GROUP	D
EXHIBIT	
18	

Agency / Organization

Oxy Vinyls, LP

Title

Oxy Vinyls Tank Car Residue Sampling and Analysis Report

ANALYSIS REPORT

Background:

Twelve samples were analyzed from five different railcars at OxyChem's Avon Lake, Ohio Laboratory; Samples were received in sealed Ziploc bags. The analysis consisted of Scanning Electron Microscopy (SEM) with Energy Dispersive Spectroscopy (EDS), Thermogravimetric Analysis (TGA), and Fourier-Transform Infrared Spectroscopy (FTIR).

SEM provides visual surface images. EDS gives clues to chemical elements which might be present in relative abundance, as well as elemental mapping across an image area. EDS is blind to light elements of Hydrogen, Helium, Lithium, and Beryllium, even if they are present in the sample. The EDS assumes a flat, smooth, surface and provides only an approximate representation of elements which may be present on the top layer of a sample surface. Some elements have similar spectral lines and cannot be distinguished from each other. Accordingly, EDS is not intended to define or quantify absolute composition. Samples were analyzed, uncoated, on a Hitachi FlexSEM 1000 instrument.

Thermogravimetric Analysis (TGA) measures weight loss of a sample with a microbalance as it is heated. This quantifies evaporation or decomposition weight loss throughout the temperature range. Samples were analyzed with a TA Instruments TGA 550 from room temperature to $1000^{O}C$. The heating rate was $20^{O}C$ per minute and the gas used was air.

Fourier-Transform Infrared Spectroscopy (FTIR) measures the absorbance of light at different wavelengths. This instrument identifies molecular vibrations and provides information on the identity of a material. Since bonds for every molecule are different, a spectral "fingerprint" can be generated by recording the absorbance of light as a function of wavelength. The area of the FTIR spectrum $1400cm^{-1}$ and lower is referred to as the FTIR fingerprint region. Samples were analyzed with a KBr carrier using a Nicolet iS50 FTIR.

Observations:

SEM/EDS, TGA, and FTIR results are given in Appendixes A, B, and C respectively.

SEMs images revealed the samples were not homogeneous. EDS revealed all samples contained iron and chlorine. All but two of the samples contained significant carbon as suspected from their black appearance.

PVC weight loss by TGA is shown in comparison with weight loss curves for the railcar samples. PVC undergoes weight loss at visibly different temperatures than all railcar samples.

The FTIR peaks from 3700 to 3000 cm^{-1} for both PVC and railcar samples we believe to be associated with stretching energy of O-H bonds suggesting there may be moisture in the samples. The EDS analysis will not confirm presence of hydrogen. The peaks between 3000 and 2700 cm^{-1} are typical of energy absorbed from C-H bonds stretching some of the carbon could be aliphatic in nature. The red peaks between 1400 and 1150 cm^{-1} and between 750 and 550 cm^{-1}, we believe are C-Cl bond stretching energies as expected from PVC.

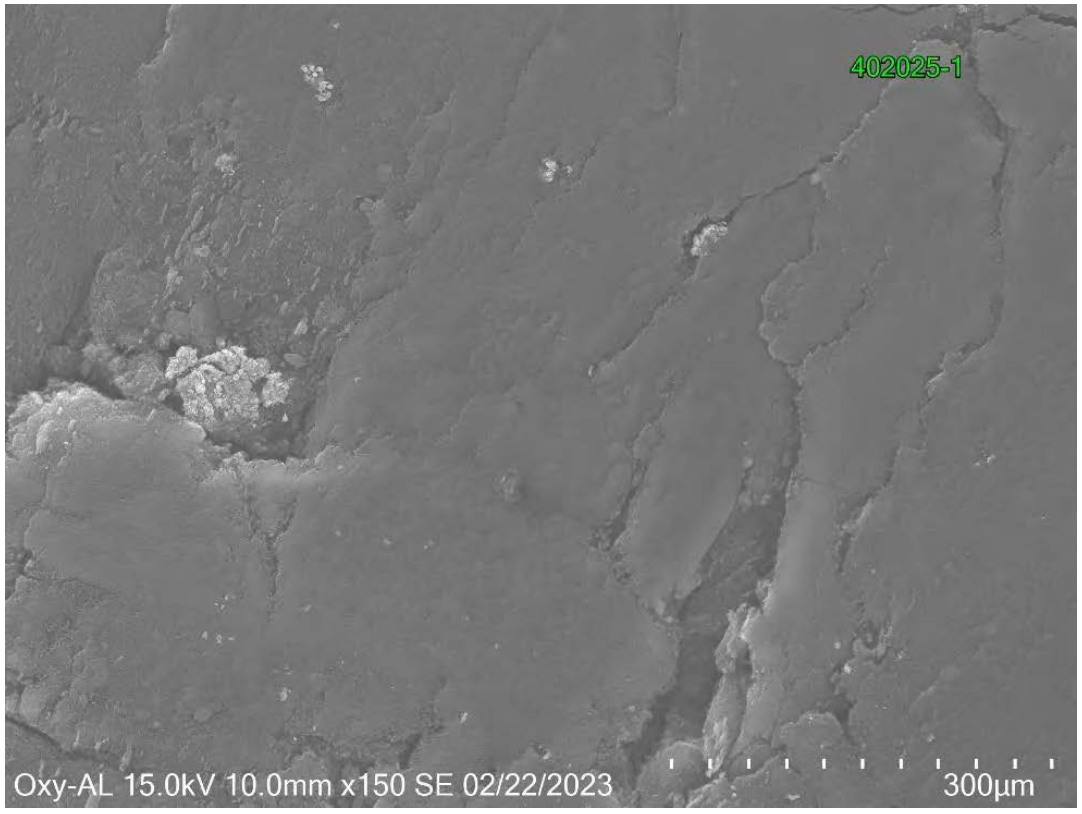
Based on these analyses, PVC was not present in any of the railcar samples.

