle diameter in micrometers. Representative SEM field images of the three magnifications are shown in Figures 1 to 4.

Table 2 – Field size and particle size ranges employed

Magnification Designation	View Field (µm)	Size Range (µm)
Low (Mag 0)	800	7.5 to max
Medium (Mag 1)	400	2.5 to 7.5
High (Mag 2)	80	0.3 to 2.5

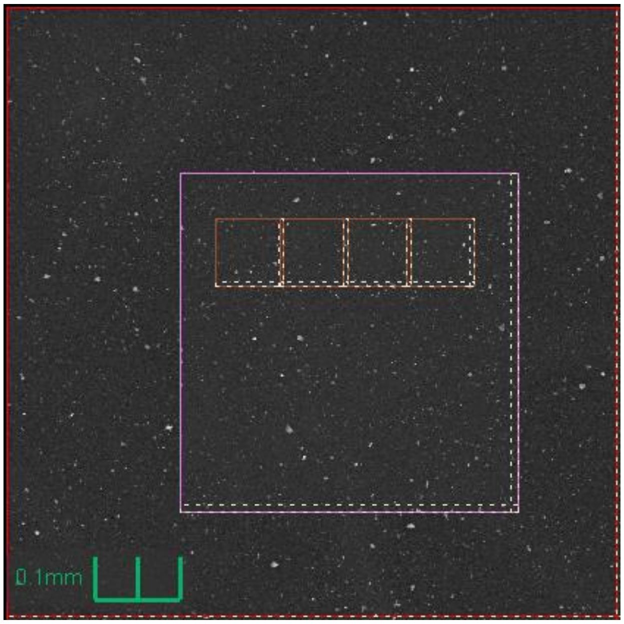

Figure 1 - SEM image showing the low magnification, medium magnification, and high magnification fields.

Figure 2 – Low magnification field from Fig. 1 to analyze particles larger than 7.5 µm. (Field width = 800 µm)

Figure 3 – Medium magnification field from Fig. 1 to analyze particles between 7.5 µm and 2.5 µm. (Field width = 400 µm.)

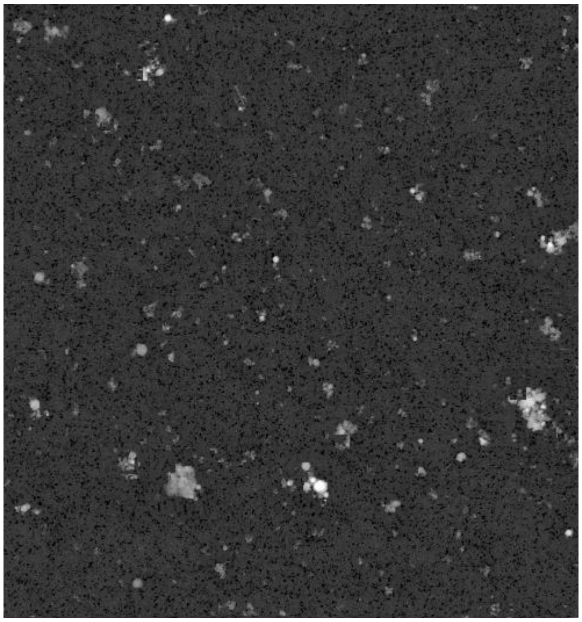

Figure 4 – High magnification field From Fig. 1 to analyze particles smaller than 2.5 µm. (Field width = 80 µm.)

Particle Analysis

Under the control of its computer program, starting at the lowest magnification, the instrument detects a particle based on a brightness threshold, determines its perimeter, calculates various diameters, finds the center, places the beam at the particle center and analyzes the energy of X-rays generated. The resulting X-ray energy spectrum is processed to recognize spectral peaks, to relate those peaks to specific elements present and to calculate the percentages of the total x-ray counts attributable to each identified element. The lower limit of relative x-ray counts quantification was set at 1% to reliably differentiate X-ray peaks from background spectral noise. Note that all elemental percentages in this report refer to the EDS peak relative area percent and are not weight percentages. Finally, an image of that particle is acquired. All particles in that field at the determined size range are characterized. Next a field image is acquired at the medium magnification and the particles of the determined size range are characterized and the process then continues at the highest magnification. The stage is then moved to a second position and the process continues until a stopping criterion (i.e., number of particles) is met.

The analyzed particles are categorized by their elemental composition. The number of particles in each classification, the average diameter, the average percent nickel and sulfur, and the estimated mass and mass percent of each classification are reported in tables A1-A3.

Data was acquired on the submitted samples for 1,000 particles per magnification resulting in 3,000 particles analyzed for each sample. To characterize the nickel subsulfide standard, one hundred particles per magnification were analyzed since no significant variability is expected in a single uniform standard. The elements analyzed in this study include O, Na, Mg, Al, Si, P, S, Cl, K, Ca, Ti, Cr, Mn, Fe, Co, Ni, Cu, Zn, Zr, Nb, Mo, and W. Elements not in this list would not be labeled and quantified if present. The EDS spectra were acquired for 2 seconds per particle for the low and medium magnifications, and 3 seconds at the high magnification. Any element producing a peak area lower than 1% was not reported. Most of these elements have little overlap and their identification and peak area measurement is straight forward at higher peak areas. However, there is considerable overlap in the peak of sulfur and those of molybdenum and, to a lesser extent, niobium, and automated identifications of sulfur at concentrations of less than 4-5% peak area may require closer examination. The analysis was performed with an electron beam acceleration voltage of 30 keV to generate a higher energy peak of molybdenum which does not exist for sulfur which can assist in differentiating the two elements. Also in some cases, visual inspection of the saved spectrum reveals peak shape characteristics that can be used to aid in element identification. Example SEM images and an EDS spectrum from the nickel subsulfide reference standard are shown in Figure 5.

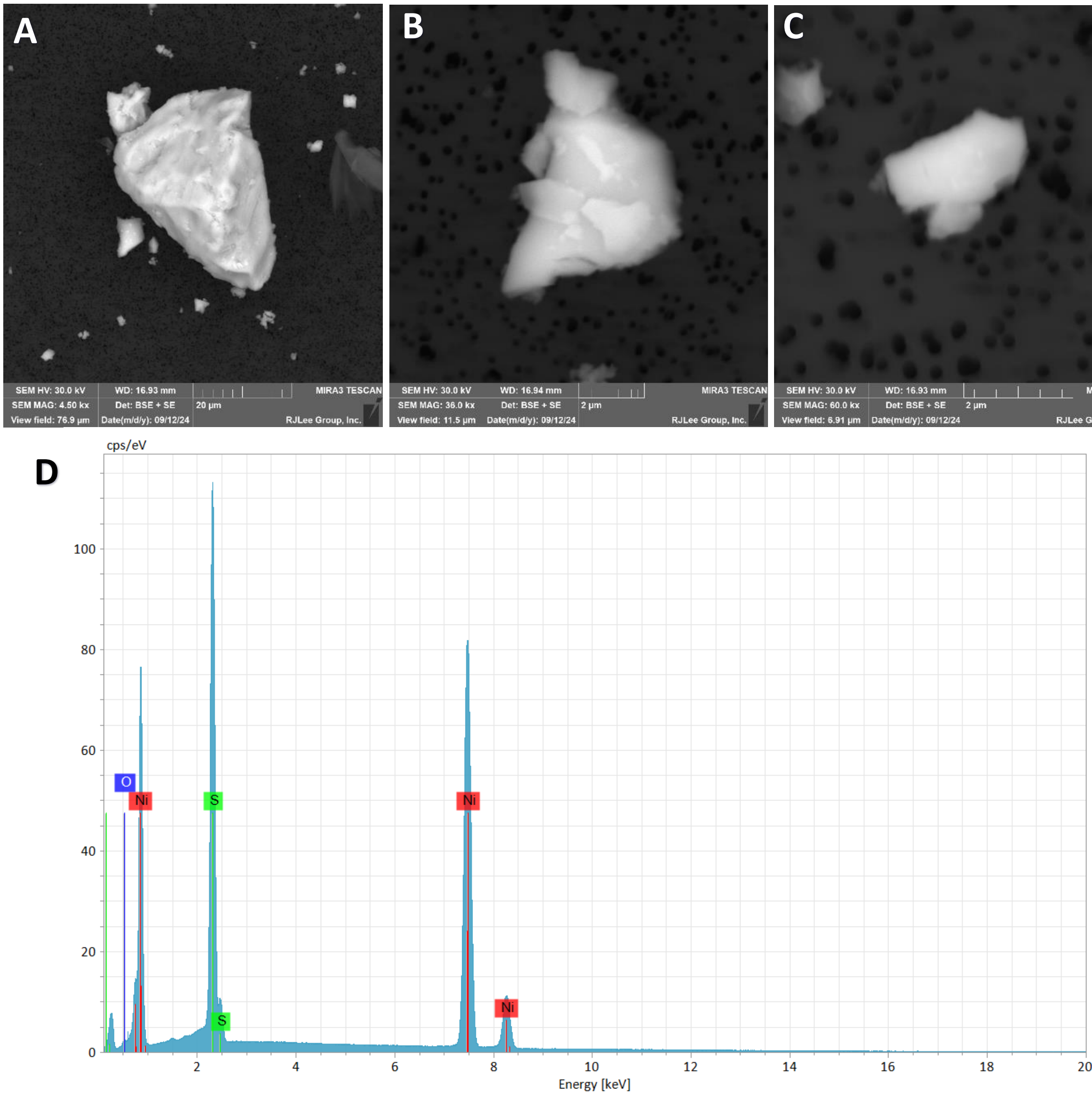

Figure 5 – A-C) SEM images and D) EDS spectrum from nickel subsulfide reference standard (sample 3190019).

Results

Standard

The compositional results for the analysis of the nickel subsulfide particles from the reference standard are shown in Figure 6 where the percent of nickel, sulfur and oxygen are plotted as a ternary diagram[1] and the particle sizes are represented by different colors. Note that the largest particles show minimal oxygen and the EDS peak ratios are approximately 50 to 70% nickel and 30 to 50% sulfur. The smaller particles maintain similar nickel to sulfur ratios but also display up to 50% oxygen. This is to be expected since the EDS spectrum of the smaller particles is generated partially from the filter substrate which contains oxygen. This data indicates that the EDS spectra of nickel subsulfide may show up to 50% oxygen peaks if the particles are small.

