

Quickly Identify and Source Foreign Material Contaminants Found in Food Products with Handheld XRF

Bruker Nano Analytics Webinar
July 1, 2021

Speakers



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Food & Agriculture, Bruker
Nano Analytics



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Handheld XRF, Bruker Nano
Analytics

Webinar Agenda

01 Introduction

02 Objectives

03 Managing the prevention of physical contaminants in food products

04 How handheld XRF technology helps quickly ID and source foreign objects

05 Creating a spectral fingerprint library with handheld XRF

06 Matching contaminants with a spectral fingerprint library and Artax PC software

07 Food Contaminant characterization with micro-XRF technique

08 Summary

09 Questions & Answers

02 Objectives

Webinar: Quickly Identify and Source Foreign Material
Contaminants Found in Food Products with Handheld XRF

Objectives

No manufacturer wants physical contaminants found in their products, but it happens. The faster you can identify it and determine if it is from faulty equipment, starting material, or even a false claim, the faster you can get production going again and minimize costs.

- Illustrate how handheld XRF can decrease the time required to ID a physical contaminant and locate its source
- Describe nondestructive handheld XRF technology and how it is used
- Explain how XRF spectral fingerprinting works to help find the source of contaminants in complex situations
- Describe best practices in creating a production floor ID data library of XRF spectral fingerprints
- Illustrate best practices in identifying contaminants with XRF spectral fingerprint matching software



03 Managing the prevention of physical contaminants in food products

Webinar: Quickly Identify and Source Foreign Material Contaminants Found in Food Products with Handheld XRF

Physical contaminants can be found in food products



Metal slivers and shards



Plastic and rubber pieces



Glass fragments



Stone and ceramic chips



Managing prevention of physical contaminants in end products

Typical prevention



1. **Inspect** food material with X-ray or metal detector
2. **Detect** foreign body
3. **Remove** product containing foreign body

Enhanced prevention



1. **Identify** found contaminant to determine its source
2. **Correct** issue based on source of the contaminant



Potential sources of metal contaminants in manufactured foods



Illustration of baking production line equipment



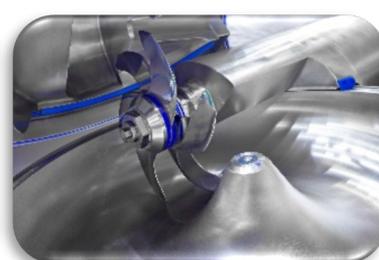
Auger



Conveyor



Grinder/cutter



Mixer

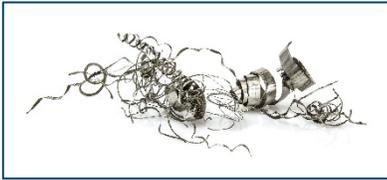


Roller mill



Sorter/packager

Identification of the contaminant is critical



Metal



Glass



Plastic and rubber



Stone and ceramic

- Enhances physical contaminant QA/QC programs
- Monitors equipment for maintenance
- Reduces future delays in production
- Increases confidence in suppliers
- Assists with false claim investigations
- Helps optimize overall risk management



04 How handheld XRF technology helps quickly ID and source foreign objects

Webinar: Quickly Identify and Source Foreign Material
Contaminants Found in Food Products with Handheld XRF

Handheld XRF technology

- Easy to use
- Nondestructive
- Instant result
- Portable
- Used on site
- Cost effective
- Accurate



• **Periodic Table of Elements and X-ray Energies**

www.bruker.com/hhxf

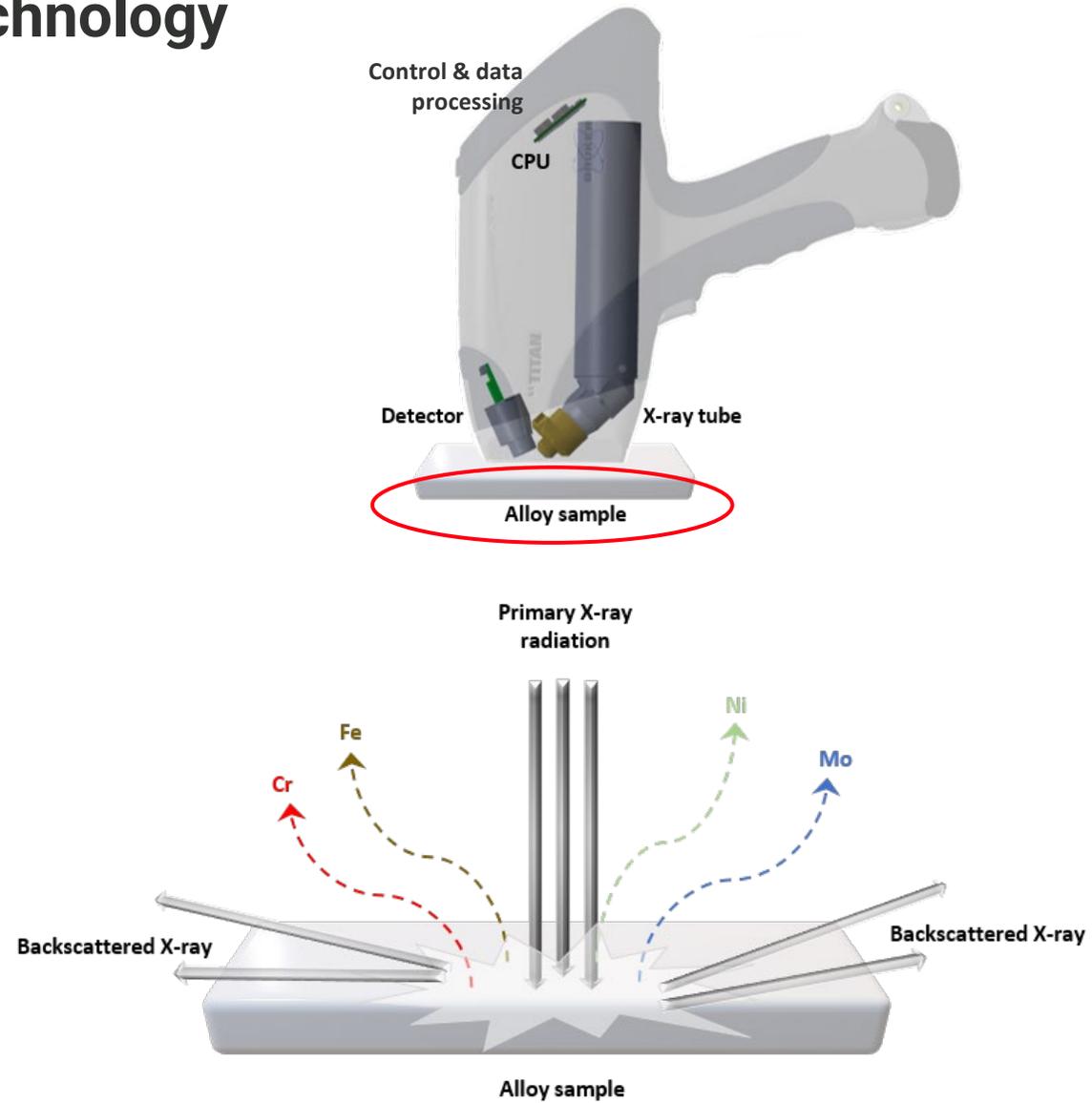
1 H 1.01 0.0007 Hydrogen	2 He 4.00 0.0002 Helium																	10 Ne 20.18 0.0008 Neon																											
3 Li 6.94 0.53 Lithium	4 Be 9.01 1.85 Beryllium																	18 Ar 39.95 0.002 Argon																											
11 Na 22.99 0.97 Sodium	12 Mg 24.31 1.74 Magnesium																	18 Ar 39.95 0.002 Argon																											
19 K 39.10 0.86 Potassium	20 Ca 40.08 1.54 Calcium	21 Sc 44.96 2.99 Scandium	22 Ti 47.87 4.54 Titanium	23 V 50.94 6.01 Vanadium	24 Cr 52.00 7.15 Chromium	25 Mn 54.94 7.4 Manganese	26 Fe 55.85 7.87 Iron	27 Co 58.93 8.9 Cobalt	28 Ni 58.69 8.91 Nickel	29 Cu 63.55 8.93 Copper	30 Zn 65.38 7.13 Zinc	31 Ga 69.72 5.91 Gallium	32 Ge 72.64 5.32 Germanium	33 As 74.92 5.78 Arsenic	34 Se 78.96 4.81 Selenium	35 Br 79.90 3.12 Bromine	36 Kr 83.80 0.004 Krypton																												
37 Rb 85.47 1.53 Rubidium	38 Sr 87.62 2.64 Strontium	39 Y 88.91 4.47 Yttrium	40 Zr 91.22 6.51 Zirconium	41 Nb 92.91 8.9 Niobium	42 Mo 95.94 10.22 Molybdenum	43 Tc (98) 11.50 Technetium	44 Ru 101.07 12.37 Ruthenium	45 Rh 102.91 12.41 Rhodium	46 Pd 106.42 12.02 Palladium	47 Ag 107.87 10.50 Silver	48 Cd 112.41 8.69 Cadmium	49 In 114.82 7.31 Indium	50 Sn 118.72 7.29 Tin	51 Sb 121.76 6.69 Antimony	52 Te 127.60 6.23 Tellurium	53 I 126.90 4.93 Iodine	54 Xe 131.29 0.006 Xenon																												
55 Cs 132.91 1.87 Cesium	56 Ba 137.33 3.69 Barium	57 La 138.91 6.16 Lanthanum	72 Hf 178.49 13.31 Hafnium	73 Ta 180.95 16.65 Tantalum	74 W 183.84 19.25 Tungsten	75 Re 186.21 22.61 Rhenium	76 Os 190.23 22.65 Osmium	77 Ir 192.22 22.65 Iridium	78 Pt 195.08 21.46 Platinum	79 Au 196.97 19.28 Gold	80 Hg 200.59 13.53 Mercury	81 Tl 204.37 11.85 Thallium	82 Pb 207.20 11.34 Lead	83 Bi 208.98 9.81 Bismuth	84 (209) 9.32 (209) Po	85 (210) 7.00 (210) At	86 (222) 0.01 (222) Rn																												
87 Fr (223) 1.87 Francium	88 Ra (226) 5.50 Radium	89 Ac (227) 10.07 Actinium																																											
<table border="1"> <tr> <td>35 Br 79.90 3.12 0.884 Bromine</td> <td>59 Pr 140.91 6.77 0.979 Praseodymium</td> <td>60 Nd 144.24 7.01 1.023 Neodymium</td> <td>61 Pm 144.91 7.26 1.078 Promethium</td> <td>62 Sm 150.36 7.52 1.078 Samarium</td> <td>63 Eu 151.96 5.24 1.131 Europium</td> <td>64 Gd 157.25 7.90 1.181 Gadolinium</td> <td>65 Tb 158.93 8.23 1.240 Terbium</td> <td>66 Dy 162.50 8.55 1.293 Dysprosium</td> <td>67 Ho 164.93 8.80 1.348 Holmium</td> <td>68 Er 167.26 9.07 1.404 Erbium</td> <td>69 Tm 168.93 9.32 1.462 Thulium</td> <td>70 Yb 173.04 6.97 1.526 Ytterbium</td> <td>71 Lu 174.97 9.84 1.580 Lutetium</td> </tr> <tr> <td>90 Th 232.04 11.72 2.996 Thorium</td> <td>91 Pa 231.04 15.37 3.082 Protactinium</td> <td>92 U 238.03 18.95 3.171 Uranium</td> <td>93 Np (237) 20.45 3.250 Neptunium</td> <td>94 Pu (244) 19.84 3.339 Plutonium</td> <td>95 Am (243) 13.69 3.436 Americium</td> <td>96 Cm (247) 13.51 3.436 Curium</td> <td>97 Bk (247) 14.79 3.436 Berkelium</td> <td>98 Cf (251) 15.1 3.436 Californium</td> <td>99 Es (252) 13.5 3.436 Einsteinium</td> <td>100 Fm (257) 13.5 3.436 Fermium</td> <td>101 Md (258) 13.5 3.436 Mendelevium</td> <td>102 No (259) 13.5 3.436 Nobelium</td> <td>103 Lr (262) 13.5 3.436 Lawrencium</td> </tr> </table>																		35 Br 79.90 3.12 0.884 Bromine	59 Pr 140.91 6.77 0.979 Praseodymium	60 Nd 144.24 7.01 1.023 Neodymium	61 Pm 144.91 7.26 1.078 Promethium	62 Sm 150.36 7.52 1.078 Samarium	63 Eu 151.96 5.24 1.131 Europium	64 Gd 157.25 7.90 1.181 Gadolinium	65 Tb 158.93 8.23 1.240 Terbium	66 Dy 162.50 8.55 1.293 Dysprosium	67 Ho 164.93 8.80 1.348 Holmium	68 Er 167.26 9.07 1.404 Erbium	69 Tm 168.93 9.32 1.462 Thulium	70 Yb 173.04 6.97 1.526 Ytterbium	71 Lu 174.97 9.84 1.580 Lutetium	90 Th 232.04 11.72 2.996 Thorium	91 Pa 231.04 15.37 3.082 Protactinium	92 U 238.03 18.95 3.171 Uranium	93 Np (237) 20.45 3.250 Neptunium	94 Pu (244) 19.84 3.339 Plutonium	95 Am (243) 13.69 3.436 Americium	96 Cm (247) 13.51 3.436 Curium	97 Bk (247) 14.79 3.436 Berkelium	98 Cf (251) 15.1 3.436 Californium	99 Es (252) 13.5 3.436 Einsteinium	100 Fm (257) 13.5 3.436 Fermium	101 Md (258) 13.5 3.436 Mendelevium	102 No (259) 13.5 3.436 Nobelium	103 Lr (262) 13.5 3.436 Lawrencium
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Atomic number	Atomic weight
35	79.90
Br	3.12
Bromine	Element name
Kα 11.924	Energy (keV)
Lα 1.481	Spectral line