Appendix A

Table 1. Summary of relative abundance (weight percent) of elements by EDS.

Identification	TILX 402025 #1. Dome Plate Surface	TILX 402025 #2. Dome Area Surface	GATX 095098 #1. Dome Gasket Seal	GATX 095098 #2. PSV Residue Under Plate	GATX 095098 #3. Liquid Vent on Belly & Side	GATX 095098 #4. Top Dome	OCPX 80179 #1. Dome Area Pressure Plate	OCPX 80179 #2. Dome Area Surface	OCPX 80235 #1. PSV Side	OCPX 80235 #2. Dome Plate Surface	OCPX 80370 #1. Dome Pressure Plate	OCPX 80370 #2. Dome Surface Area
Description	Pressure Plate Underside	Tank Car Riser to Pressure Plate	Gasket Seal (No Gasket Found)	Exterior of PSV Spring Cover	Residue at Liquid Vent on Belly & Side	Top of Pressure Plate Near Angle Valve	Pressure Plate Underside	Tank Car Riser to Pressure Plate	Exterior of PSV Spring Cover	Tank Car Riser to Pressure Plate	Pressure Plate Underside	Tank Car Riser to Pressure Plate
Carbon	96	39	65	81		50	88	35	17		83	34
Iron	1	37	18	8	6	31	3	41	53	76	7	42
Oxygen		14	5	5	13	10	4	14	20	19	5	16
Copper					66							
Chlorine	3	1.8	9.7	5.2	10.9	7.5	4.2	1.3	2.5	1.4	4.1	5.3
Silicon		4						3	3	1		
Calcium		1			1			2	2	1		1
Aluminum		1	1					2	1			
Titanium		1							2			
Magnesium								1	1			
Bromine										1		
Manganese					1							
Sodium		1										
Major Components	Carbon	Carbon, Iron oxide	Carbon	Carbon	Copper oxide	Carbon, Iron Oxide	Carbon	Iron oxide, Carbon	Iron oxide, Carbon	Iron oxide	Carbon	Carbon, Iron Oxide
Likely Minor Components	Iron chloride	NaCl, $CaCl_2$, and maybe iron chloride	Iron chloride and aluminum oxide	Iron chloride	Copper chloride and iron chloride	Iron chloride	Iron chloride	$CaCl_2$, $MgCl_2$, SiO_2, Al_2O_3, and maybe iron chloride	$CaCl_2$ and maybe $MgCl_2$ and iron chloride	$CaCl_2$ and maybe iron chloride	Iron chloride	Iron chloride

Figure 1. SEM and EDS of TILX 402025 #1. Dome Plate Surface.



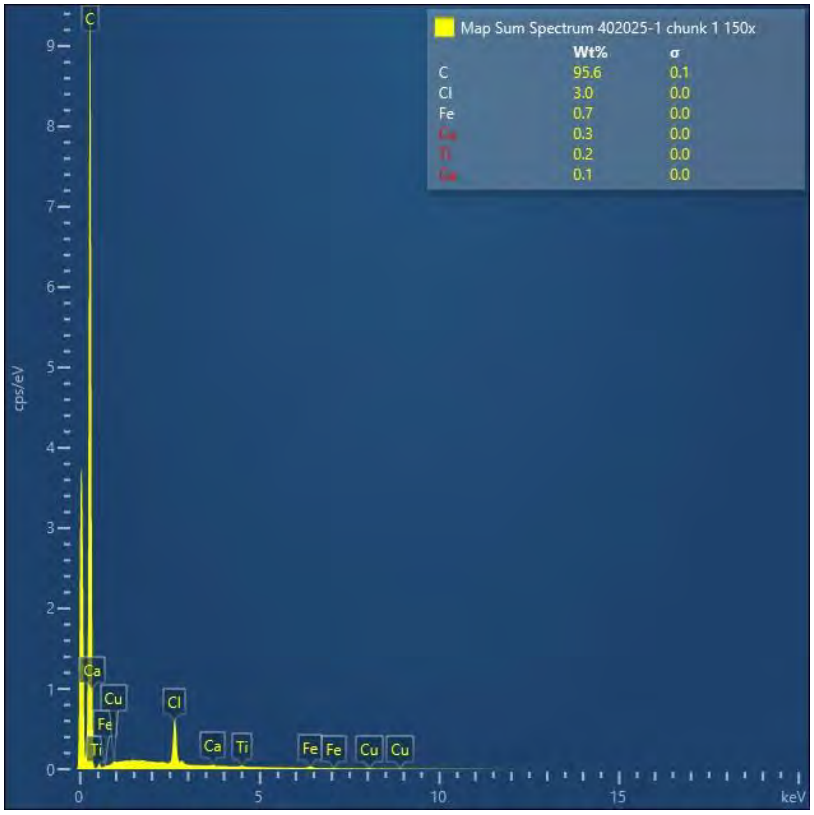


Figure 2. SEM and EDS of TILX 402025 #2. Dome Area Surface.