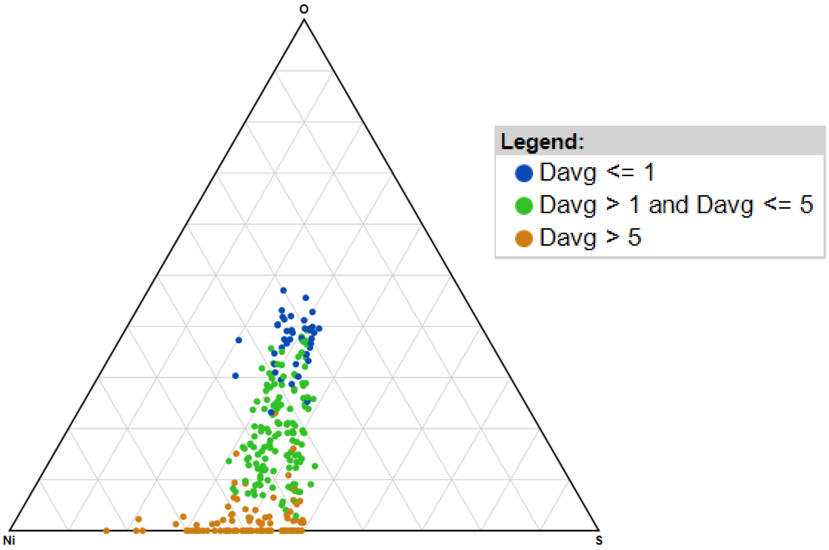

Figure 6 – Ternary diagram of EDS peak percentages of nickel (Ni), sulfur (S) and oxygen (O) from the analyzed nickel subsulfide standard.

Submitted Samples

The particles analyzed of the submitted samples were categorized into four major chemistry classes: sulfur-bearing, carbon-rich or unclassified, metallic, and non-metallic. The sulfur-bearing and metallic classes each contain multiple subcategory classifiers. Each particle was classified into only one "bin" or classifier. Particles were classified in order according to the rules listed in Table 3. The logic statements follow the sequence that each particle evaluates true or false for the first/top rule, "Consistent with NiS". If the rule evaluates true, the particle is classified as "Consistent with NiS" and does not proceed any further through the rule statements. If false, the particle proceeds onto the next rule "Possible NiS" for true/false evaluation. This sequence continues through the entire rule list until each particle is classified into one bin. For example, Cr-rich particles were evaluated as false for the "Sulfur" and "Unclassified" class types. They were then evaluated to be false for Ni-rich due to either the 25% Ni threshold not being met, or Ni wasn't the highest EDS % metal. If %Cr > %Ni, the Ni-rich rule would be evaluated false, and the sequence would proceed to Cr-rich. Once a particle evaluated "true" for Cr-rich, that became its classification and the evaluation concluded.

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[1] A ternary diagram depicts the ratios of three variables (in this case chemical elements present in each analyzed particle) normalized to 100%. A point at each apex would be 100% of that variable. A point at the center would be 33.3% each variable.

Particles with oxygen > 60% were considered carbon rich or unclassified. Carbon was not an element quantified during the CCSEM/EDS analysis because of the carbon substrate background being constantly present. A carbonaceous particle's spectrum, under this quantification scenario, would calculate a high percentage of oxygen. A variety of other reasons such as particle thickness and scattering sites can also attribute to spectra being weighted towards carbon and oxygen due to the carbon background. For these reasons, particles with oxygen > 60% were separated into their own category. This rule implies that these particles are either carbonaceous or that none of the peaks being quantified are prominent enough to confidently use another classification.

Particles were considered metallic if they were comprised of >= 50% metallic elements. For the purpose of this study, the following elements were considered as metallic: Ni, Cr, Fe, Cu, Co, Mn, Ti, Zn, Zr, Nb, W and Mo. The most abundantly present metallic elements were used as subcategories within the metallic class. For Ni, Cr, Fe, Cu, and Mo particles were further categorized by the specific element which had the greatest peak area and meeting the minimum given threshold of 25% for that element. Metallic particles that did not fall into one of these subcategories, but did meet the 50% metallic threshold were considered "Other Metallic". Ternary diagrams of the most common metals for the metallic particle classifications can be viewed in Figure 7.

The remaining particles were considered non-metallic as they were comprised of < 50% metallic elements. Many of these particles consisted of compounds rich in elements such as calcium, silicon, magnesium and aluminum[2]. The non-metallic particles were slightly more frequent in the large particle size magnification; 30% less than 2.5 µm, 32% in the 2.5 – 7 µm range, and 38% greater than 7 µm. Example non-metallic images and spectra are shown in Figure A2.
A complete rule list of particle classifications can be seen in Table 3, and the submitted samples' results in Tables A1-A3.

Table 3 – Rule list of the particle classifications. Each particle class is categorized in the hierarchy presented. Metal-rich classes were created for the most abundant metallic elements.

Class Type	Classifier	Rule or Description (numbers are %)
Sulfur	Consistent with NiS	Ni>20 and S>10 and Ni+S+O>=90
Sulfur	Possible NiS	Ni>20 and S>10
Sulfur	Containing Ni & S	Ni>10 and S>5
Sulfur	Possible FeS	Fe>10 and S>5
Sulfur	Possible CaS	Ca>10 and S>5
Sulfur	Other S	S>5
Unclassified	C-rich or Unclassified	O>60
Metallic	Ni-rich	Ni>25 and greatest % metal
Metallic	Cr-rich	Cr>25 and greatest % metal
Metallic	Fe-rich	Fe>25 and greatest % metal
Metallic	Cu-rich	Cu>25 and greatest % metal
Metallic	Mo-rich	Mo>25 and greatest % metal
Metallic	Other Metallic	Ni+Cr+Fe+Cu+Co+Mn+Ti+Zn+Zr+Nb+W+Mo>=50
Non-Metallic	Non-Metallic	Ni+Cr+Fe+Cu+Co+Mn+Ti+Zn+Zr+Nb+W+Mo<50

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[2] Aluminum was not in the metal form, but rather it was associated with other elements.

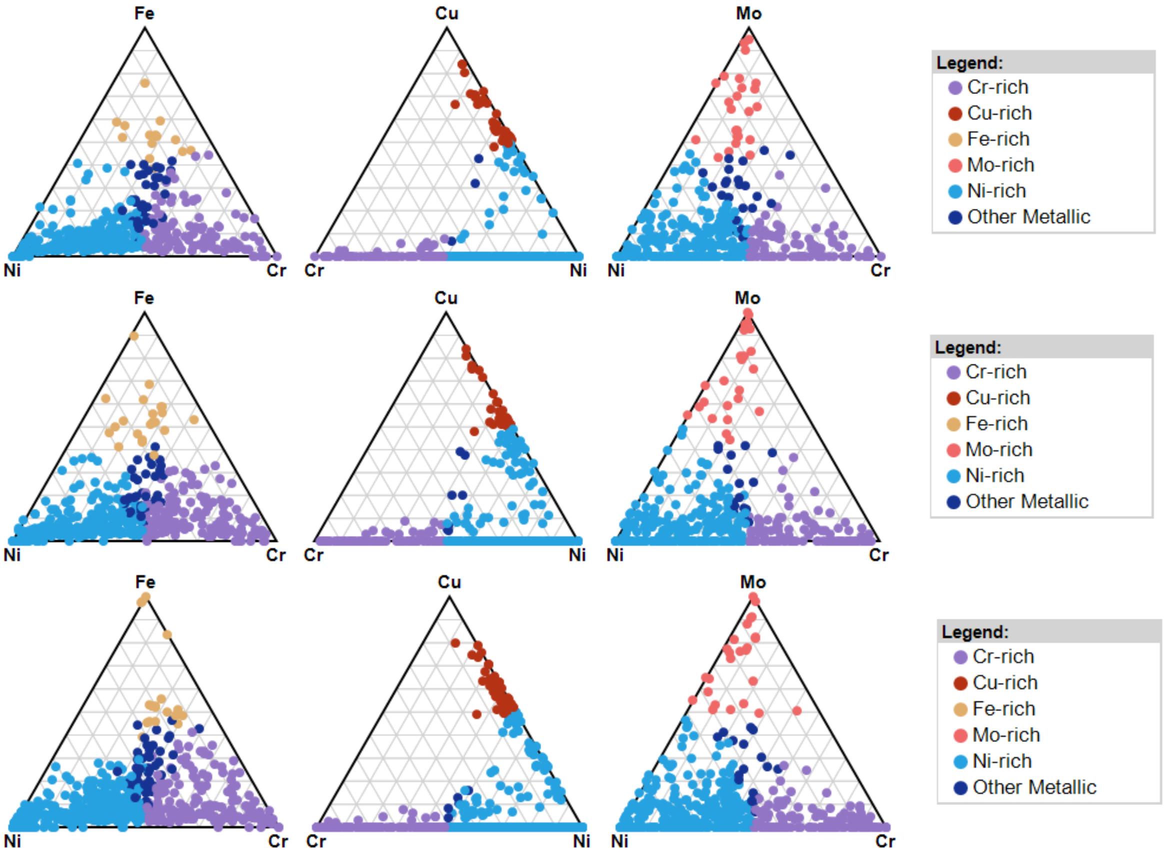


Figure 7 –Ternary diagrams of the most abundant metallic elements for the 3 bag house samples. Top row is sample 3190016, middle row is sample 3190017, and bottom row is sample 3190018.

Discrete Nickel Subsulfide Presence

Two particles were classified as “Possible NiS”, and three particles classified as “Consistent with NiS”. All five of these particles received further manual SEM/EDS evaluation. After manual evaluation, the five particles all remained in their initial classifications. Three particles were evaluated to be consistent with the discrete nickel subsulfide particles from the standard. The other two particles had noticeable nickel and sulfur peaks mixed in with other elements and non-uniform compositon. It is possible that these particles contained trace amounts of nickel subsulfide among other compounds, but they could not be distinguished and considered discrete nickel subsulfide particles that were consistent with the NiS standard. Images, spectra, and a summary of these five particles are as follows:

- **Sample 3190016, Particle 3271**: This particle consisted of two distinct areas. An agglomeration of small particles at the top of the below particle SEM image showed a variety of elements such as Ni, Cr, Fe, Mo, Cu, Al, Mg, K, Ca, and O (Spectrum 1). This portion was not considered consistent with NiS. A separate larger particle can also be seen in the SEM image. This particle had major Ni and S peaks with a minor O peak (Spectrum 2). No other element had a peak greater than 1%. This larger particle was considered consistent with NiS from the standard and had an average diameter of 5.3 µm. SEM image is presented in Figure 8 and EDS spectra in Figure 9.