Innovation with Integrity

Handheld XRF

Handheld XRF technology

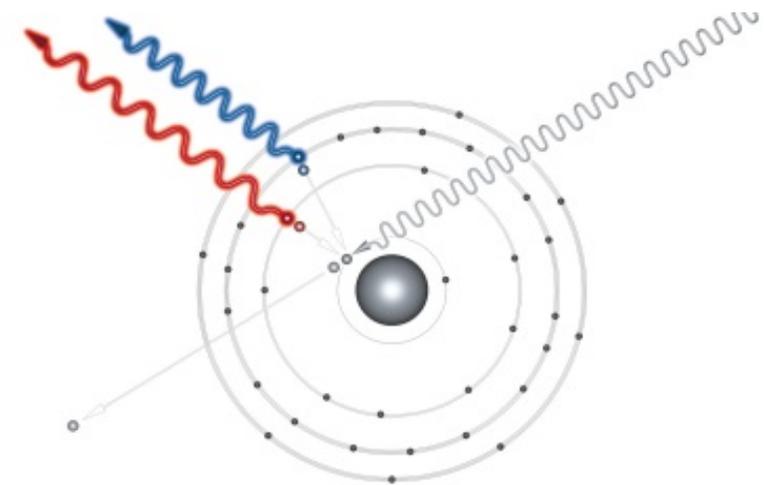
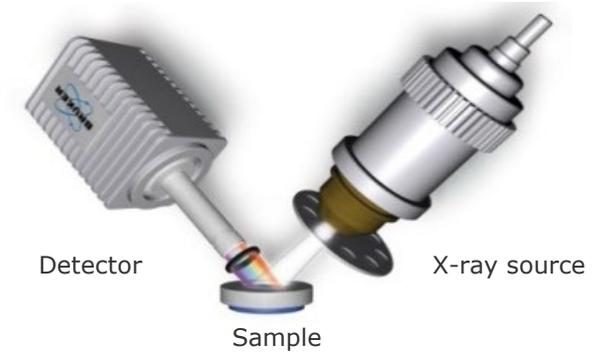


Handheld XRF technology

Energy Dispersive (ED) X-ray Fluorescence (XRF) Spectroscopy

- Energy from an X-ray source aimed at a sample can eject electrons from an element's inner atomic orbital
- Outer electrons move into the voids to regain stability
- While moving in, the outer electrons generate energy characteristic of the element
- These characteristic energies are the fluorescent X-rays of the element

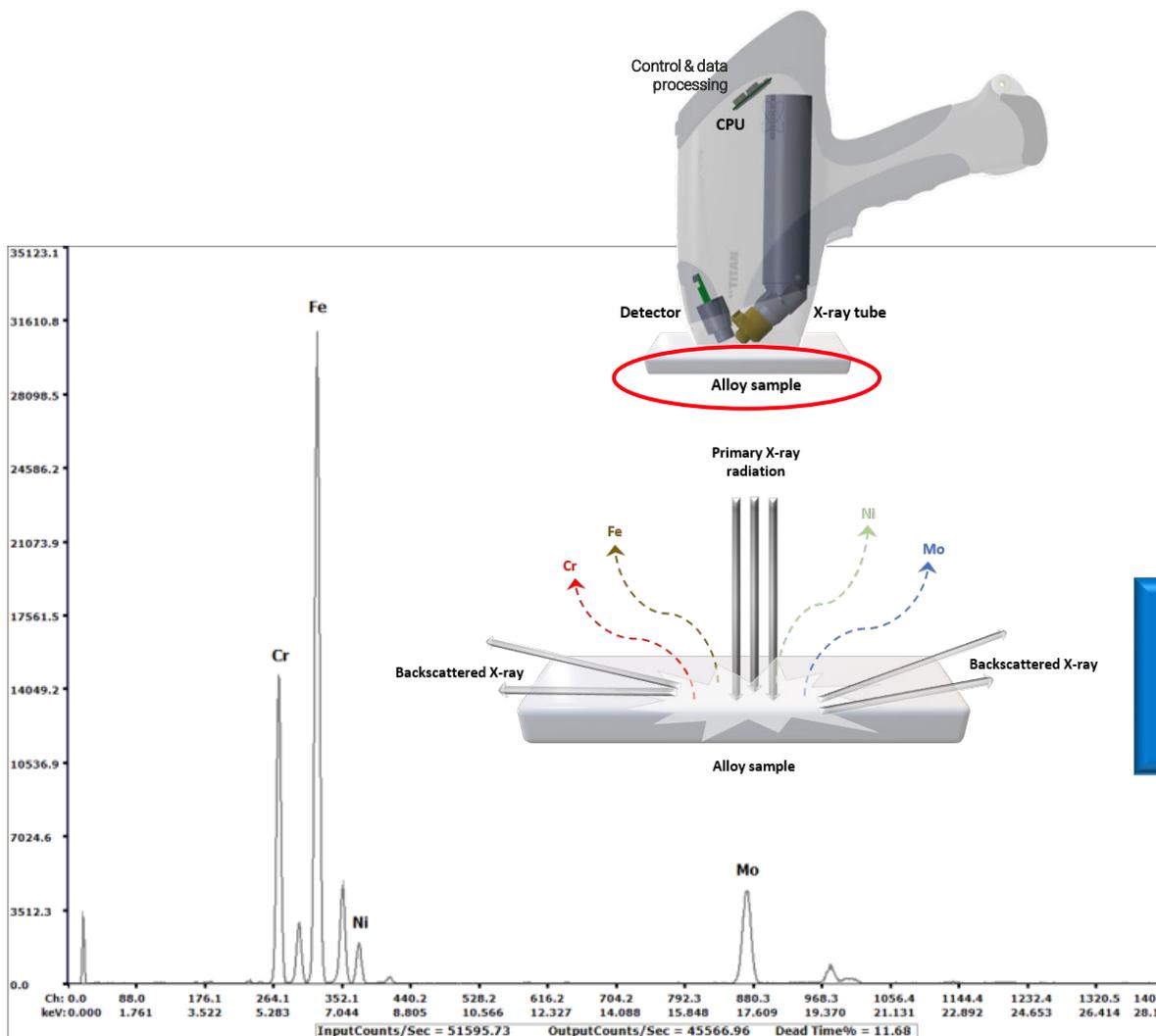
Atomic number	35	Atomic weight	79.90
Symbol	Br	Density (g/cm ³)	3.12
Element name	Bromine	Element name	
K _α Energy (keV)	11.924	L _α Energy (keV)	1.481
Spectral line			