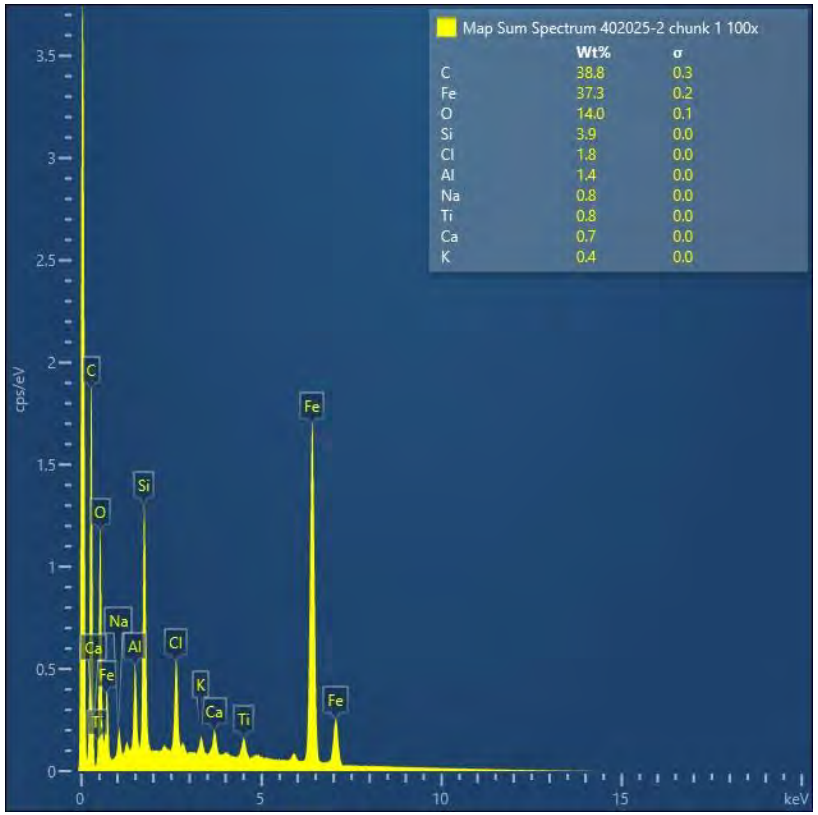
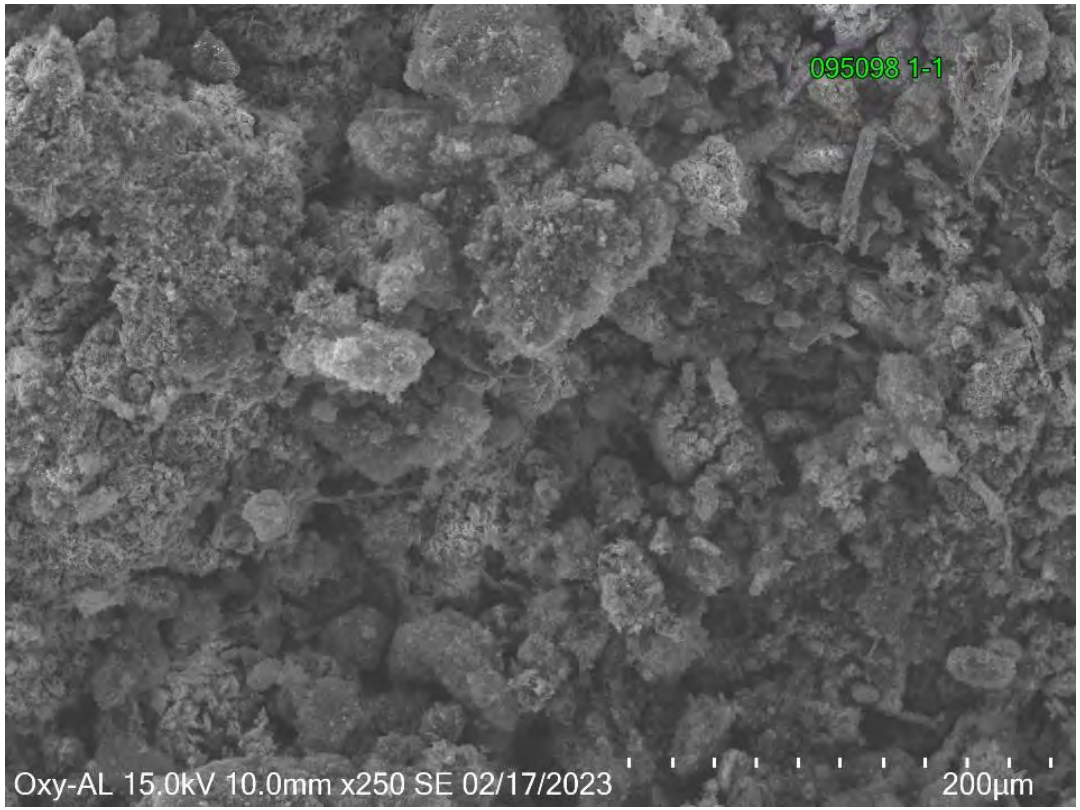


Figure 3. SEM and EDS of GATX 095098 #1. Dome Gasket Seal.