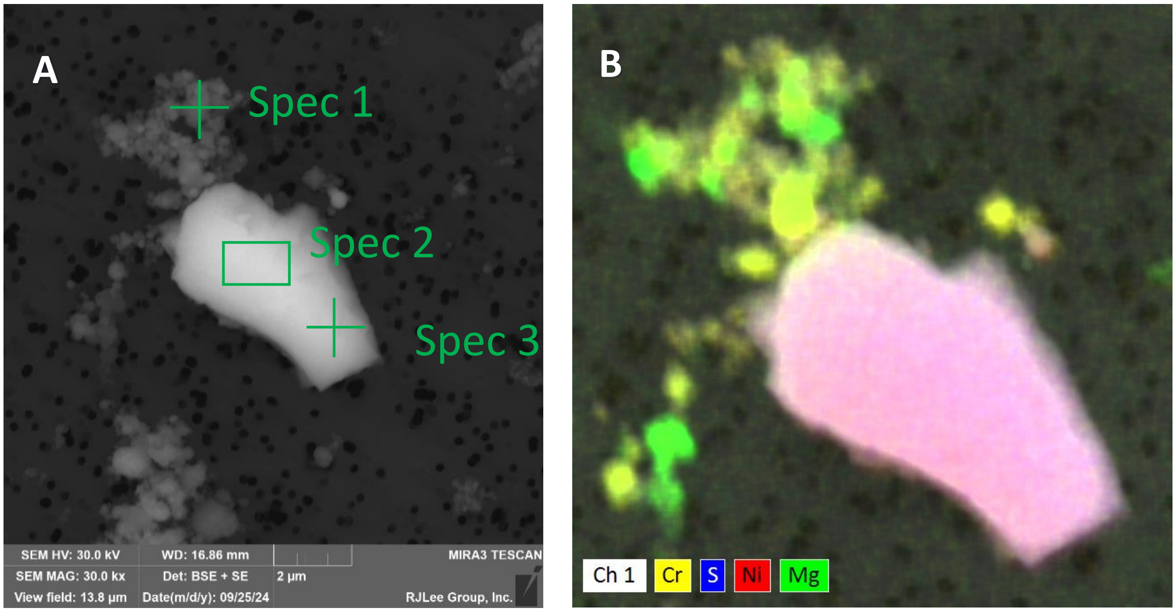


Figure 8 – A) Manual SEM image of particle 3271 with marked locations of EDS spectra. B) EDS map of particle 3271.

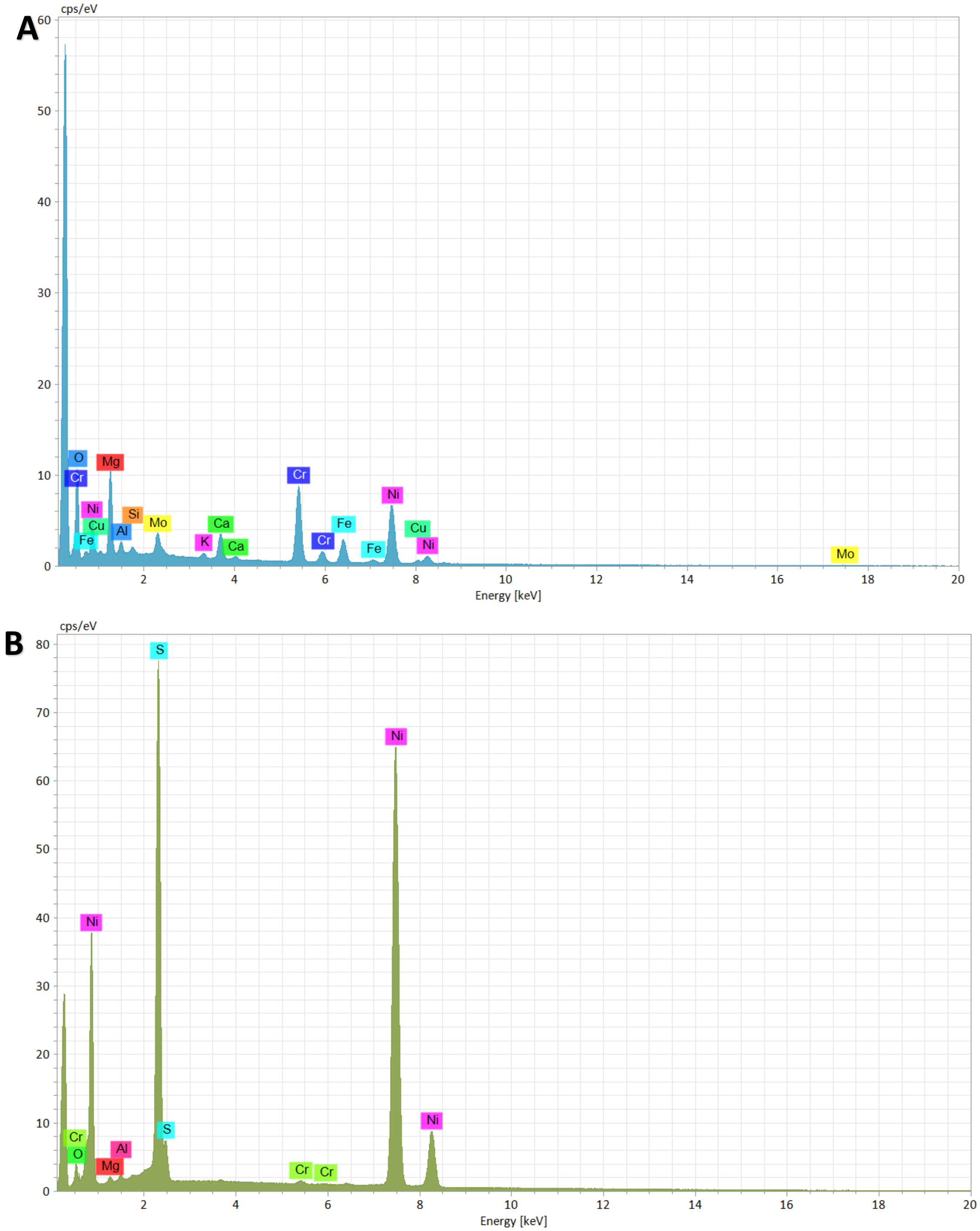


Figure 9 – A) EDS Spectrum 1 of particle 3271. B) EDS Spectrum 2 of particle 3271.

- **Sample 3190016, Particle 4313**: In addition to Ni and S, this particle had various recognized peaks such as Cr, Fe, Mg, Al, W, Cu, K, Ca and others. Various combinations of these elements were found throughout the particle thus this particle is not consistent with nickel subsulfide from the standard. SEM image is presented in Figure 10 and EDS spectra in Figure 11. The largest Ni and S peaks were found in spectrum 4 of this particle. This particle had an average diameter of 8.5 μm.

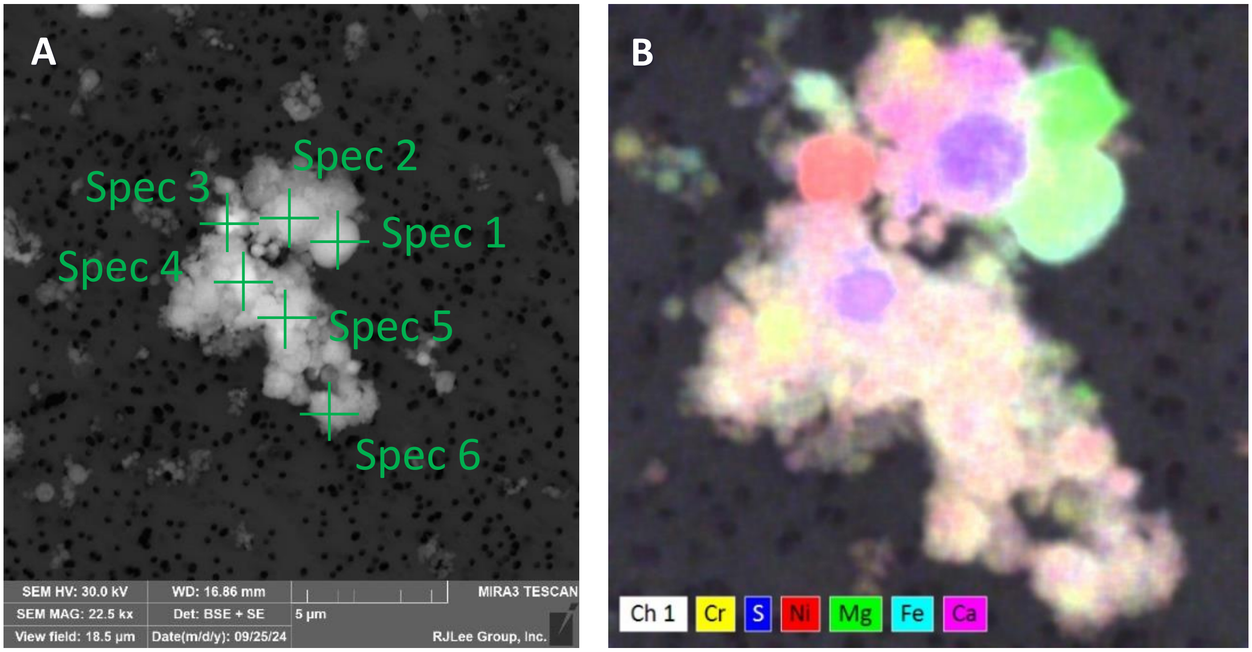
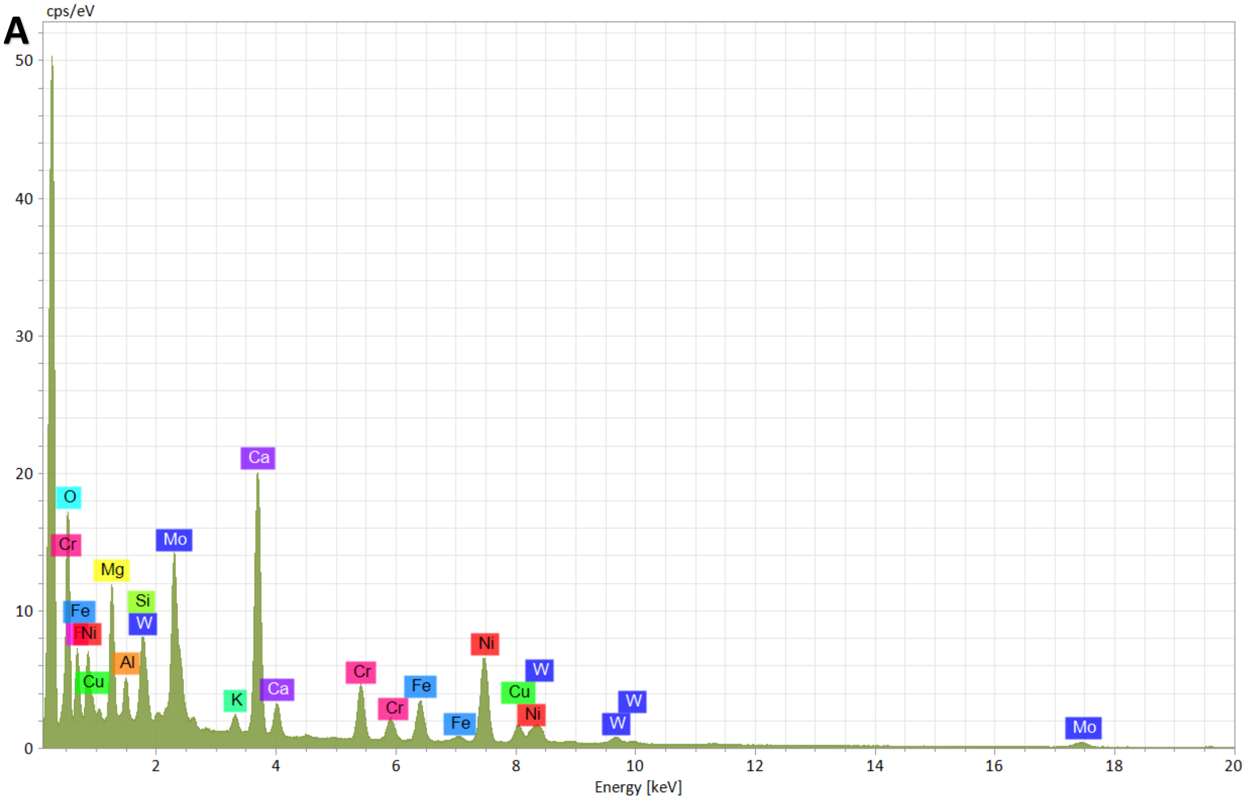


Figure 10 – A) Manual SEM image of particle 4313 with marked locations of EDS spectra. B) EDS map of particle 4313.