Electron orbitals of element's atom

Handheld XRF results

XRF Spectrum



Handheld XRF metal alloy results

- Handheld XRFs configured with an Alloy Calibration include libraries with pre-defined alloy grades
- Alloy grades are defined based on their known chemical compositions
- An unknown metal sample is identified based on comparing its measured composition to those stored in the on-board alloy grade libraries



On-board Grade Libraries:

Bruker's handheld XRF Alloy Calibration includes extensive grade libraries for accurate alloy identification with more than 1,000 grade definitions covering various international standards. User selectable libraries include: EN-DIN, JIS, GB and other standards. They cover the following classes:

- Low alloy steels
- Cr-Mo steels
- Tool steels
- Stainless steel
- Zirconium alloys
- Specialty alloys
- Nickel alloys
- Brasses
- Bronzes
- Cobalt alloys
- Zinc alloys
- Aluminum
- Titanium
- Exotic alloys

Alloy grade libraries can be edited, including the addition of other alloy definitions

Device Tools Windows Help					
File Edit					
	Base	Alloy Group	Comment	Alloy ID	UNS Id
1					
2					

Element Name	Min	Max	Balance
Mg	0	0	<input checked="" type="checkbox"/>
Al	0	0	<input type="checkbox"/>
Si	0	0	<input type="checkbox"/>
P	0	0	<input type="checkbox"/>
S	0	0	<input type="checkbox"/>
Ti	0	0	<input type="checkbox"/>

Handheld XRF testing of a foreign metal object

- Small physical contaminants found in food products can be tested on the production floor or in the lab with handheld XRF analyzers
- As shown in previous slides, a found metal object can be identified by determining its composition, the type of metal alloy, and the alloy grade name
- There are 4 simple steps to ID small metal contaminants with handheld XRF



1. Prepare found object



2. Select "Alloys" App



3. Position with camera



4. Press trigger & view results



Handheld XRF sourcing of a foreign metal object

Once you have identified the foreign material, in this case an alloy sample, the equipment or components made with that alloy grade can be inspected for wear and tear as the potential source.



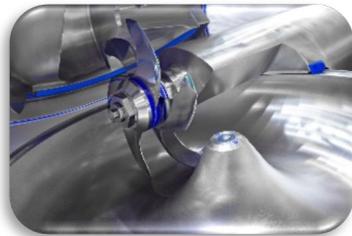
Auger



Conveyor



Grinder/cutter



Mixer



Roller mill



Sorter/packager

If many components are all made of the same alloy grade, a little more work is needed to help determine its source.

05 Creating a spectral fingerprint library with handheld XRF

Webinar: Quickly Identify and Source Foreign Material
Contaminants Found in Food Products with Handheld XRF

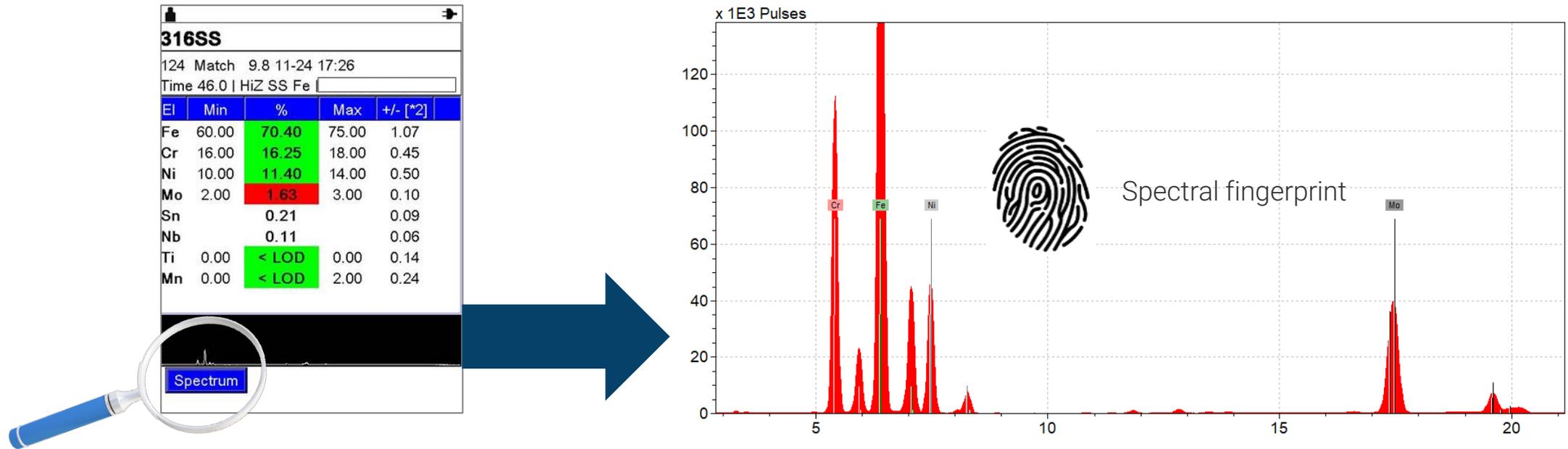
Why create a spectral fingerprint library?

Typical Steels Found in Food Production Equipment

Types	Typical Applications
420 (martensitic)	Cooks and professional knives, spatulas etc
430 (ferritic)	Table surfaces, equipment cladding, panel (ie components requiring little formability or weldability). Used for moderately corrosive environments (e.g. vegetables, fruits, drinks, dry foods, etc).
304 (austenitic)	Vats, bowls, pipework, machinery parts (i.e. components requiring some formability or weldability). Corrosion resistance superior to 430.
316 (austenitic)	Components used with more corrosive foods (e.g. meat/blood, foods with moderate salt contents), which are frequently cleaned, with no stationary solids and not under excessive stress.
1.4539 (austenitic)	Used with corrosive foods (e.g. hot brine with solids that act as crevice forms, stagnant and slow moving salty foods).
1.4462 (duplex)	Used with corrosive foods (e.g. hot brine with solids, stagnant and slow moving salty foods). Higher strength than austenitics. Good resistance to stress corrosion cracking in salt solutions at elevated temperatures.
6%Mo. types (austenitic)	Used with corrosive foods (e.g. hot brine with solids, which act as crevice formers, stagnant and slow moving salty foods). Good resistance to stress corrosion cracking in salt solutions at elevated temperatures. Used in steam heating and hot work circuits, hot water boilers, etc

304SS				
42 Match 9.6 01-04 22:38				
Time 2.0				
El	Min	%	Max	+/-
Fe	66.35	71.80	74.00	0.37
Cr	18.00	18.05	20.00	0.16
Ni	8.00	8.36	10.50	0.16
Mn	0.00	1.22	2.00	0.09
Cu	0.00	0.17	0.50	0.03
Mo	0.00	0.13	0.50	0.01
Co		0.28		0.03

Spectral fingerprint matching



Identification using spectral fingerprint matching

- Identification is based on library of reference spectra
- Very selective, can differentiate samples with similar Grade ID
- Works well for small samples down to 1mm (0.04") in size
- Works for all types of materials, including metals, plastics and ceramics
- More complicated to use than standard alloy grade ID

Creating a spectral fingerprint library

1



Create food contact material library

- Create a spectral fingerprint library of all food contact devices and components
- This library contains XRF spectra of these materials

This stage takes significant time to set up and collect data for; but once it's done, sourcing a contaminant is fast. And, the library can be added to whenever needed.

2

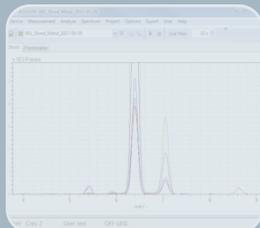


Measure Food Contaminant

- Collect and clean the contaminant sample
- Measure contaminant sample to acquire XRF spectrum

This stage takes just a few minutes at most.

3



Identify Food Contaminant

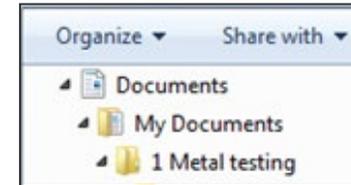
- Compare library spectra with contaminant spectra
- Find best match to determine source of the contamination

This stage can take up to 5 minutes; but, it significantly decreases the time needed to determine if a metal contaminant is from the production line or not; and, if so, what the source is.