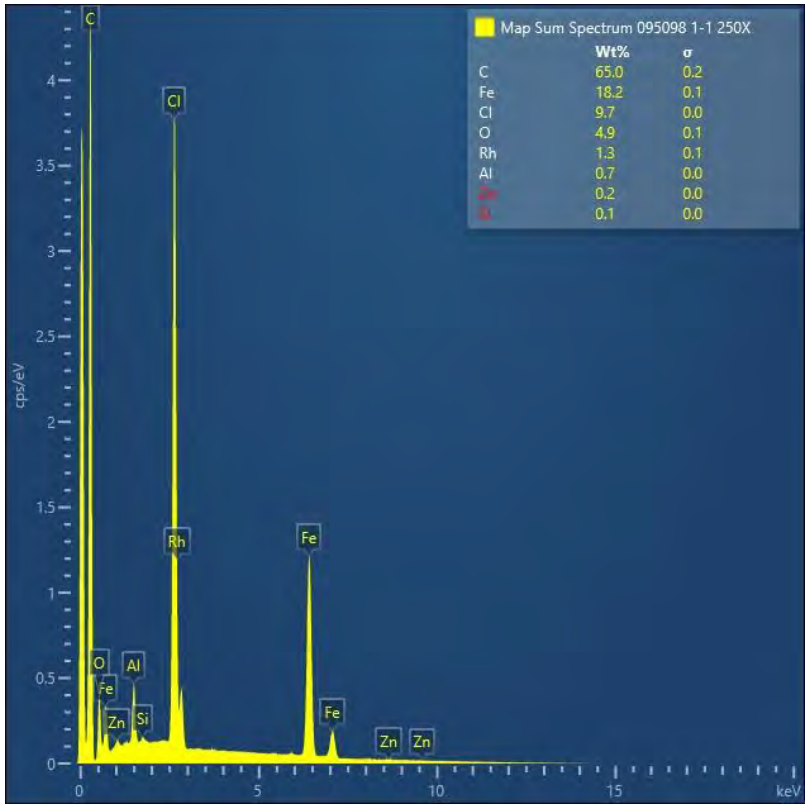
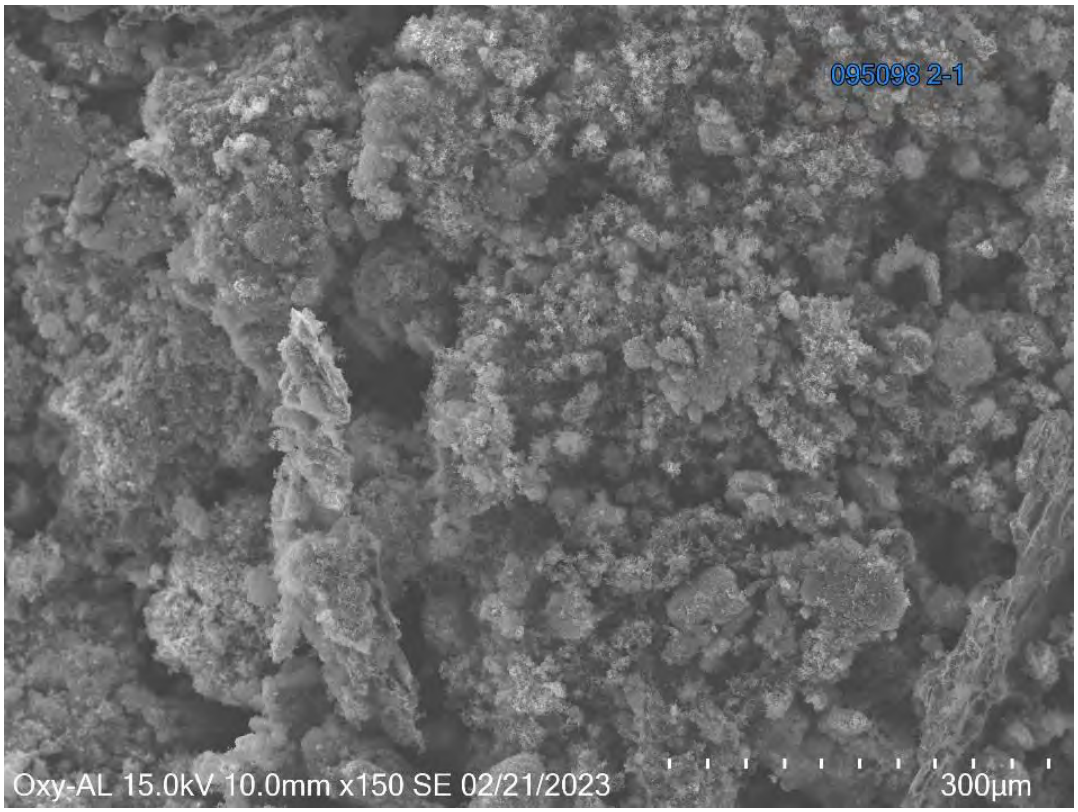


Figure 4. SEM and EDS of GATX 095098 #2. PSV Residue Under Plate.