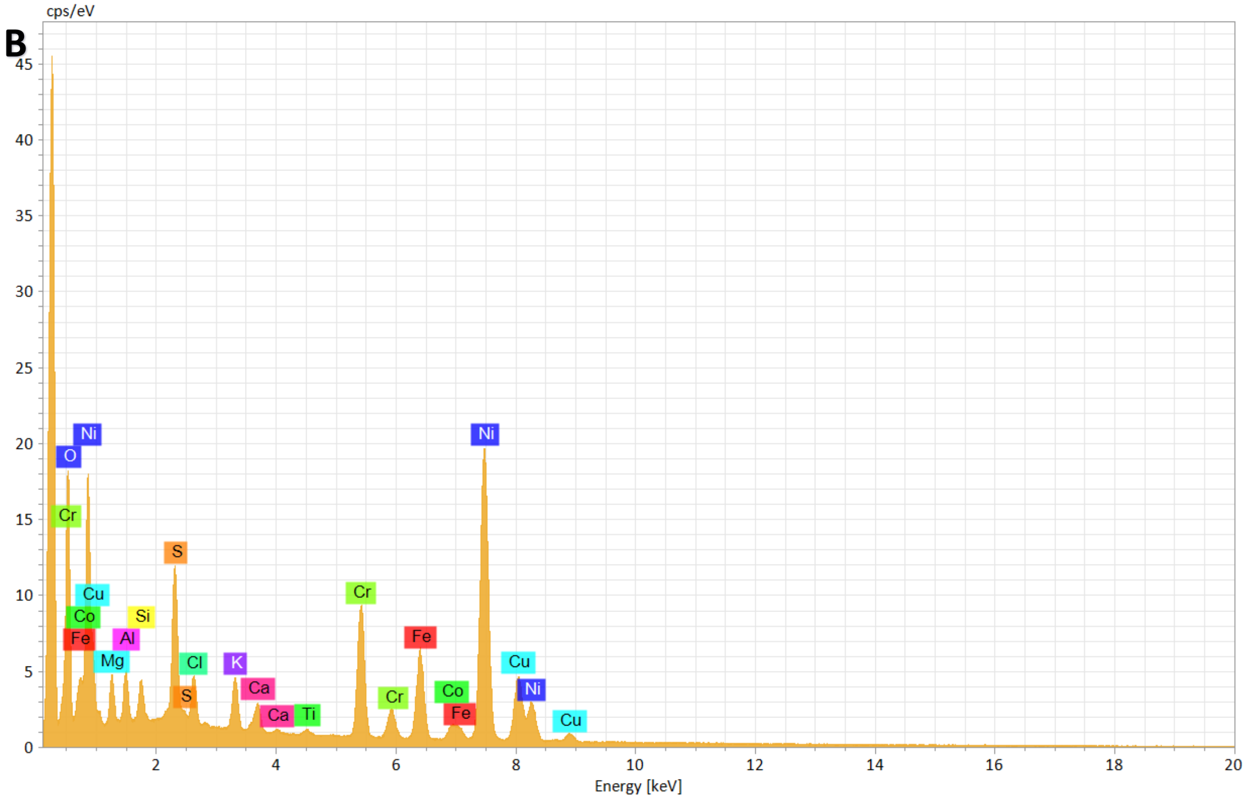


Figure 11 – A) EDS Spectrum 2 of particle 4313. B) EDS Spectrum 4 of particle 4313.

- **Sample 3190018, Particle 685**: In addition to Ni and S, this particle had various recognized peaks such as Cr, Fe, Mg, Ca. Due to the presence of other elements and non-uniform composition, this particle is not classified as consistent with nickel subsulfide from the standard. Spectra 1 and 3 did show significant Ni and S peaks. This particle had an average diameter of 1.9 µm. SEM image is presented in Figure 12 and EDS spectra in Figure 13.

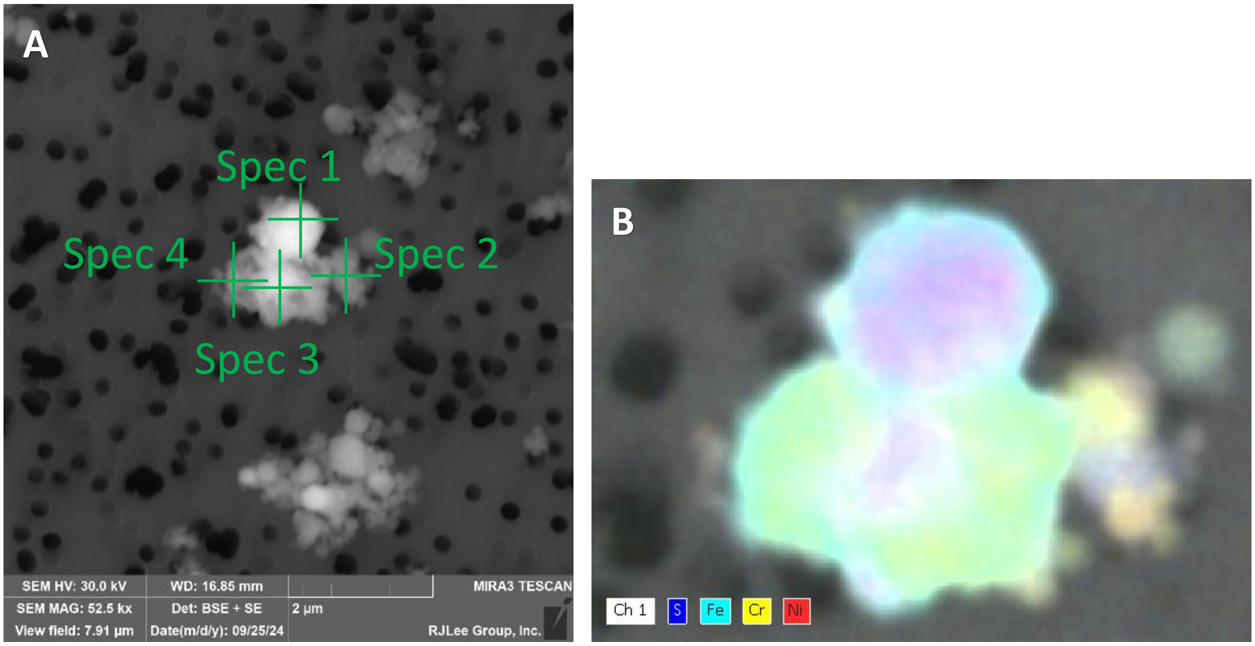


Figure 12 – A) Manual SEM image of particle 685 with marked locations of EDS spectra. B) EDS map of particle 685.

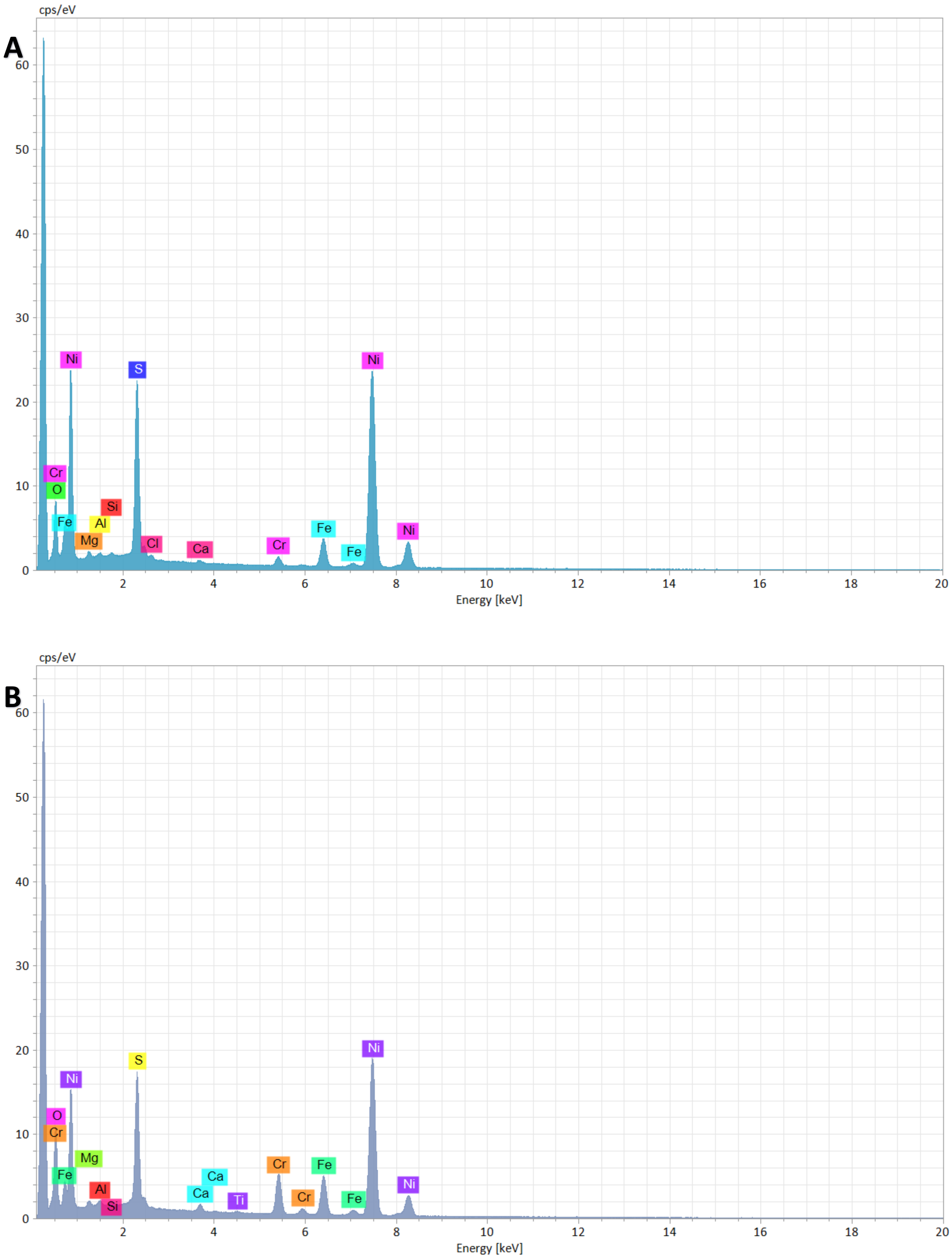


Figure 13 – A) EDS Spectrum 1 of particle 685. B) EDS Spectrum 3 of particle 685.