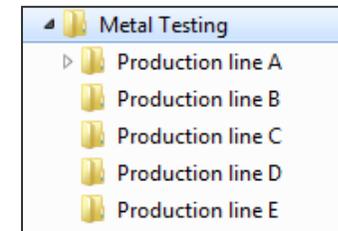
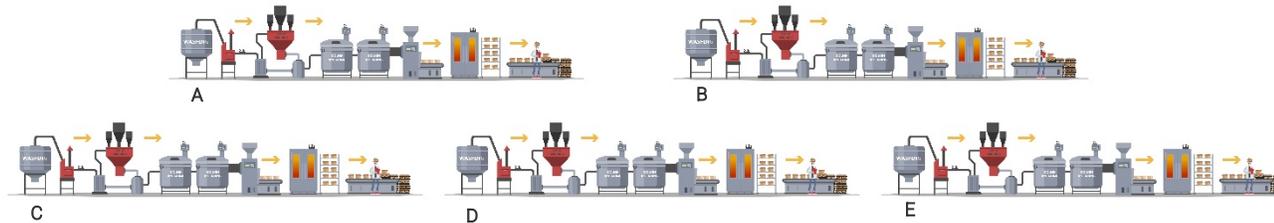
Best practices in setting up a spectral fingerprint library system



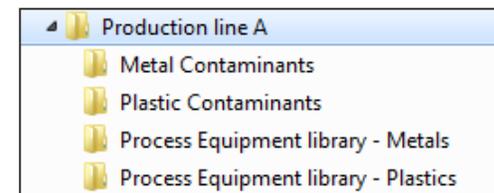
1. Create a main folder for all of the test data



2. Create a sub folder for each of the production lines

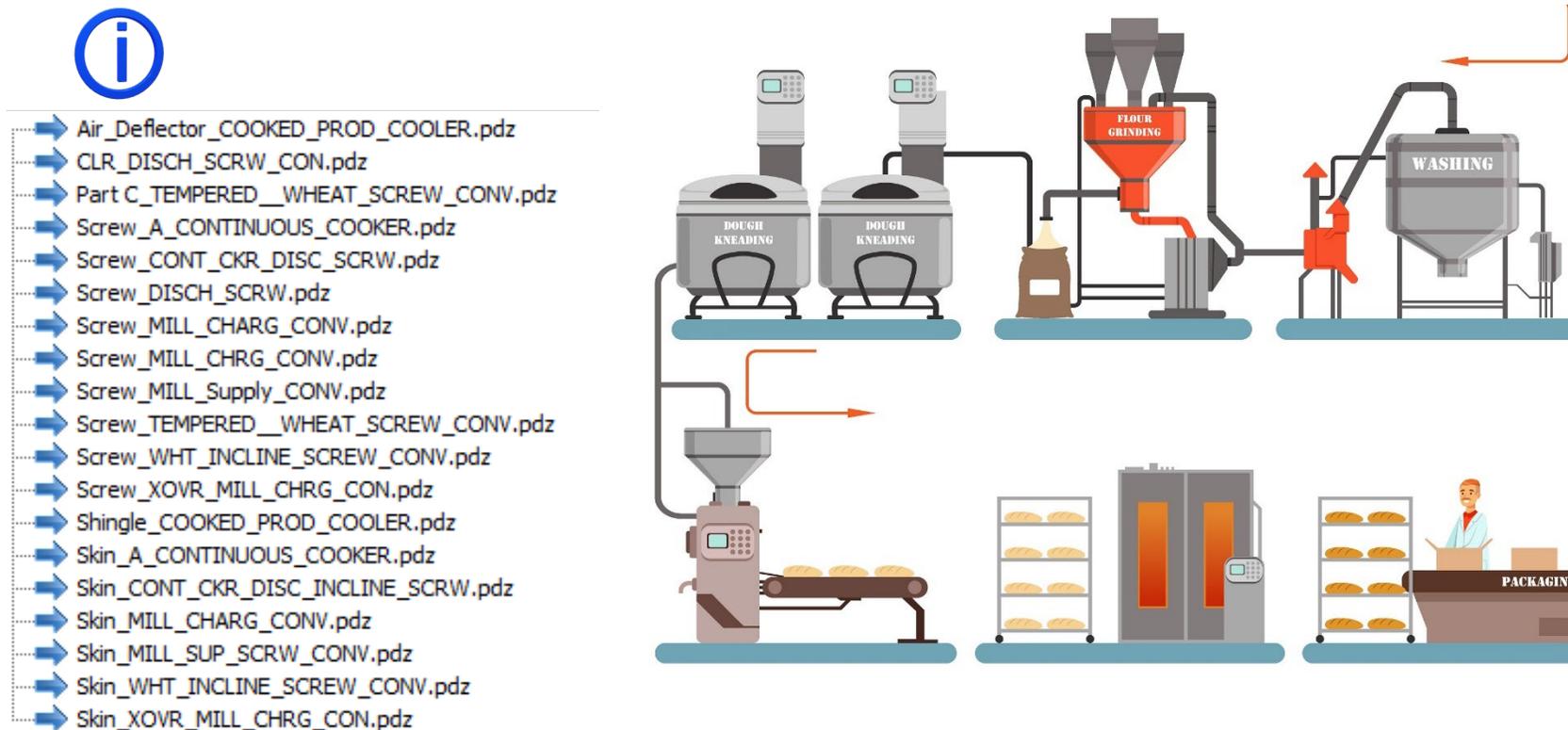


3. For each production line folder, create subfolders for both process equipment libraries and for physical contaminant tests



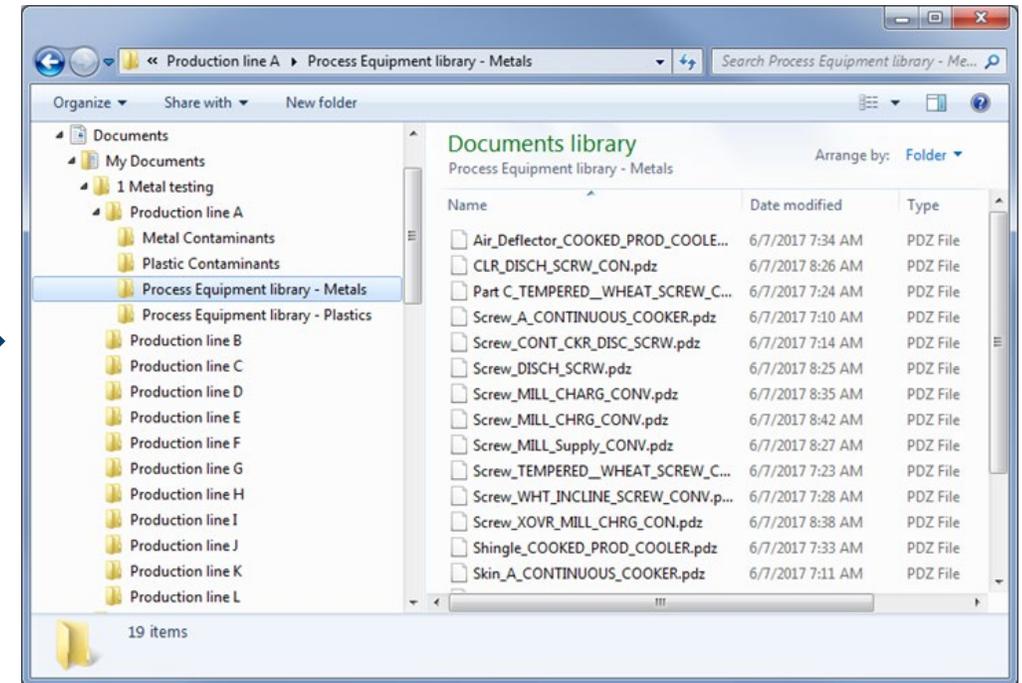
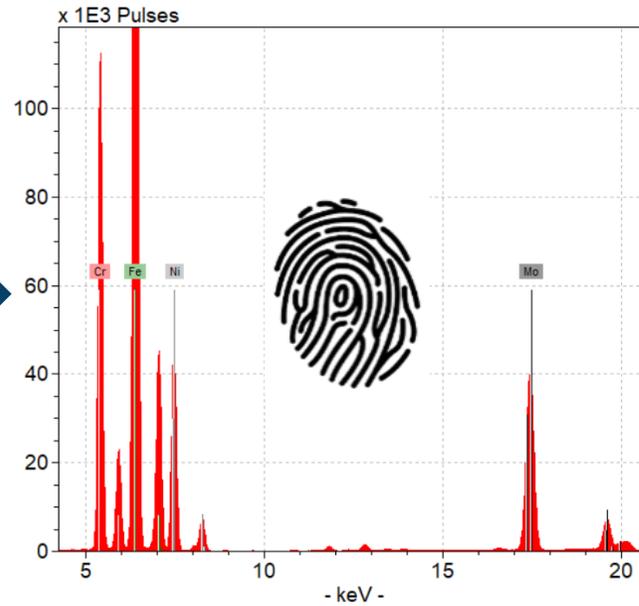
Best practices in setting up a spectral fingerprint library system

4. Determine a naming convention for each piece of process equipment tested to store its spectral fingerprint



Best practices in setting up a spectral fingerprint library system

5. Test each piece of process equipment and store its spectral fingerprint in the correct folder



Best practices in measuring a food contaminant

1



Create food contact material library

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- This library contains XRF spectra of these materials

This step takes significant time to set up and collect data for; but once it's done, sourcing a contaminant is fast. And, the library can be added to whenever needed.

2

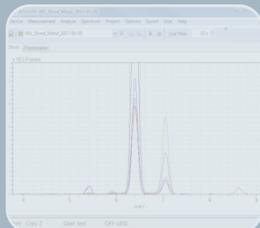


Measure Food Contaminant

- Collect and clean the contaminant sample
- Measure contaminant sample to acquire XRF spectrum

This step takes just a few minutes at most.

3



Identify Food Contaminant

- Compare library spectra with contaminant spectra
- Find best match to determine source of the contamination

This step can take up to 5 minutes; but, it significantly decreases the time needed to determine if a metal contaminant is from the production line or not; and, if so, what the source is.

Best practices in testing a small food contaminant

- Isolate and clean the contaminant
- For small samples, use of XRF sample cups is recommended as it makes positioning and storing the sample easy
- Use the camera view to ensure optimal sample positioning
- Use of desktop stand is recommended for accuracy, ease-of-use and safety



Small Piece Foreign Body Identification Test

Best practice procedure for handheld XRF to test small samples:

1. Prepare the sample using a thin Prolene® or Ultralene™ XRF film.
2. Place contaminant sample on a sample cup.
3. Place sample cup on the desktop stand.
4. Position the cup with sample at the center of the XRF window.