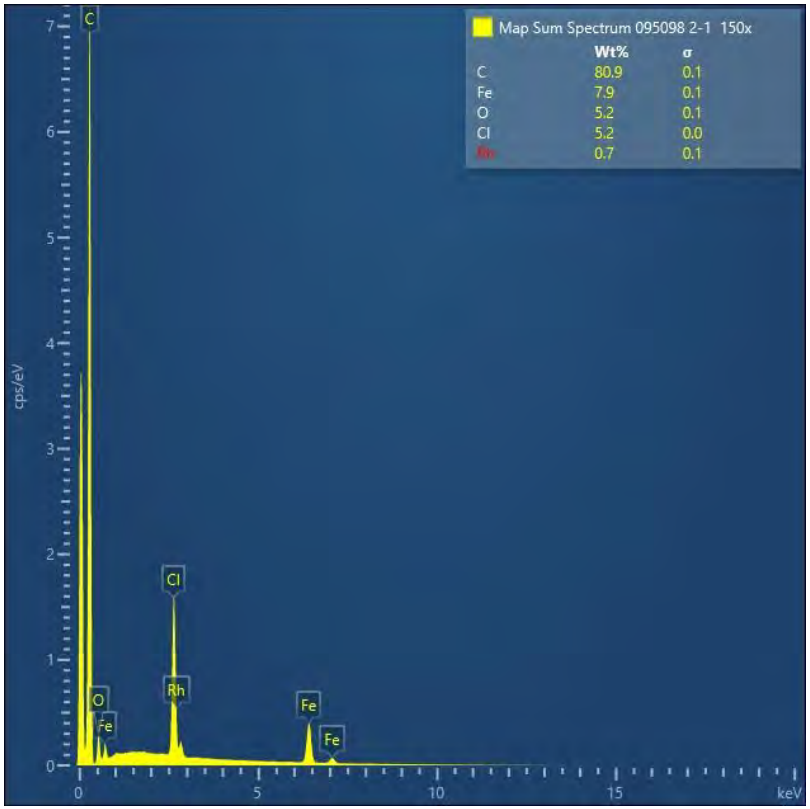
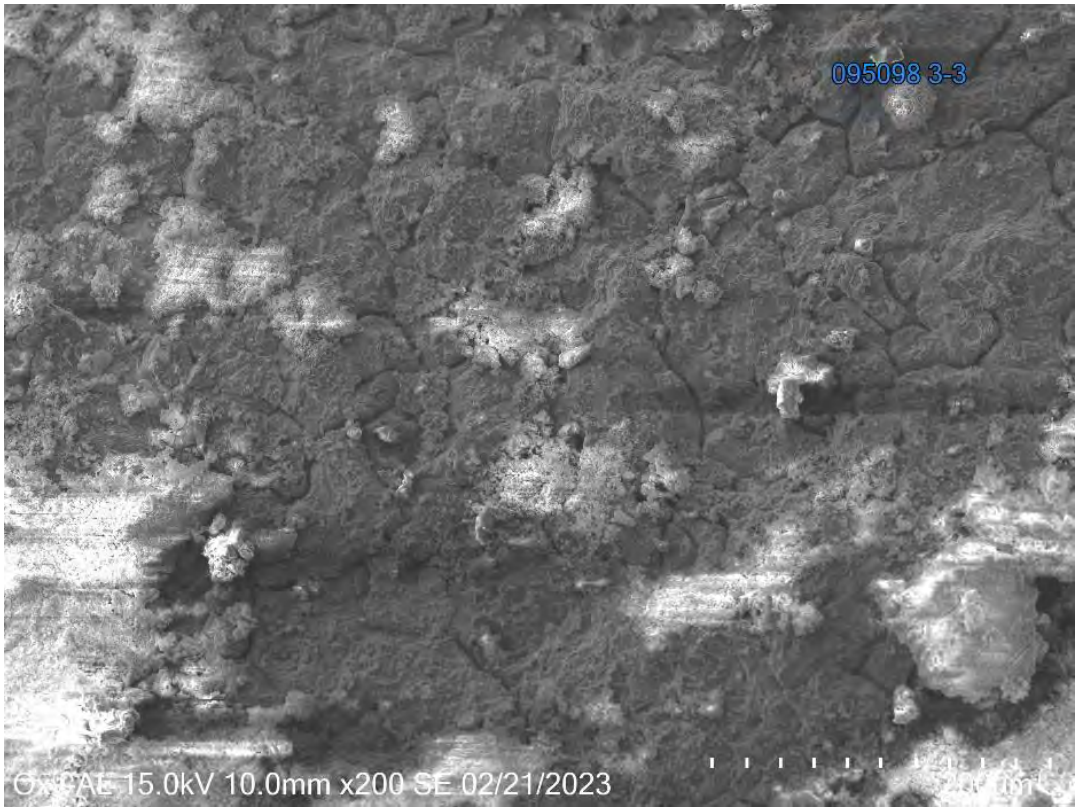


Figure 5. SEM and EDS of GATX 095098 #3. Liquid Vent on Belly & Side.



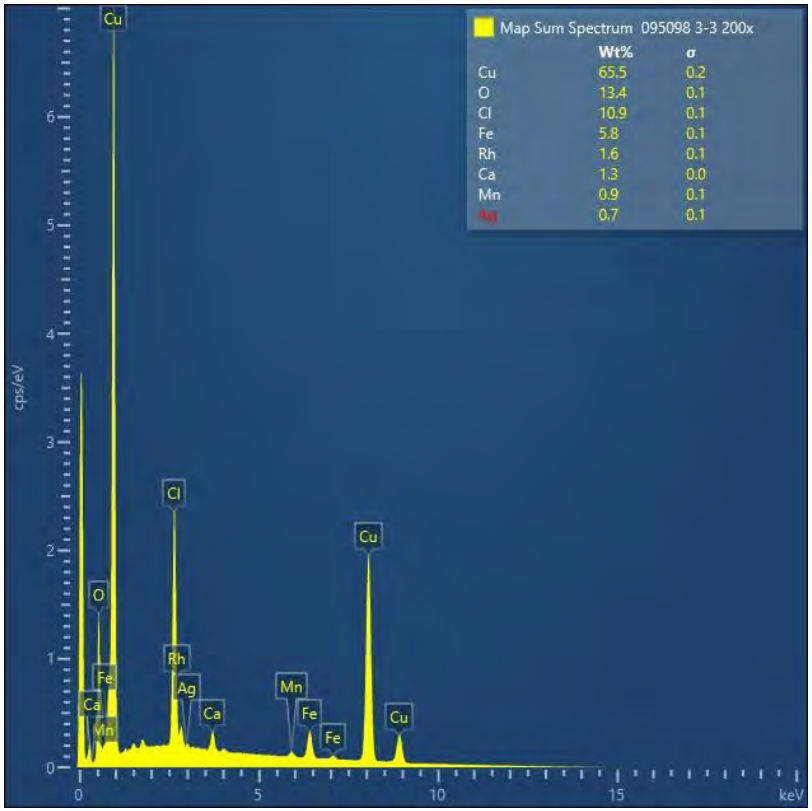
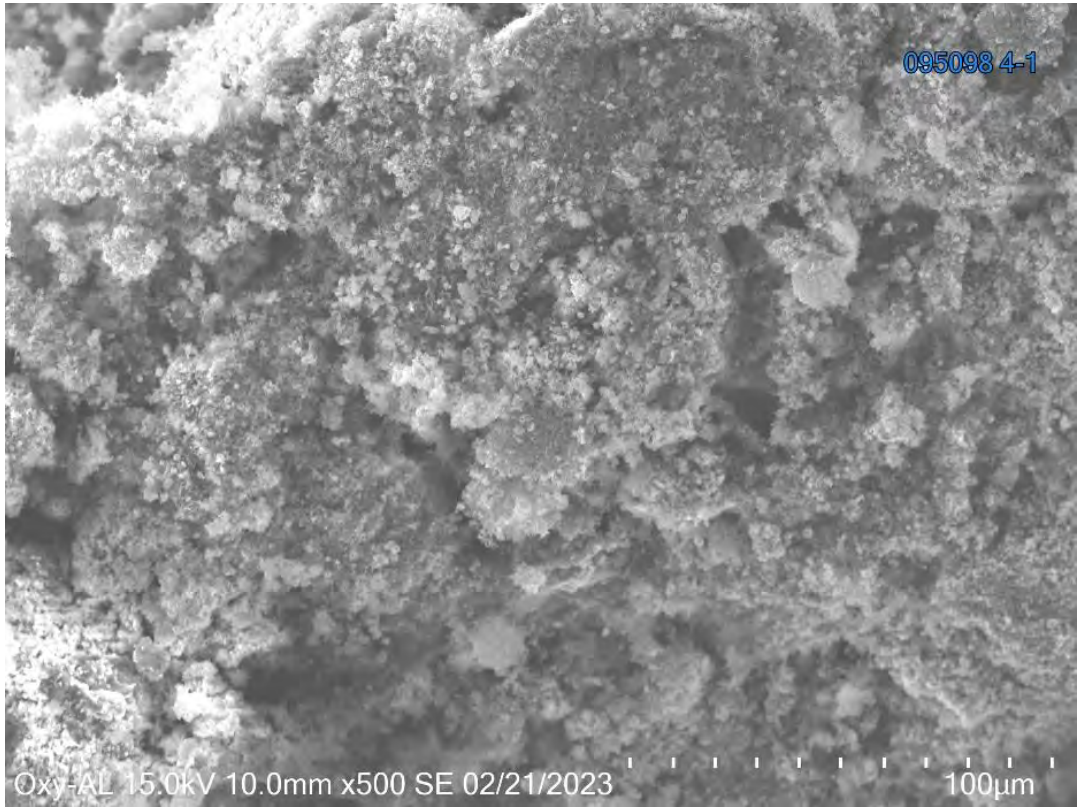