- **Sample 3190018, Particle 4353**: This particle was considered one discrete particle. The elemental composition consisted of substantial Ni and S peaks with a minor O peak. No other element had a peak greater than 1%. This particle was considered consistent with NiS from the standard and had an average diameter of 8.5 μm. SEM image is presented in Figure 14 and EDS spectrum in Figure 15.

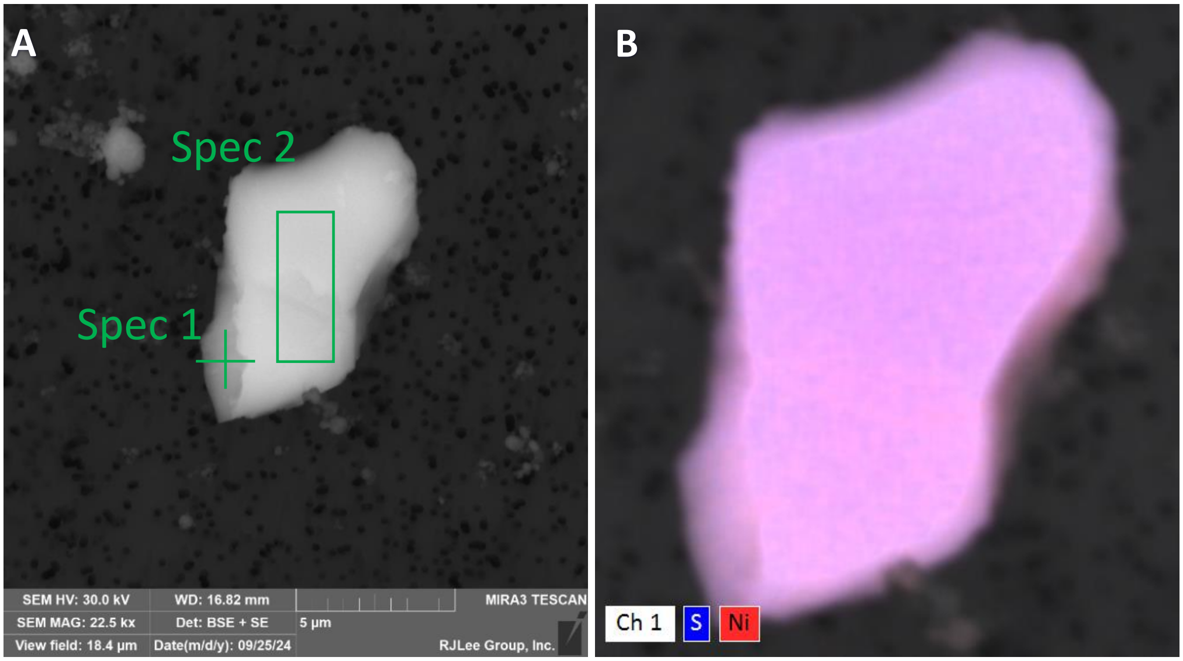


Figure 14 – A) Manual SEM image of particle 4353 with marked locations of EDS spectra. B) EDS map of particle 4353.

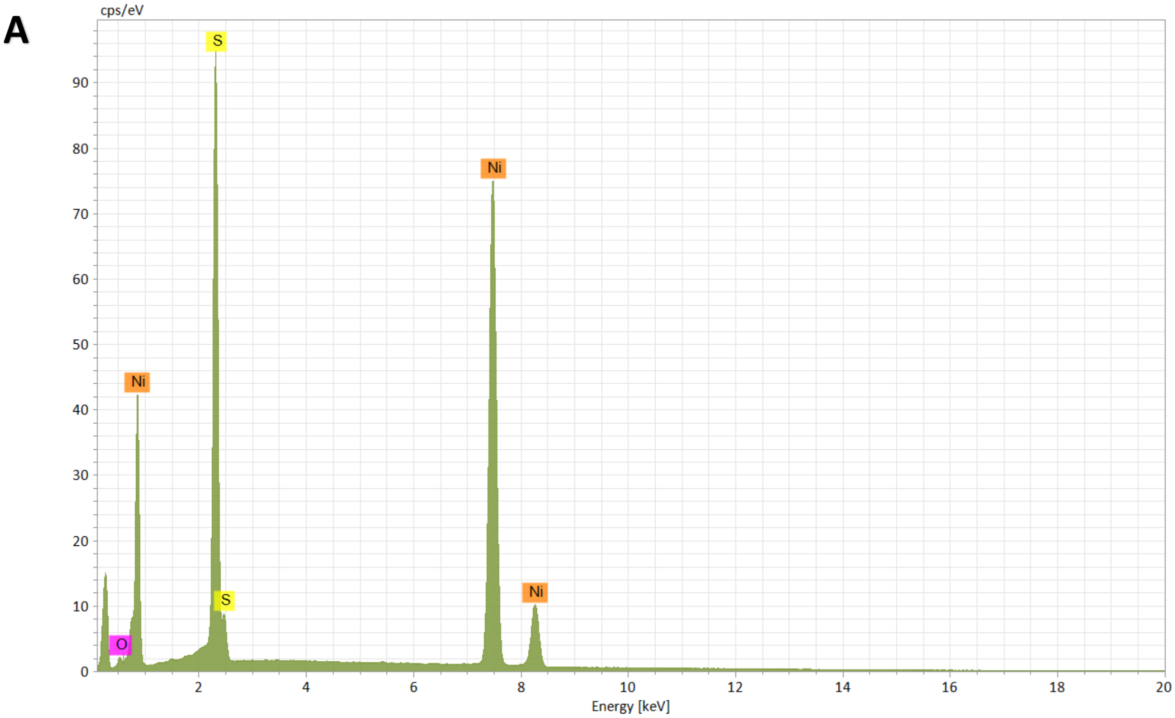


Figure 15 – A) EDS Spectrum 2 of particle 4353.

- **Sample 3190018, Particle 4996**: This particle was considered one discrete particle. The elemental composition consisted of substantial Ni and S peaks with a minor O peak. No other element had a peak greater than 1%. This particle was considered consistent with NiS from the standard and had an average diameter of 12.6 µm. SEM image is presented in Figure 16 and EDS spectrum in Figure 17.

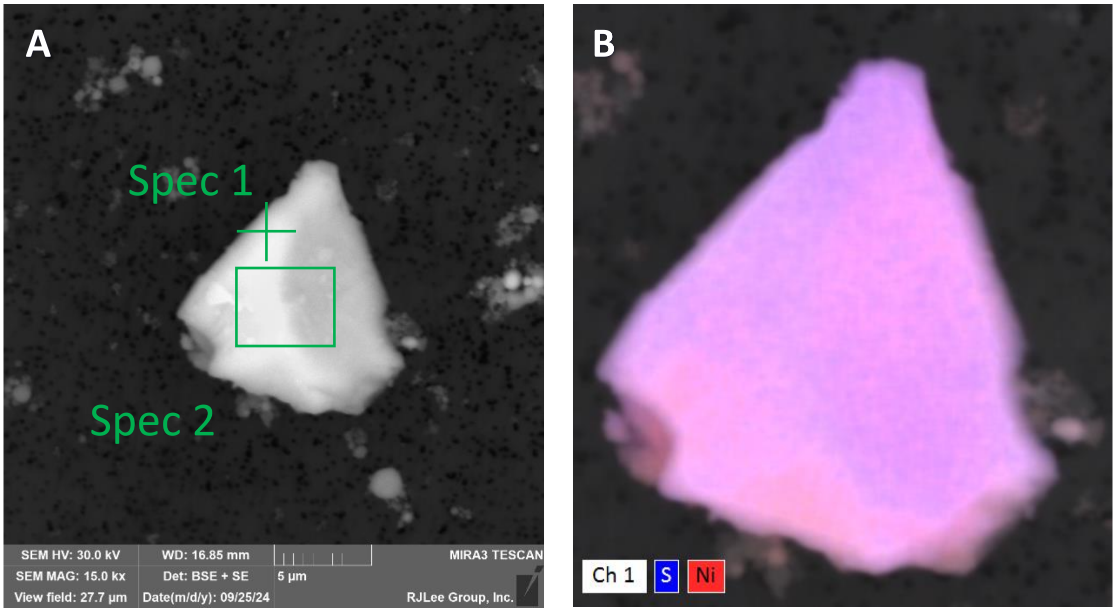


Figure 16 – A) Manual SEM image of particle 4996 with marked locations of EDS spectra. B) EDS map of particle 4996.

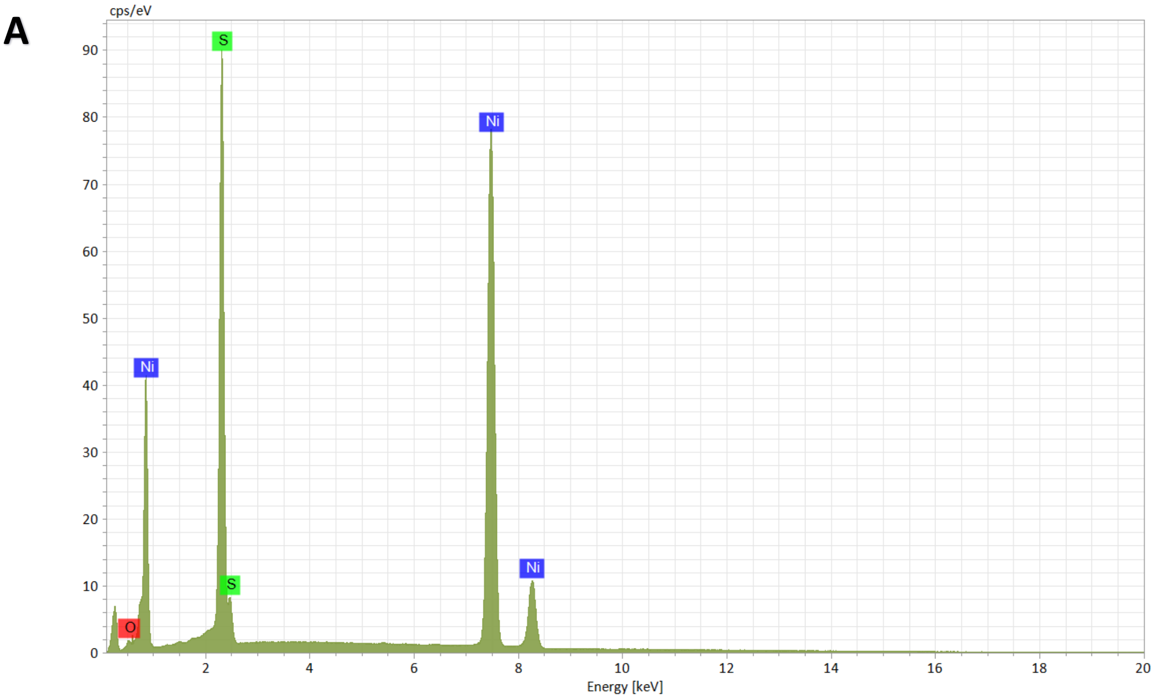


Figure 17 – A) EDS Spectrum 2 of particle 4996.