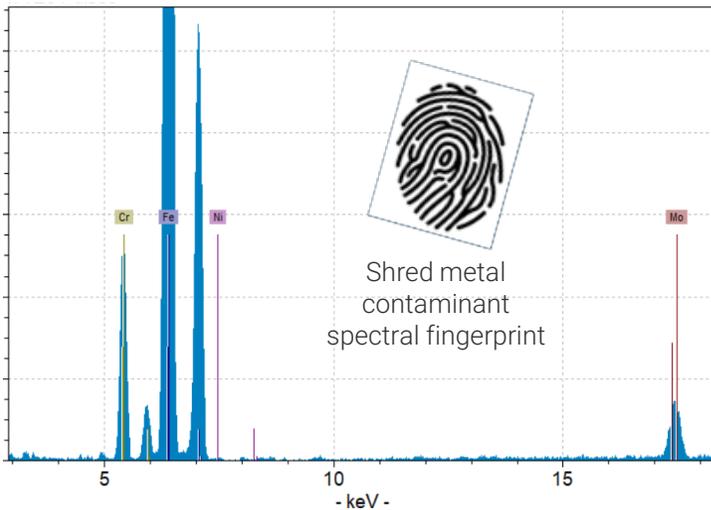


06 Matching contaminants with a spectral fingerprint library and Artax PC software

Webinar: Quickly Identify and Source Foreign Material Contaminants Found in Food Products with Handheld XRF

Matching a contaminant with the library and Artax PC software

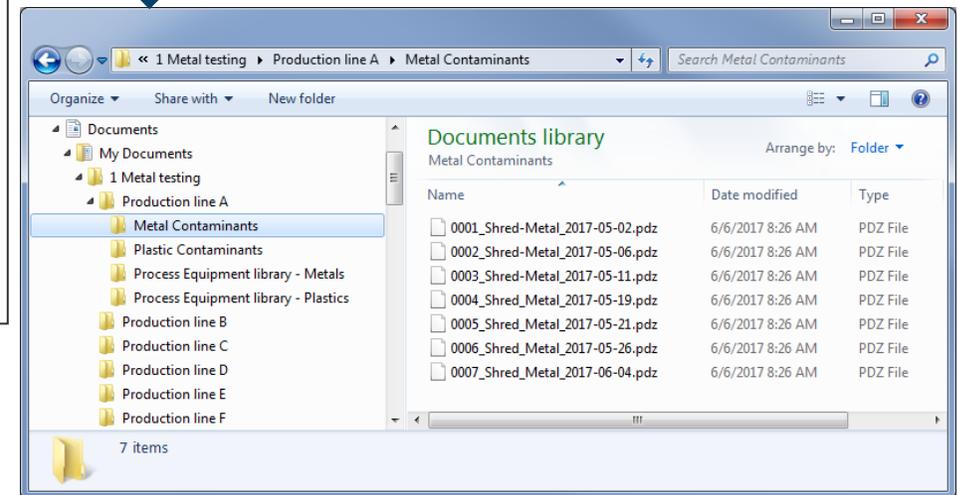
- Transfer all the contaminant spectra from instrument into the relevant folder



Documents library
Metal Contaminants

Arrange by: Folder

Name	Date modified	Type
0001_Shred-Metal_2017-05-02.pdz	6/6/2017 8:26 AM	PDZ File
0002_Shred-Metal_2017-05-06.pdz	6/6/2017 8:26 AM	PDZ File
0003_Shred-Metal_2017-05-11.pdz	6/6/2017 8:26 AM	PDZ File
0004_Shred_Metal_2017-05-19.pdz	6/6/2017 8:26 AM	PDZ File
0005_Shred_Metal_2017-05-21.pdz	6/6/2017 8:26 AM	PDZ File
0006_Shred_Metal_2017-05-26.pdz	6/6/2017 8:26 AM	PDZ File
0007_Shred_Metal_2017-06-04.pdz	6/6/2017 8:26 AM	PDZ File



Matching a contaminant with the library and Artax PC software

1



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- This library contains XRF spectra of these materials

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2

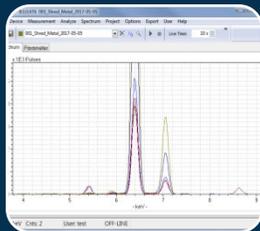


Measure Food Contaminant

- Collect and clean the contaminant sample
- Measure contaminant sample to acquire XRF spectrum

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3



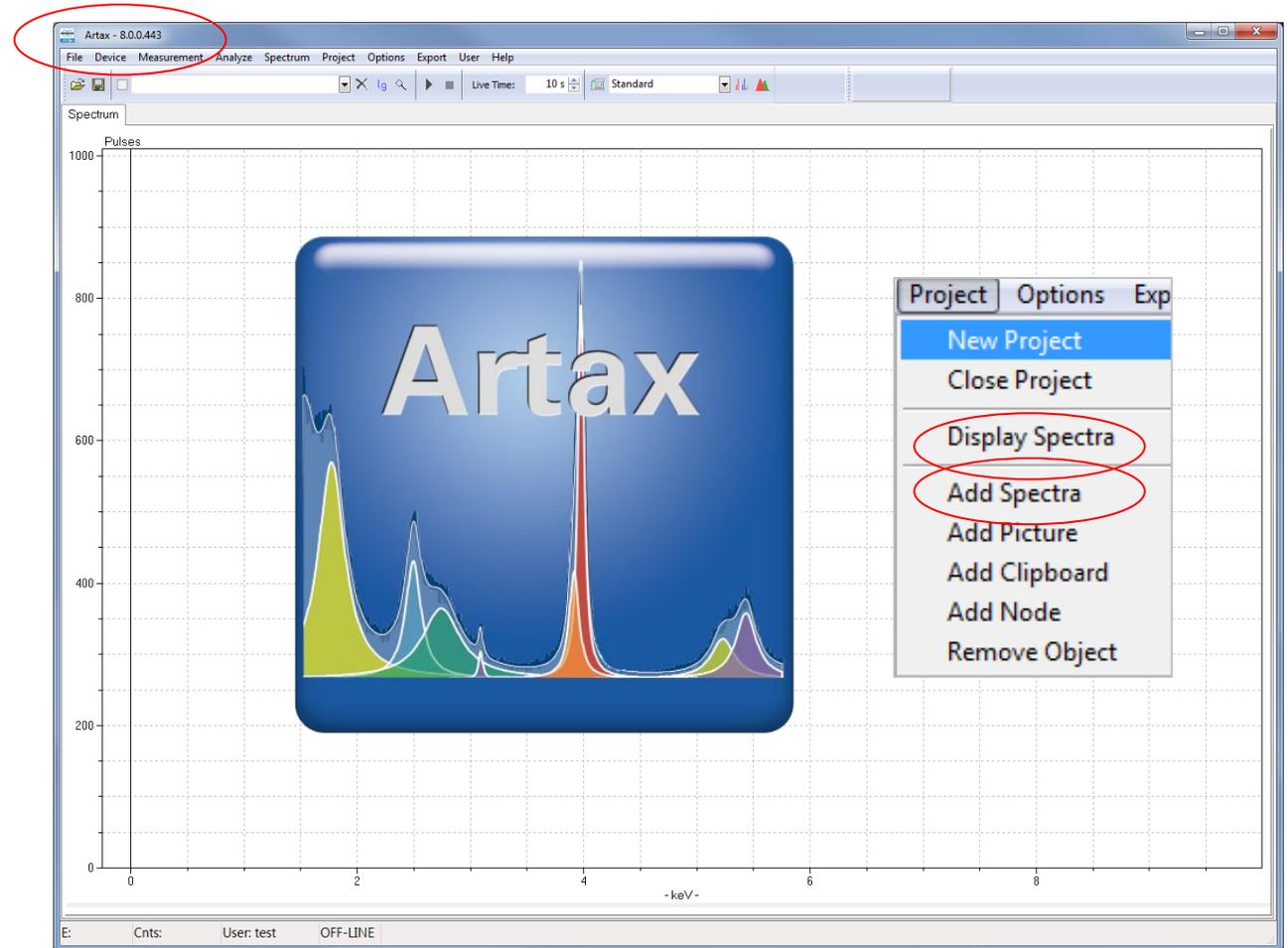
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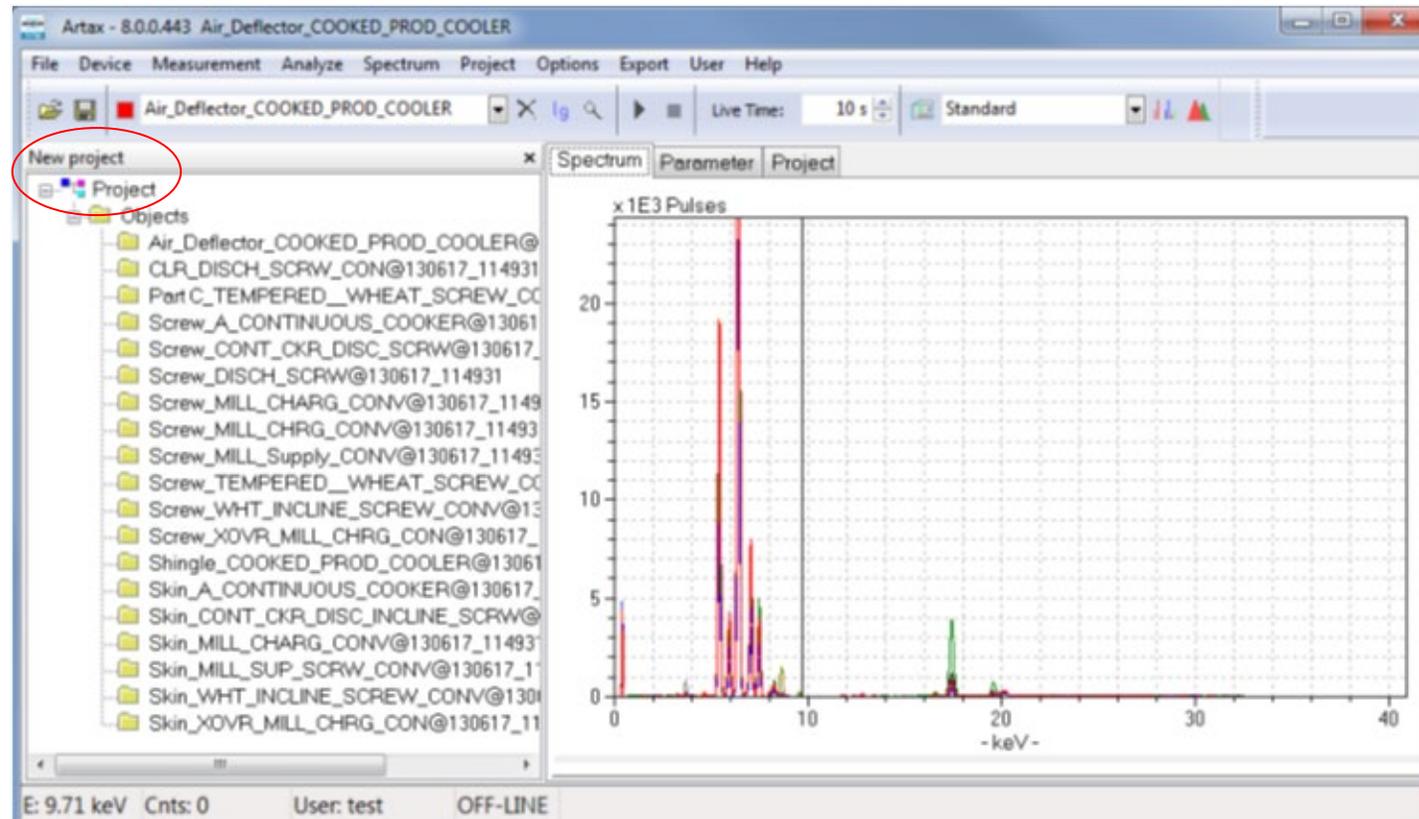
Matching a contaminant with the library and Artax PC software

- Spectral fingerprinting matching for complex situations is performed with Artax PC software.
- Artax is an advanced spectral viewing, matching and data analysis software package.
- Artax is used to both store and link information; it makes the management of large data sets easy.