Figure 6. SEM and EDS of GATX 095098 #4. Top Dome.



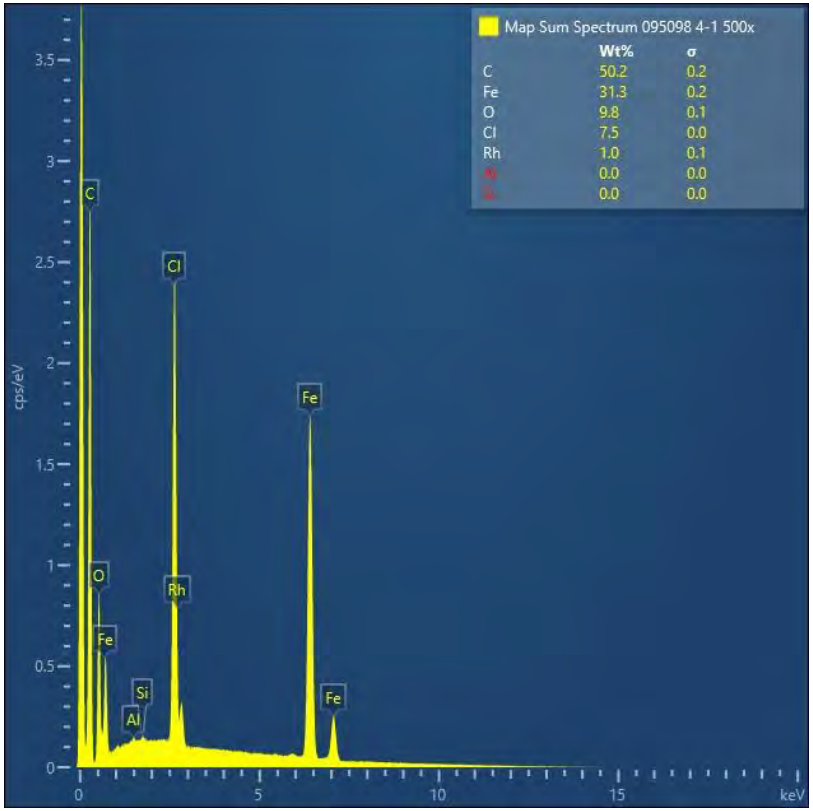
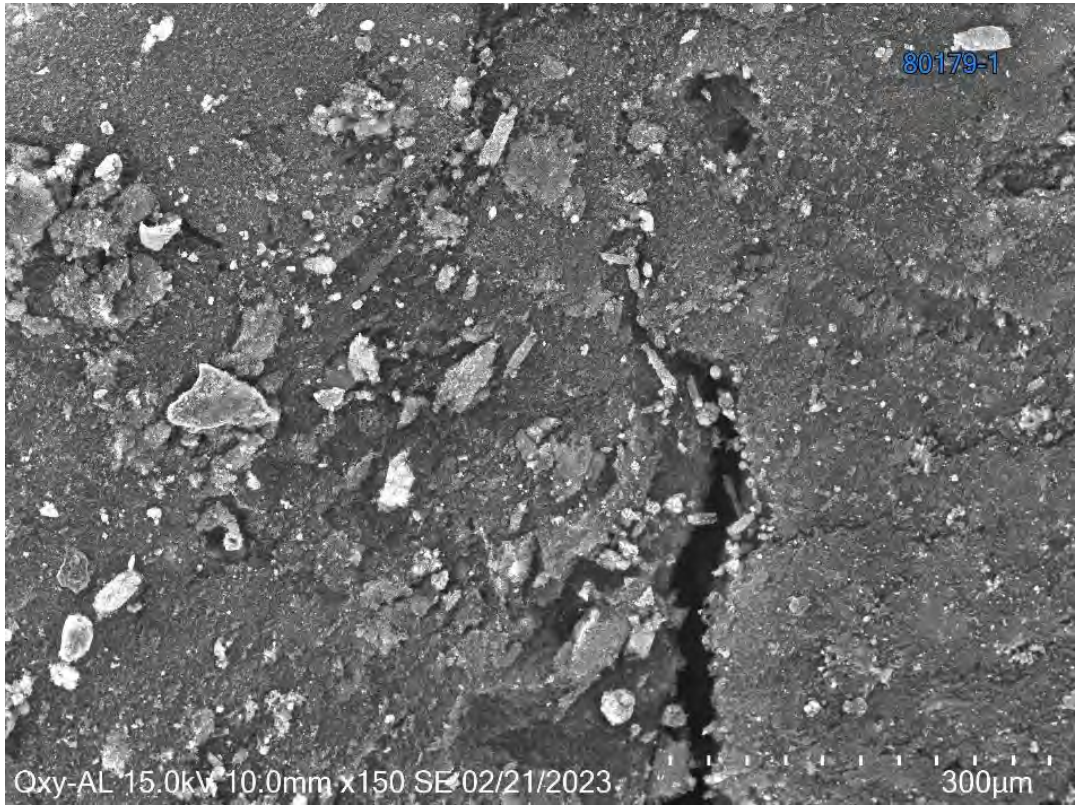