Table 4 – CCSEM EDS percentages of particles Consistent with NiS

Sample	Particle	% Ni	% S	% O
3190016	3271	52.4	42.5	5.1
3190018	4353	54.1	45.9	0
3190018	4996	57.5	42.5	0

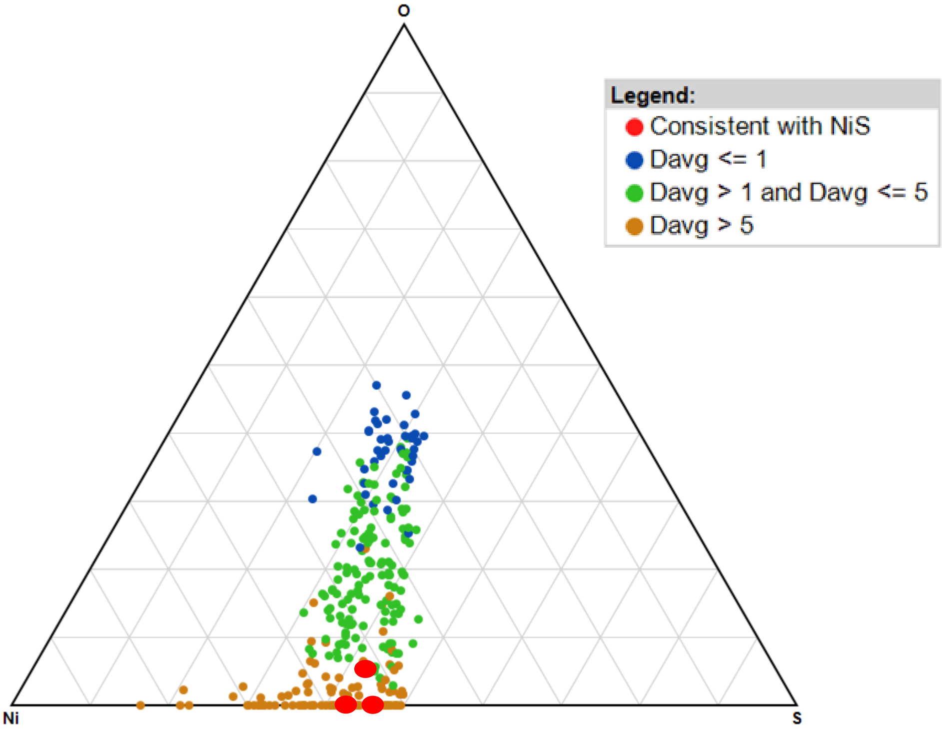


Figure 18 – Ternary diagram of EDS peak percentages of nickel (Ni), sulfur (S) and oxygen (O) from the analyzed nickel subsulfide standard with particles considered "Consistent with NiS standard" overlayed.

In summary after classifying the 9,000 particles analyzed, five particles were identified as possible nickel subsulfide particles. These five particles were further evaluated by manual SEM/EDS analysis. Three of the five particles are considered consistent with discrete nickel subsulfide particles from the reference standard. All other particles containing both Ni and S in the EDS spectra, but with S in much lower amounts, cannot be distinguished as being consistent with nickel subsulfide. Refer to Table 4 and Figure 18 for peak percentages of the "consistent with NiS" particles.

These results are submitted pursuant to RJ Lee Group's current terms and conditions of sale, including the company's standard warranty and limitation of liability provisions. No responsibility or liability is assumed for the manner in which the results are used or interpreted. This test report is not to be reproduced except in full, without written approval of the laboratory.

Should you have any questions regarding this information, please do not hesitate to contact me.

Sincerely,

Dustin L. Schrecongost, Ph.D.
Senior Scientist

References

Casuccio, G.S., Janocko, P.B., Lee, R.J., Kelly, J.F., Dattner, S.L., and Mgebroff, J.S., 1983, "The Use of Computer Controlled Scanning Electron Microscopy in Environmental Studies," Journal of the Air Pollution Control Association, v. 33, no. 10, p. 937 – 943.

Kennedy S.K., Casuccio, G.S., Lee, R.J. Slifka, G.A., and Ruby, M.V., 1996, "Microbeam Analysis of Heavy Element Phases in Polished Sections of Particulate Material – An Improved Insight into Origin and Bioavailability," Sampling Environmental Media, ASTM STP 1282, James Howard Morgan, Ed., American Society for Testing and Materials, p. 317-328.

Kennedy, S.K. et al., 2002 "Speciation and Characterization of Heavy Metal Contaminated Soils using Computer-Controlled Scanning Electron Microscopy," Environmental Forensics, v. 3, p 131-143.

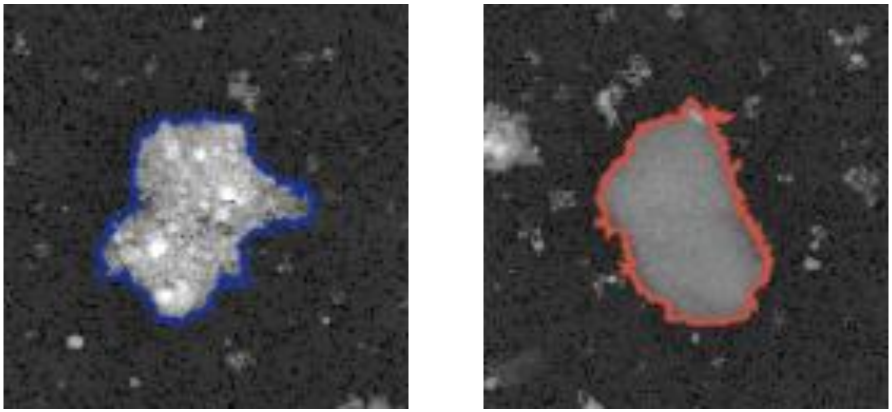
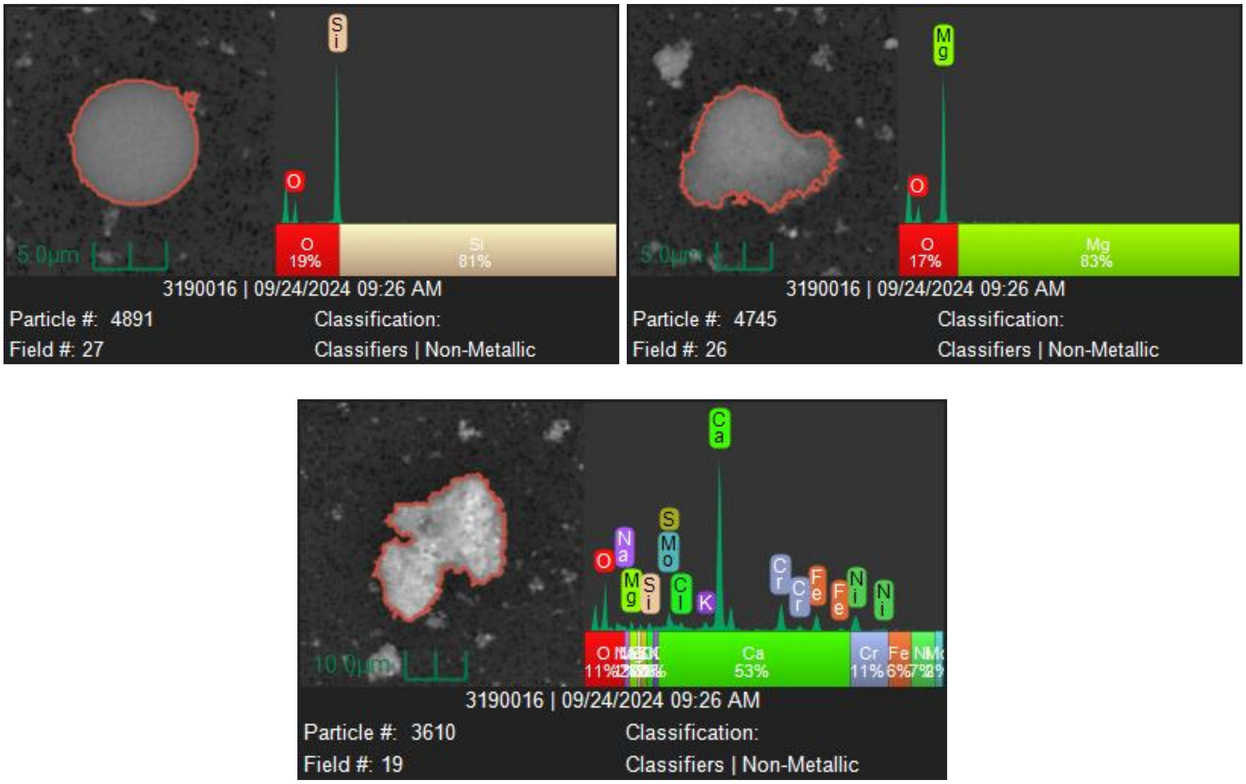


Figure A1 – Left image is an example of a "mixed or agglomerated" particle where the overall large particle contains many small particles with varying compositions and sizes. Right image is an example of a "discrete" particle where the overall particle is primarily one distinct particle.



3190016 | 09/24/2024 09:26 AM
Particle #: 4891
Field #: 27
Classification:
Classifiers | Non-Metallic

3190016 | 09/24/2024 09:26 AM
Particle #: 4745
Field #: 26
Classification:
Classifiers | Non-Metallic

3190016 | 09/24/2024 09:26 AM
Particle #: 3610
Field #: 19
Classification:
Classifiers | Non-Metallic

Figure A2 – Example Non-Metallic CCSEM images and spectra. Top left: SiO particle, Top Right: MgO particle, Bottom: Ca-rich particle with trace amounts of other elements including metallics.

Table A1 – Summary of CCSEM/EDS results for Sample A-SMC-EAF-DUST (3190016). "#" is the raw number of particles analyzed in each class for the sample. Davg is the average diameter of all particles within the classification. Average %S and Average %Ni of the particles in each classification. Mass is the estimated total particle mass of each classification scaled to per mm^2. Mass % is the percentage each classification represents of the sample estimated total particle mass per mm^2 for all classifications.