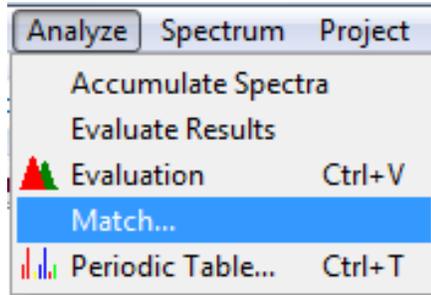


Matching a contaminant with the library and Artax PC software

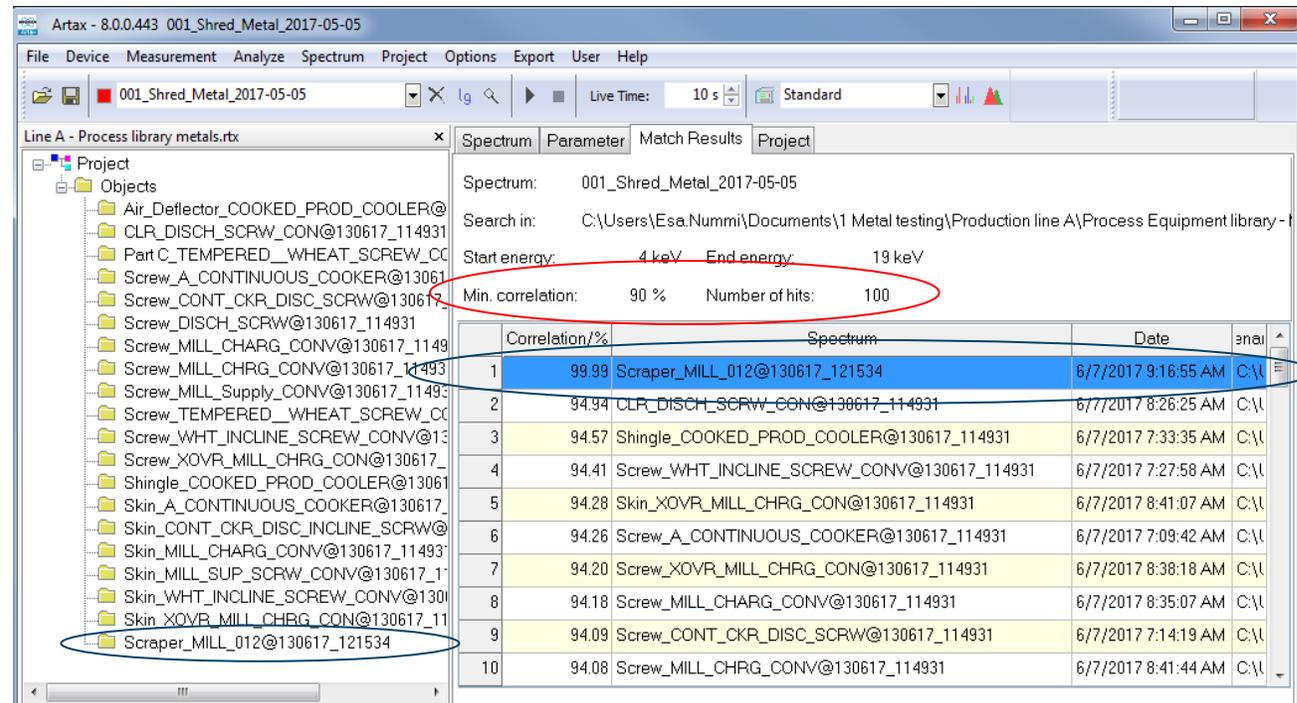
- After the spectral fingerprint folders for a given production line are populated with data, those folders are transferred into an Artax "Project" folder to be used as a library reference set for a found physical contaminant.



Matching a contaminant with the library and Artax PC software



- Fingerprint spectra is then analyzed using the Artax “Match” program to find the most likely source of the contaminant.
- In the case below, Artax found 100 “hits” with a correlation of 90% or better.
- One Artax Match “hit” had a correlation of 99.99%



Artax - 8.0.0.443 001_Shred_Metal_2017-05-05

File Device Measurement Analyze Spectrum Project Options Export User Help

001_Shred_Metal_2017-05-05 | Live Time: 10 s | Standard

Line A - Process library metals.rtx

Project

- Objects
 - Air_Deflector_COOKED_PROD_COOLER@130617_114931
 - CLR_DISCH_SCRW_CONV@130617_114931
 - Part_C_TEMPERED_WHEAT_SCREW_CONV@130617_114931
 - Screw_A_CONTINUOUS_COOKER@130617_114931
 - Screw_CONT_CKR_DISC_SCRW@130617_114931
 - Screw_DISCH_SCRW@130617_114931
 - Screw_MILL_CHARG_CONV@130617_114931
 - Screw_MILL_CHRG_CONV@130617_114931
 - Screw_MILL_Supply_CONV@130617_114931
 - Screw_TEMPERED_WHEAT_SCREW_CONV@130617_114931
 - Screw_WHT_INCLINE_SCREW_CONV@130617_114931
 - Screw_XOVR_MILL_CHRG_CONV@130617_114931
 - Shingle_COOKED_PROD_COOLER@130617_114931
 - Skin_A_CONTINUOUS_COOKER@130617_114931
 - Skin_CONT_CKR_DISC_INCLINE_SCRW@130617_114931
 - Skin_MILL_CHARG_CONV@130617_114931
 - Skin_MILL_SUP_SCRW_CONV@130617_114931
 - Skin_WHT_INCLINE_SCREW_CONV@130617_114931
 - Skin_XOVR_MILL_CHRG_CONV@130617_114931
 - Scrapers_MILL_012@130617_121534

Spectrum: 001_Shred_Metal_2017-05-05

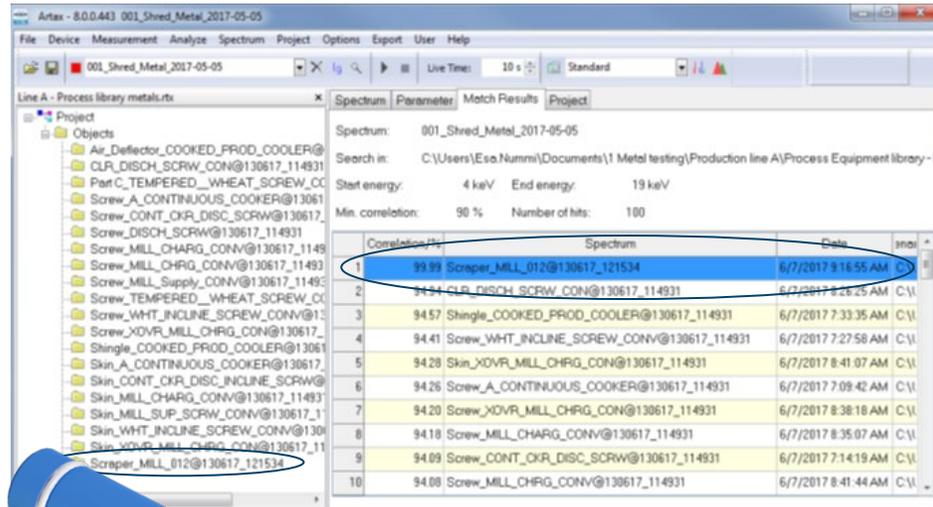
Search in: C:\Users\Esa.Nummi\Documents\1 Metal testing\Production line A\Process Equipment library - f