Figure 7. SEM and EDS of OCPX 80179 #1. Dome Area Pressure Plate.



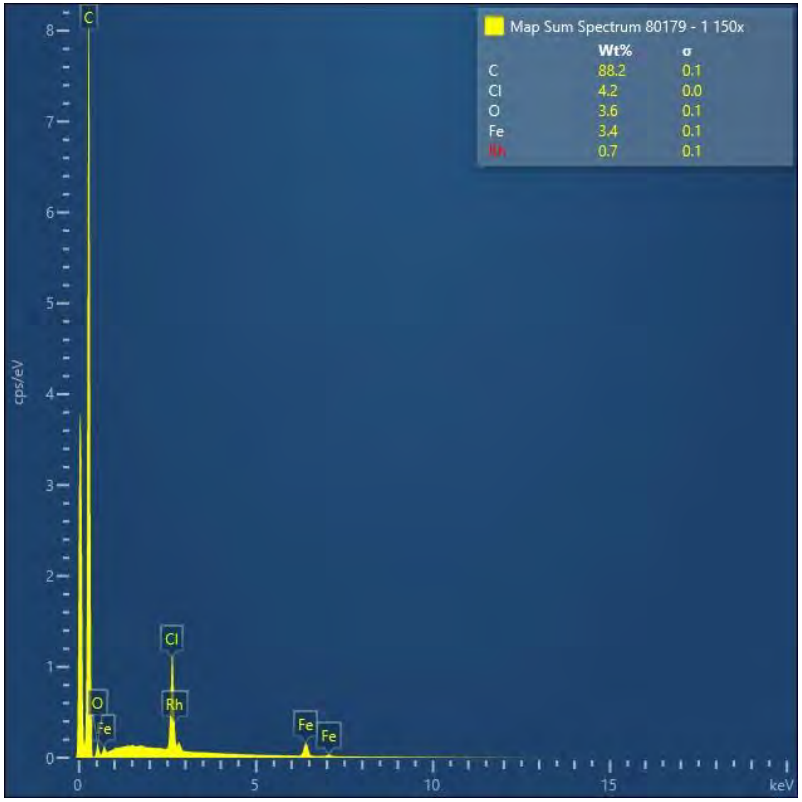
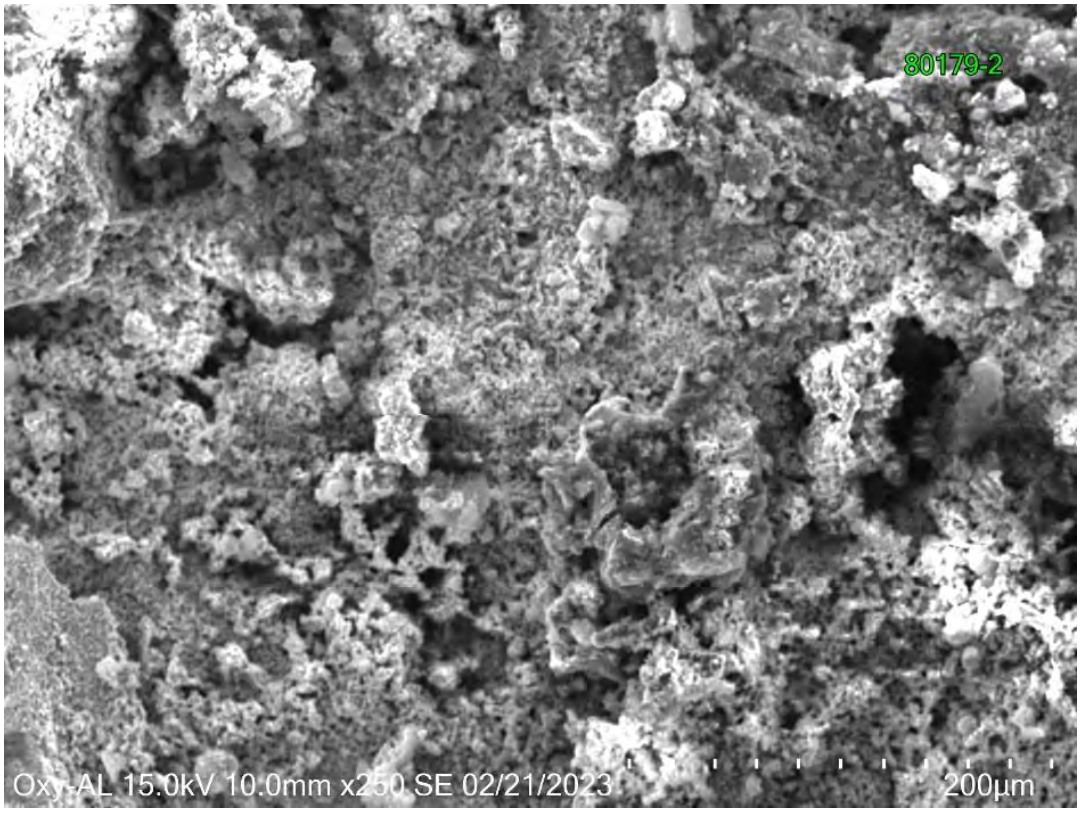


Figure 8. SEM and EDS of OCPX 80179 #2. Dome Area Surface.