Sample 3190016	#	Davg (µm)	Average %S	Average %Ni	Mass (ng/mm^2)	Mass %
Consistent with NiS	1	7.6	42.5	52.4	0.05	0.01
Containing Ni & S	4	6.2	7.9	27.4	0.77	0.14
C-rich or Unclassified	449	2.2	0.2	9.9	46.77	8.59
Cr-rich	244	4.6	0.1	10.9	51.47	9.46
Cu-rich	36	3.6	0.0	23.4	8.98	1.65
Fe-rich	16	5.8	0.0	12.9	5.16	0.95
Mo-rich	57	6.7	1.8	8.4	8.58	1.58
Ni-rich	425	4.4	0.2	36.7	101.80	18.70
Non-Metallic	1590	5.2	0.4	9.6	279.65	51.38
Other Metallic	171	8.1	0.5	18.6	39.66	7.29
Other S	2	14.0	5.5	3.0	0.60	0.11
Possible CaS	3	11.6	7.2	4.6	0.48	0.09
Possible FeS	1	10.8	22.2	2.3	0.20	0.04
Possible NiS	1	8.5	20.5	29.6	0.10	0.02
Total	**3000**				**544.28**	**100**

Table A2 – Summary of CCSEM/EDS results for Sample B-SMC-EAF-DUST (3190017). "#" is the raw number of particles analyzed in each class for the sample. Davg is the average diameter of all particles within the classification. Average %S and Average %Ni of the particles in each classification. Mass is the estimated total particle mass of each classification scaled to per mm^2. Mass % is the percentage each classification represents of the sample estimated total particle mass per mm^2 for all classifications.

Sample 3190017	#	Davg (µm)	Average %S	Average %Ni	Mass (ng/mm^2)	Mass %
Consistent with NiS	0	--	--	--	--	--
Containing Ni & S	4	7.2	8.0	13.4	0.22	0.05
C-rich or Unclassified	507	4.0	0.3	8.6	75.29	18.48
Cr-rich	293	4.0	0.1	10.8	37.36	9.17
Cu-rich	36	3.8	0.2	24.9	6.46	1.59
Fe-rich	24	5.9	0.0	13.8	5.23	1.28
Mo-rich	55	6.9	2.1	8.6	7.63	1.87
Ni-rich	480	4.0	0.2	37.9	67.09	16.47
Non-Metallic	1392	5.3	0.5	9.4	178.61	43.84
Other Metallic	193	7.2	0.4	18.7	25.51	6.26
Other S	13	12.3	8.5	3.5	3.71	0.91
Possible CaS	3	6.2	7.3	7.4	0.28	0.07
Possible FeS	0	--	--	--	--	--
Possible NiS	0	--	--	--	--	--
Total	**3000**				**407.39**	**100**

Table A3 – Summary of CCSEM/EDS results for Sample C-SMC-EAF-DUST (3190018). "#" is the raw number of particles analyzed in each class for the sample. Davg is the average diameter of all particles within the classification. Average %S and Average %Ni of the particles in each classification. Mass is the estimated total particle mass of each classification scaled to per mm^2. Mass % is the percentage each classification represents of the sample estimated total particle mass per mm^2 for all classifications.

Sample 3190018	#	Davg (µm)	Average %S	Average %Ni	Mass (ng/mm^2)	Mass %
Consistent with NiS	2	10.5	44.2	55.8	0.24	0.07
Containing Ni & S	6	8.6	7.3	31.8	2.05	0.61
C-rich or Unclassified	192	4.7	0.3	8.8	15.22	4.51
Cr-rich	333	3.6	0.1	10.7	36.08	10.70
Cu-rich	57	3.4	0.1	23.5	10.47	3.11
Fe-rich	21	4.6	0.2	9.7	1.62	0.48
Mo-rich	59	6.2	1.9	7.8	6.81	2.02
Ni-rich	613	3.7	0.2	37.6	76.89	22.80
Non-Metallic	1504	5.1	0.6	10.3	159.34	47.24
Other Metallic	190	6.6	0.4	18.4	24.58	7.29
Other S	15	13.7	7.7	3.1	2.16	0.64
Possible CaS	6	9.2	6.8	4.1	0.88	0.26
Possible FeS	1	8.1	8.6	2.3	0.02	0.00
Possible NiS	1	1.9	17.0	33.2	0.90	0.27
Total	**3000**				**337.28**	**100**

ToxStrategies

Innovative solutions
Sound science

December 11, 2024

Mr. Tom Bell
Environmental Manager, HBE
Huntington Alloys Corp.
3200 Riverside Drive
Huntington, WV 25705

SUBJECT: Characterization of Electric Arc Furnace (EAF) Baghouse Samples for Oral Bioaccessibility

Dear Mr. Bell:

At your request, ToxStrategies LLC (ToxStrategies) has analyzed four samples collected from the electric arc furnace (EAF) baghouse at Special Metals Huntington Alloys (Huntington Alloys) to measure the oral bioaccessibility of nickel as an indicator of bioavailability. As suggested by the West Virginia Department of Environmental Protection (WVDEP), the oral bioaccessibility of these samples was measured using US Environmental Protection Agency (EPA) Test Method 1340. The oral bioaccessibility of four baghouse samples ranged from 13% to 14%, indicating that 86-87% of the nickel in the EAF baghouse dust is insoluble in simulated gastric conditions. In other words, the relative bioavailability of nickel in EAF baghouse dust from Huntington Alloys is much lower (13-14%) than the default assumption of 100% bioavailability assumed in risk assessments. This finding is consistent with the investigation of the nickel in particles from the EAF baghouse, which found that the metallic particles within the dust are present in the form of an alloy.[1]

Background

The goal of quantifying bioavailability is to reduce the uncertainty in exposure estimates by recognizing the lower systemic exposure that occurs when material has low bioavailability, which improves the accuracy of risk assessment.[2] As a default, EPA typically assumes that metals in soil and solid media are as available for oral absorption as the forms of metals used in toxicity testing (i.e., 100%). The form of nickel used in the toxicity tests that are the basis of EPA's oral toxicity criteria is freely soluble nickel sulfate

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[1] ToxStrategies LLC. 2024. Evaluation of potential nickel subsulfide in Special Metals Huntington Alloys facility Electric Arc Furnace (EAF) emissions. December 9.

[2] NAS (National Academy of Sciences). 2003. Bioavailability of contaminants in soils and sediments: Processes, tools, and applications. Committee on Bioavailability of Contaminants in Soils and Sediments, National Research Council. National Academy of Sciences. ISBN 0-309-50578-X.

($NiSO_4$). Bioavailability provides a more accurate estimate of exposure than using a default assumption of 100%.

Bioavailability is expressed as the fraction (or percentage) of a dose that can be systemically absorbed. By comparison, relative bioavailability (RBA) refers to the fraction of a metal absorbed in environmental media (e.g., soil) as compared to the more soluble form of the metal typically used for toxicity testing.[3] RBA is measured in animal studies, but due to desire to limit animal testing, bioaccessibility is commonly used as a conservative surrogate for RBA. Bioaccessibility tests are *in vitro* extractions that simulate the extraction of metals in the human digestive track.

Bioaccessibility testing is most commonly applied to inorganics in soil and solid matrices, such as mine tailings and metal slag, where the limited release of the metal from the matrix is expected to reduce systemic absorption. Because the metallic particles containing nickel in Huntington Alloy's EAF emissions have been shown to be in alloy form,[1] the bioaccessibility of nickel is expected to be low as compared to nickel sulfate.

EPA Method 1340 was used in this evaluation, at the suggestion of WVDEP, to assess the bioaccessibility of nickel in Huntington Alloys' EAF baghouse dust.[4] EPA also applies EPA Method 1340 for assessing bioaccessibility of lead and arsenic.[5] [6] There are many studies of *in vitro* bioaccessibility for nickel specifically that demonstrate that bioaccessibility may be used to conservatively predict RBA. [7,8,9,10,11] Also, in the Navy's 2000 guidance for incorporating bioaccessibility into risk assessments, the Navy concluded

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[3] EPA (US Environmental Protection Agency). 2007. Guidance for Evaluating the Oral Bioavailability of Metals in Soils for Use in Human Risk Assessment. May.

[4] Email from Michael Egnor (WVDEP) to Tom Bell (Huntington Alloys), August 8, 2024.

[5] EPA (US Environmental Protection Agency). 2017a. Method 1340. *In Vitro* Bioaccessibility Assay for Lead in Soil. Revision 1. SW-846 Update VI. February. corrected July 6.

[6] EPA (US Environmental Protection Agency). 2017b. Standard Operating Procedure for an *In Vitro* Bioaccessibility Assay for Lead and Arsenic in Soil. https://semspub.epa.gov/work/HQ/100000153.pdf.

[7] Vailuk L, et al. 2023. The effect of particle size on oral bioavailability and bioaccessibility of soil Ni from different sources. Environmental Pollution 339:122761. doi: 10.1016/j.envpol.2023.122761.

[8] Liang J-H, et al. 2022. Nickel oral bioavailability in contaminated soils using a mouse urinary excretion bioassay: Variation with bioaccessibility. Sci Total Environ 839:156366. doi: 10.1016/j.scitotenv.2022.156366.

[9] Dutton MD, et al. 2021. Gastric bioaccessibility is a conservative measure of nickel bioavailability after oral exposure: Evidence from Ni-contaminated soil, pure Ni substances and Ni alloys. Environ Poll. 268, Part A 115803, https://doi.org/10.1016/j.envpol.2020.115830.

[10] Suh M, et al. 2019. Bioaccessibility and relative oral bioavailability of cobalt and nickel in residential soil and dust affected by metal grinding operations. Science of the Total Environment 660:677–689.

[11] Kang Y, et al. 2016. Assessment of relative bioavailability of heavy metals in soil using in vivo mouse model and its implication for risk assessment compared with bioaccessibility using in vitro assay. Environ Geochem Health 38:1183–1191. https://doi.org/10.1007/s10653-015-9782-0.

that nickel is one of several metals where an *in vitro* approach is appropriate for estimating RBA.[12]

EPA does not provide a standard test method for nickel exposures other than oral (e.g., inhalation); however, it is noteworthy that the Method 1340 extraction is conducted with pH 1.5 concentrated hydrochloric acid, and can be considered conservative for other biological conditions, including inhalation.

Sample Collection at Huntington Alloys

Four samples of dust from the baghouse for the EAF were collected by filling four 8-ounce jars with material from the collection drum of the baghouses. The samples were collected by Huntington Alloys personnel. The samples were sent under chain-of-custody to Prima Environmental, Inc. (Prima), in El Dorado Hills, CA, to be analyzed for total metals content and oral bioaccessibility. The four baghouse samples were collected on September 23, 2024. The WVDEP observed the sample collection.