Start energy: 4 keV End energy: 19 keV

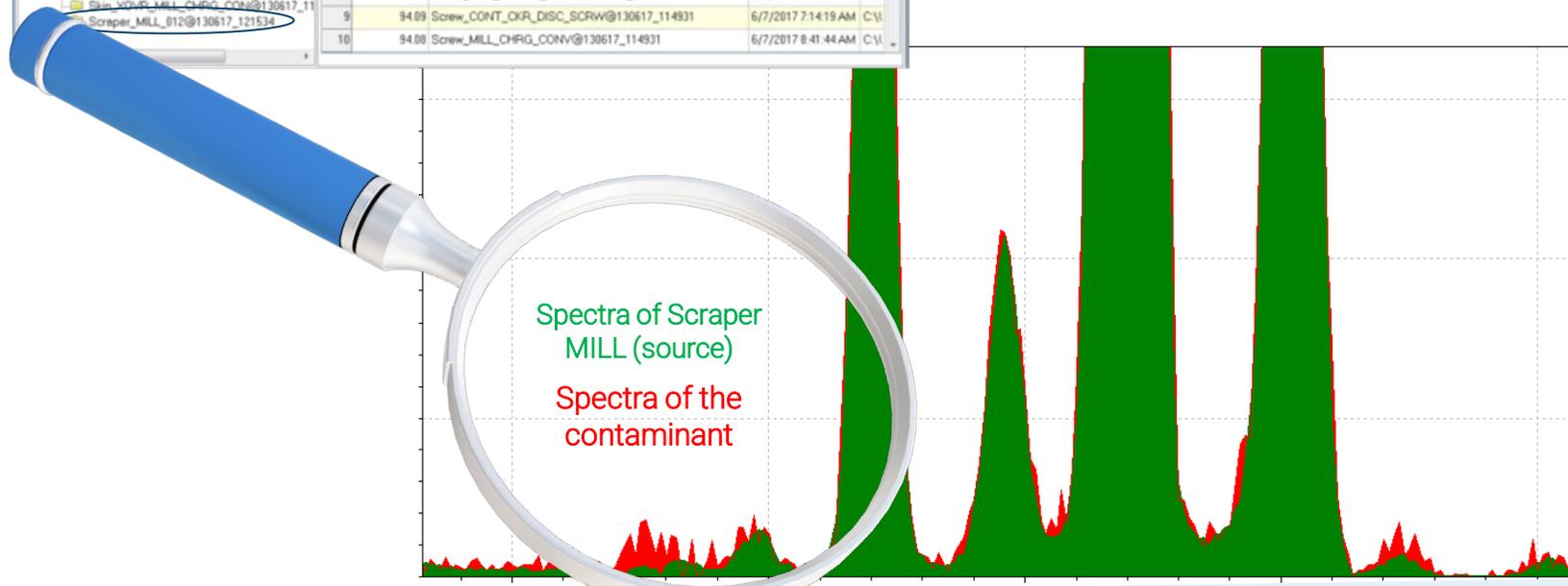
Min. correlation: 90 % Number of hits: 100

	Correlation/%	Spectrum	Date	anal
1	99.99	Scrapers_MILL_012@130617_121534	6/7/2017 9:16:55 AM	C:\
2	94.94	CLR_DISCH_SCRW_CONV@130617_114931	6/7/2017 8:26:25 AM	C:\
3	94.57	Shingle_COOKED_PROD_COOLER@130617_114931	6/7/2017 7:33:35 AM	C:\
4	94.41	Screw_WHT_INCLINE_SCREW_CONV@130617_114931	6/7/2017 7:27:58 AM	C:\
5	94.28	Skin_XOVR_MILL_CHRG_CONV@130617_114931	6/7/2017 8:41:07 AM	C:\
6	94.26	Screw_A_CONTINUOUS_COOKER@130617_114931	6/7/2017 7:09:42 AM	C:\
7	94.20	Screw_XOVR_MILL_CHRG_CONV@130617_114931	6/7/2017 8:38:18 AM	C:\
8	94.18	Screw_MILL_CHARG_CONV@130617_114931	6/7/2017 8:35:07 AM	C:\
9	94.09	Screw_CONT_CKR_DISC_SCRW@130617_114931	6/7/2017 7:14:19 AM	C:\
10	94.08	Screw_MILL_CHRG_CONV@130617_114931	6/7/2017 8:41:44 AM	C:\

Matching a contaminant with the library and Artax PC software

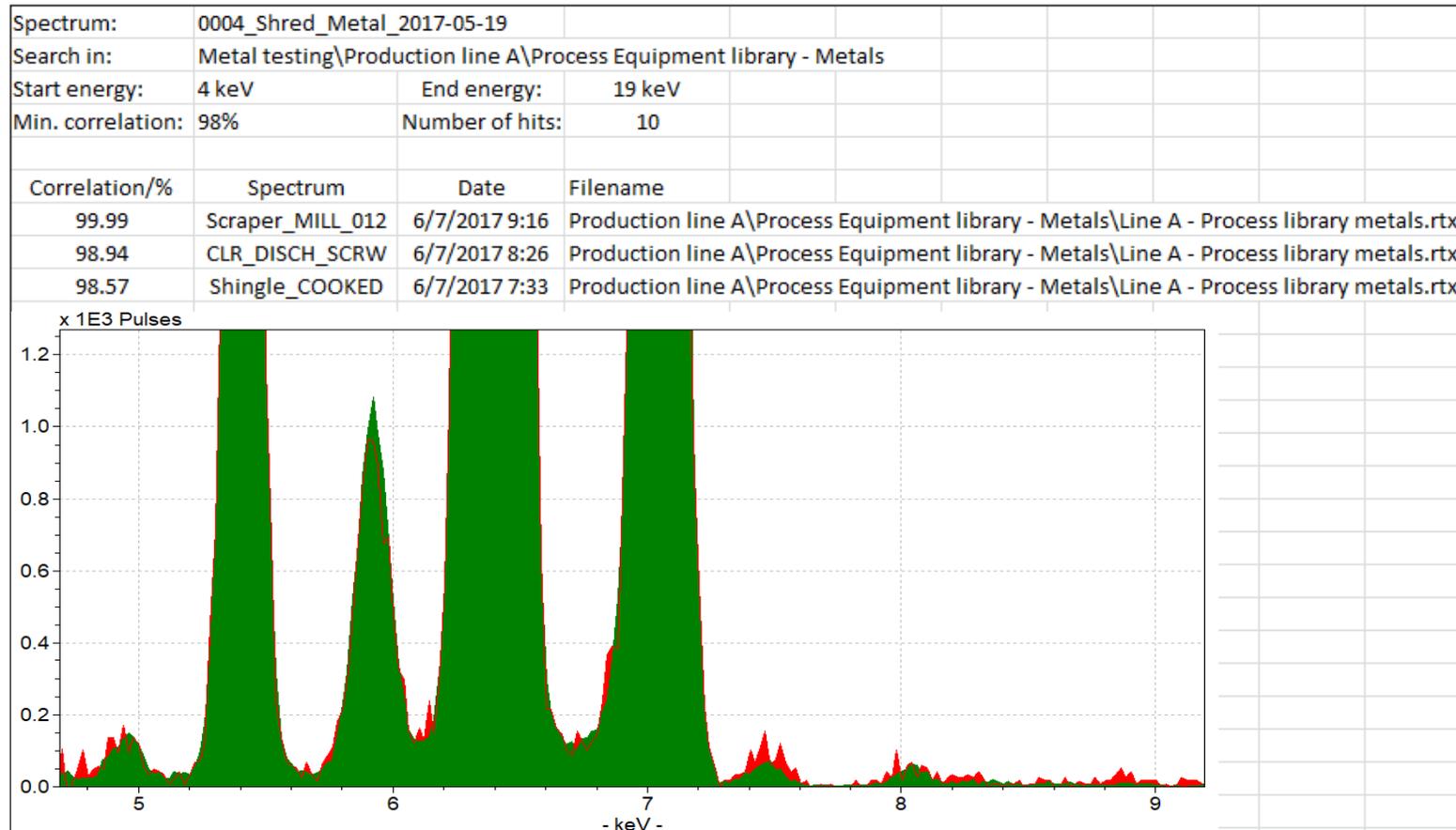


- Since identifying the source of a physical contaminant is critical, it is best practice to confirm Artax spectral matching results with a visual comparison.
- This is done by first overlaying the contaminant spectra on top of the closest matching library spectra.



Matching a contaminant with the library and Artax PC software

- Finally, it is straightforward to copy-paste Artax spectral match information to Windows programs for reporting purposes.



05 Food Contaminant characterization with micro-XRF technique

Webinar: Quickly Identify and Source Foreign Material
Contaminants Found in Food Products with Handheld XRF

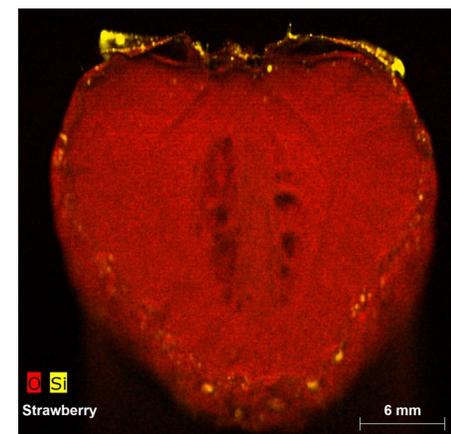
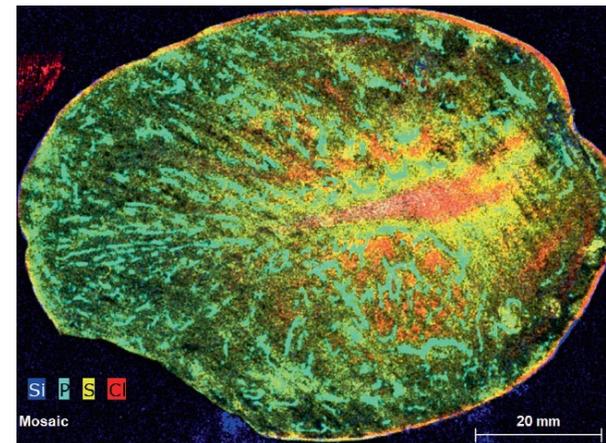
Characterizing pieces less than 1 mm in size

- Bruker's handheld XRF can measure pieces as small as 1 mm in size
- Bruker's benchtop M1 MISTRAL micro-XRF can measure pieces as small as 100 μm in size
- Bruker's laboratory M4 TORNADO micro-XRF can measure pieces as small as 20 μm in size