Bioaccessibility

To measure bioaccessibility, Prima used EPA Method 1340[5] for the gastric simulation, and the laboratory results for oral bioavailability are presented in Attachment A. Prior to analysis and in accordance with EPA Method 1340,[4] Prima sieved the four samples to <150 microns. Both the <150-micron fraction of the sieved samples and the soluble nickel in the gastric simulation were analyzed for nickel using EPA Method 6020.

As shown in Table 1, bioaccessibility results for nickel in the EAF baghouse samples were 13% to 14%. All four baghouse sample results were in a narrow range across test measurements.

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[12] Naval Facilities Engineering Command. 2000. Guide for incorporating bioavailability adjustments into human health and ecological risk assessments at U.S. Navy and Marine Corps Facilities. Part 1: Overview of Metals Bioavailability (pg. 4-2) and Part 2: Technical Background Document for Assessing Metals Bioavailability (pg. 3-15).

Table 1. Summary of bioaccessibility results

				Nickel Concentration		Bioaccessibility	
PRIMA ID	Sample	Sample Date	Mass Extracted (g)	As Received Sample (mg/kg) [2]	Extraction Fluid (mg/l) [3]	(%)	(mg Ni/kg sample)
1	EAF Baghouse A-09232024	9/23/24	1.0084	163,865	230	14	23,000
2	EAF Baghouse B-09232025	9/23/24	1.0062	165,999	230	14	23,000
3	EAF Baghouse C-09232026	9/23/24	1.0063	171,477	230	13	23,000
4	EAF Baghouse D-09232027	9/23/24	1.0004	164,963	220	13	22,000
4 dup	EAF Baghouse D-09232027-dup [1]	9/23/24	1.0064	164,963	220	13	22,000

Notes:
1."Dup" is a duplicate extraction.
2. Nickel in each solid sample was measaured twice. The reported result is the average of the two measurements.
3. All samples were extracted on 8/10/2024.

As presented in Table 1, duplicate extraction sample results were identical, indicating good precision in the data. Although some nickel was detected in the reagent and method blank, the concentrations were orders of magnitude lower than the measurements in extraction fluids and would not affect the results. The nickel spike recovery sample result was 110%, which is within laboratory acceptance criteria for typical spike samples (80% to 120%).

These results demonstrate that the bioaccessibility of nickel in the EAF baghouse dust is only 13.5%. These results are consistent with those of the elemental nickel analysis[13] and support these conclusions:

- nickel emissions from Huntington Alloys exist primarily in forms that are of low bioavailability, and
- EPA toxicity criteria for nickel are not applicable to emissions from Huntington Alloys and would overestimate the potential risk and hazard posed by the facility's emissions.

Thank you for the opportunity to work on this project. Let us know if you have any questions.

Sincerely,

Ann H. Verwiel　　　　Deborah Proctor

Ann H. Verwiel
Senior Managing Scientist

Deborah Proctor
Managing Principal

Attachment A

---

[13] ToxStrategies LLC. 2024. Evaluation of potential nickel subsulfide in Special Metals Huntington Alloys facility Electric Arc Furnace (EAF) emissions. December 9.

ATTACHMENT A

Laboratory Results for Bioaccessibility

PRIMA ENVIRONMENTAL INC.
Questions Answered.

November 12, 2024

Ann Verweil
Tox Strategies
1010 B Street
San Rafael, CA 94901

RE: EPA 1340 IVBA for Nickel – revision 1
Client Project No.: Bag House Dust Samples
Client Project ID: SMC Huntington Alloys WV
PRIMA Project ID: ToxStrat-Huntington

Dear Ms. Verwiel:

PRIMA Environmental, Inc. performed in vitro bioaccessibility test (IVBA) to measure the bioaccessibility of nickel in four samples received September 26, 2024.

Procedure. IVBA tests were performed using EPA Method 1340 revision February 2017. Each sample sieved via mechanical shaker to obtain the < 150 micron (< 100 mesh) size fraction required for the IVBA extraction. The IVBA tests used 100 ± 0.5 mL of extraction fluid and 1.00 ± 0.05 g sample. The sample was extracted at 37°C for 60 minutes using an end-over-end extraction apparatus. The initial pH of the 0.4 M glycine extraction fluid was 1.5 ± 0.05. The final pH of each extract was within ± 0.5 pH units of the initial pH. Nickel in the extraction fluid samples was analyzed by Enthalpy Analytical (Orange, CA) using EPA method 6020; nickel in the solid samples was analyzed by American Assay Laboratories (Sparks, NV) using inductively coupled plasma-optical emission spectroscopy (ICP-OES).

Results. The nickel concentrations in the extraction solution and in the unextracted sieved sample (< 150 μm fraction) are shown in **Table 1**. The *Bioaccessibility* is given in terms of percent (Eqn. 1), and as the mass of soluble metal per mass of sample (Eqn. 2). Note that the mass of sample is the mass of the *sieved* fraction used in the test, not the mass of bulk sample. The QC results are given in **Table 2**. QC limits have not been established for nickel. However, the nickel concentration in the reagent blank (RB) and method blank (MB) were below the reporting limit (and several orders of magnitude below the concentration in sample extracts), the spike recovery was between 80-120%, and the duplicate extract was in excellent agreement.

$$\text{Bioaccessibility (\%)} = 100 \times \frac{\text{(concentration in extract, mg/L)} * (0.1\text{L})}{\text{(concentration in sample, mg/kg)} * (0.001\text{kg})} \qquad \text{Eqn. 1}$$

$$\text{Bioaccessibility (mg Ni/kg sample)} = \frac{\text{(concentration in extract, mg/L)} * \text{(volume extract, L)}}{\text{(mass of sample, kg)}} \qquad \text{Eqn. 2}$$

If you have any questions regarding this report, please give me a call at 916-939-7300. Thank you for the opportunity to be of service.

Sincerely,
PRIMA Environmental, Inc.
Cindy G. Schreier
Cindy G. Schreier, Ph.D.
President & Chief Scientist

Attachments

Table 1. Results of IVBA Tests.

				Nickel Concentration		Bioaccessibility	
PRIMA ID	Extraction Date	Sample	Mass Extracted	As Received Sample	Extraction Fluid		
			g	mg/kg	mg/L	%	mg Ni/kg sample
1	8-Oct-2024	EAF Baghouse A-09232024	1.0084	163,865	230	14	23,000
2	8-Oct-2024	EAF Baghouse B-09232025	1.0062	165,999	230	14	23,000
3	8-Oct-2024	EAF Baghouse C-09232026	1.0063	171,477	230	13	23,000
4	8-Oct-2024	EAF Baghouse D-09232027	1.0004	164,963	220	13	22,000
4dup	8-Oct-2024	EAF Baghouse D-09232027-dup	1.0064	164,963	220	13	22,000

^ "Dup" is a duplicate extraction.

* Nickel in each solid sample was measaured twice. The reported result is the average of the two measurements.

Table 2. QC Data for IVBA Tests.

PRIMA ID	Date	Sample Description	Conc. mg/L	Spike, mg/L	% Recovery	IVBA, %	RPD	Limits
Hunt-RB	8-Oct-2024	Reagent Blank	0.0025 J	--	--	--	--	NE
Hunt-MB	8-Oct-2024	Method Blank	0.0023 J	--	--	--	--	NE
Hunt-SPK	8-Oct-2024	Blank - Spike	1.1	1.0	110	--	--	NE
Hunt-4	8-Oct-2024	IS-01-SS-BS-04	--	--	--	220	0.0	NE
Hunt-4dup		IS-01-SS-BS-04 dup				220		

RPD = relative percent difference

J = estimated value. The analyte was positively detected below the reporting limit; the quantitation is an estimation.

PRIMA ENVIRONMENTAL INC.
Questions Answered.

5070 Robert J Mathews Parkway, Suite 300
El Dorado Hills, CA 95762
916-939-7300
www.primaenvironmental.com

Sample Receipt Summary

Date/Time: 09/26/2024 09:30

Client/Company: Tox Strat

Project: ~~EAF Baghouse~~ Huntington
BvB

	Yes	No	N/A
Custody seals intact?	☐	☒	☐
Chain of custody Present?	☒	☐	☐
If no, list number of samples and Sample ID			
Ice present?	☒	☐	☐
If no, what is temperature? _____			
Samples in good condition?	☒	☐	☐
If no, explain:			
Do sample IDs on containers match IDs on COC?	☒	☐	☐
If no, explain:			

Other Comments:

☐

Chain of Custody Form

☑

Page 1 of 1

Customer Information		Project Information		Parameter/Method Request for Analysis	
Purchase Order	NA	Project Name	SMC Huntington Alloys WV	A	
Work Order	NA	Project Number	BAG House Dust Samples	B	EPA Method 1340
Company Name	SMC Huntington Alloys WV	Bill To Company	SMC (Huntington ALLOYS)	C	EPA Method 6010B
Send Report To	TOXSTRATEGIES - A. VERWIEL	Invoice Attn.		D	
Address	1010 B STREET Suite 215	Address	CONTACT: TOM BELL 3200 Riverside DRIVE	E F	
City/State/Zip	San Rafael, CA 94901	City/State/Zip	Huntington WV	G	
Phone	415-446-9858	Phone	304-526-5258	H	
Fax	NA	Fax		I	
e-Mail Address	Kevin.Patton@Arcadis			J	

No.	Sample Description	Comp / Grab	Date	Time	Matrix	Pres.	# Bottles	A	B	C	D	E	F	G	H	I	J	Hold
1	EAF Baghouse A-09232024	G	09.23.24	1015	Soild	None	2	X	X									
2	EAF Baghouse B-09232025	G	09.23.24	1230	Soild	None	2	X	X									
3	EAF Baghouse C-09232026	G	09.23.24	1430	Soild	None	2	X	X									
4	EAF Baghouse D-09232027	G	09.23.24	1700	Soild	None	2	X	X									
5																		
6																		
7																		
8																		
9																		
10																		

Sampler(s): Please Print & Sign John Nelson

Shipment Method: FEDEX

Required Turnaround Time: ☐ Other ________ ☐ STD 10 Wk Days ☑ 5 Wk Days ☐ 2 Wk Days ☐ 24 Hour

Results Due Date: STANDARD

Relinquished by:	Date: 9-25-24	Time: N 1200	Received by:	Temp:	Notes: REPORT TO ANN VERWIEL BAG HOUSE DUST SAMPLES
Relinquished by:	Date: 09/26/24	Time: 0930	Received by:		
Relinquished by:	Date:	Time:	Received by:	Temp:	QC Package: (Check Box Below)
Relinquished by:	Date:	Time:	Received by (Laboratory):		Level II: Standard QC ☐
Logged by (Laboratory):	Date:	Time:	Checked by (Laboratory):		Level III: Standard QC + Raw Data ☐ Level IV: SW846 Methods/CLP ☐ Other: ________ ☐

Preservative Key: 1-HCl 2-HNO_3 3-H_2SO_4 4-NaOH 5-$Na_2S_2O_3$ 6-$NaHSO_4$ 7-Other 8-4°C