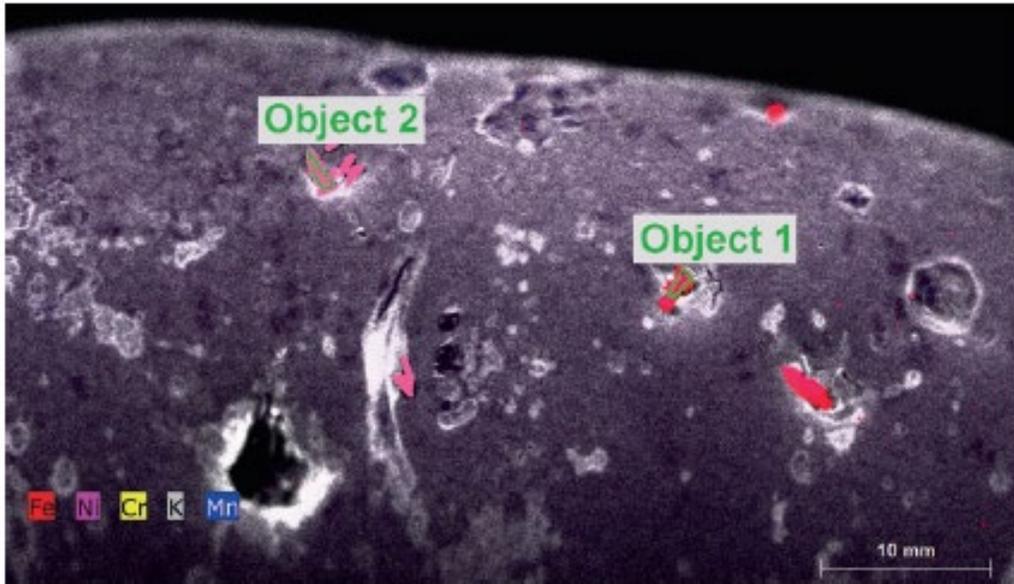


M4 TORNADO Plus Micro-XRF analyzer

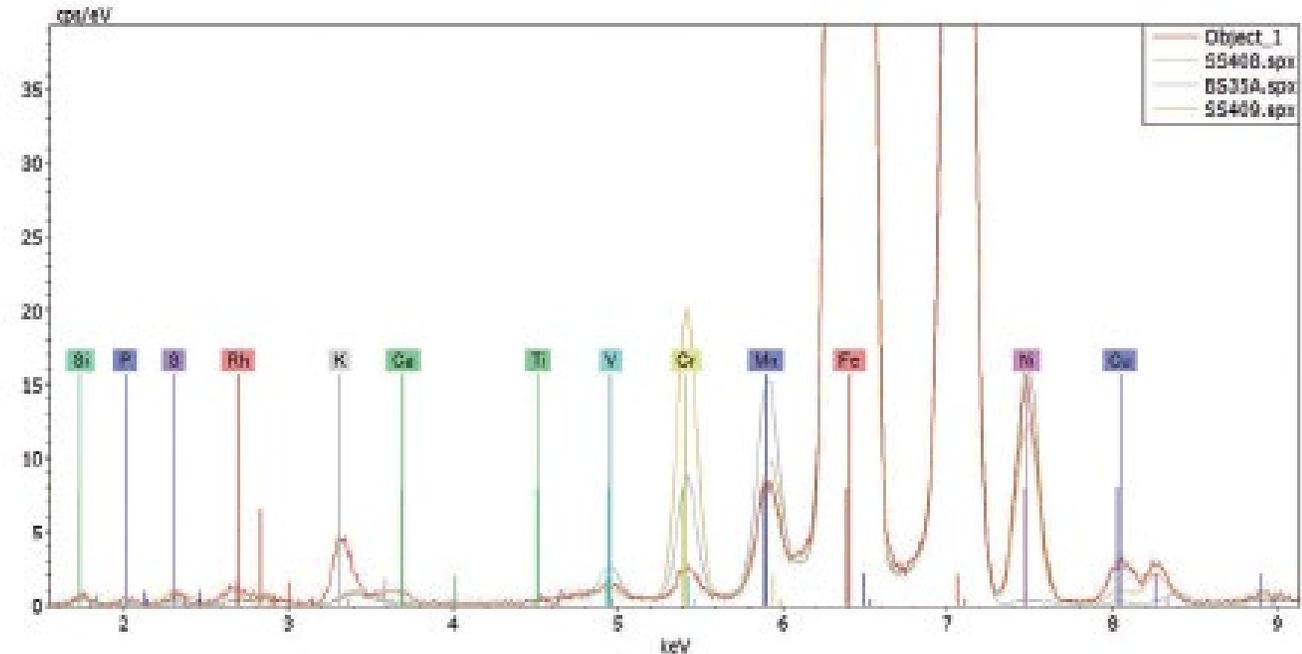
- Advanced Micro-XRF with the ability to record spectra, line scans and maps of the complete element range starting from carbon
- Micro-focus X-ray source with polycapillary lens <math>< 20 \mu\text{m}</math> spot size and high excitation intensity
- Measure solids, particles and liquids
- Fast XYZ stage for “on-the-fly” element distribution analysis with 20 x 16 cm range and 4 μm resolution
- Vacuum sample chamber with adjustable pressure
- Helium purge allows light element measurement of wet and fresh organic samples
- Dual optical microscopes for sample view and positioning with
- Advanced mapping and image processing features



M4 TORNADO Micro-XRF Elemental distribution maps



Elemental distribution map of a potato with different metal contaminants



Spectrum of Object 1 overlaid with possible alloy database matches

M4 TORNADO Micro-XRF

Metal contaminant identification



Quantification and discrimination of low-alloy steel particles

Element	Cr	Mn	Fe	Co	Ni	Cu	Nb	Mo
Reference	0.6	0.7	96.5	0	1.2	0.1	0	0.1
Isolated particle	0.6	1.2	96.3	0.6	1.1	0.1	0.2	0.1
Embedded particle	0.6	1.0	94.7	0.8	1.4	0.1	0.3	0.2

M4 TORNADO Micro-XRF

Glass fragment identification



Glass fragment



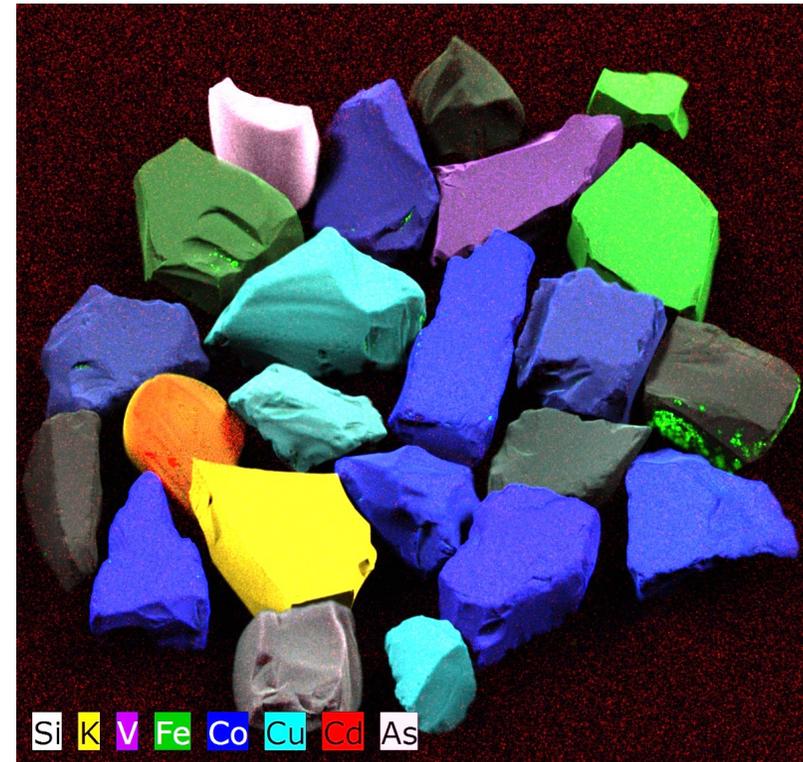
Reference jar

wt. %	Fragment	Reference jar	Analytical error
SiO ₂	71.9	71.9	± 0.5
Al ₂ O ₃	1.7	1.7	± 0.2
Na ₂ O	12.5	12.5	± 0.5
K ₂ O	1.2	1.3	± 0.1
MgO	< 0.5	< 0.5	± 0.2
CaO	12.1	11.9	± 0.2
SO ₃ tot	0.23	0.22	± 0.03
Fe ₂ O ₃ tot	0.06	0.07	± 0.01
TiO ₂	0.02	0.03	± 0.01

M4 TORNADO Micro-XRF Glass particle identification



Glass fragments optical image



Glass fragments elemental map

- At-a-glance classification of glass fragments based on selected marker elements
- Elemental maps of various glasses can be created to save in a library for comparison to found glass fragment contaminants.

07 Summary

Webinar: Quickly Identify and Source Foreign Material
Contaminants Found in Food Products with Handheld XRF

Summary

Handheld XRF can decrease the time required to ID a physical contaminant and locate its source which can result in significant cost savings by taking the following steps:

- Develop a food contact library structure for each production line
- Take measurements of all the components on that production line and populate the library
- Measure the foreign material contaminant
- Determine the most likely source of the contaminant by matching the foreign material contaminant's spectral fingerprint to those in the production line's library using Artax PC software
- If a sample is less than 1 mm in size, use a micro-XRF to identify the material
- Inspect the identified component on the production floor for wear and tear

08 Questions & Answers

Webinar: Quickly Identify and Source Foreign Material
Contaminants Found in Food Products with Handheld XRF

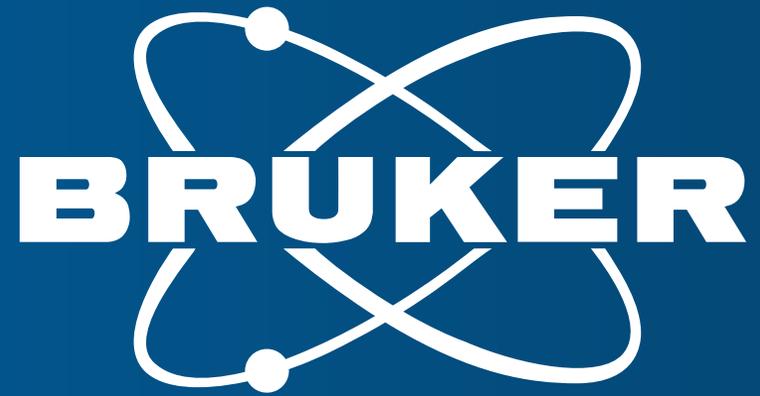
Any Questions?

Please write us: info.bna@bruker.com

Thank you!

info.bna@bruker.com

www.bruker.com



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