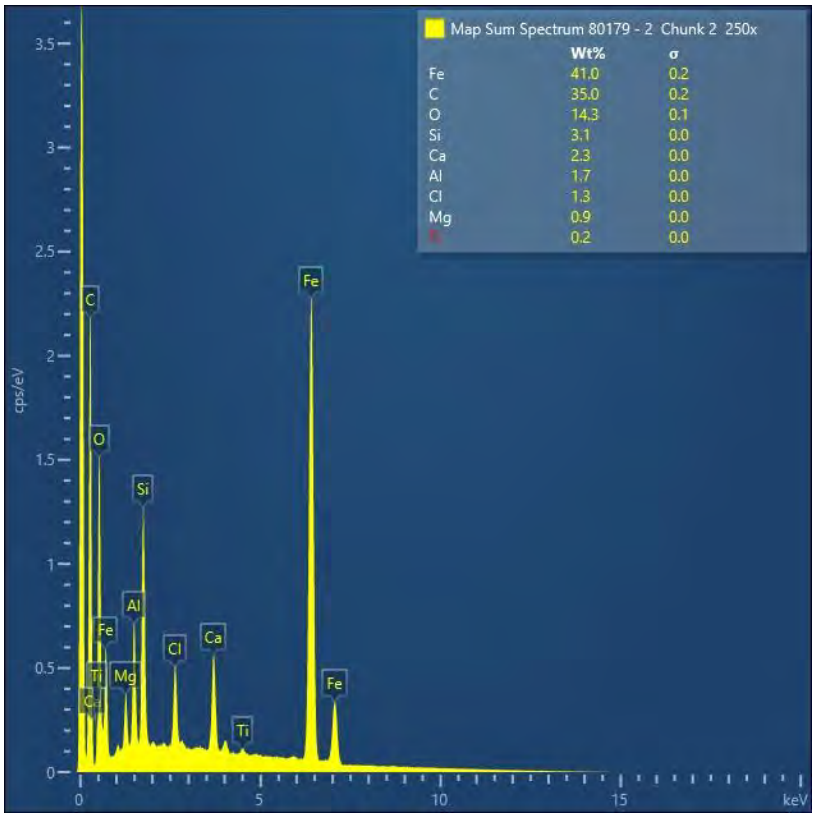
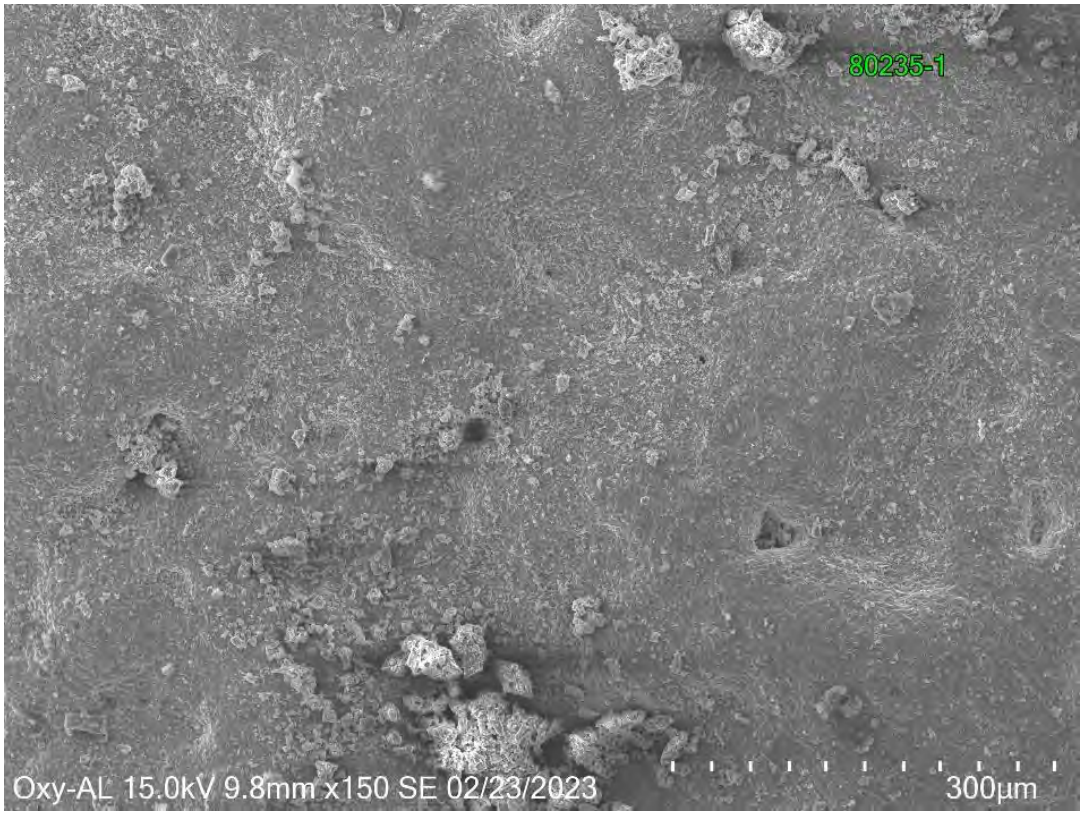


Figure 9. SEM and EDS of OCPX 80235 #1. PSV Side.



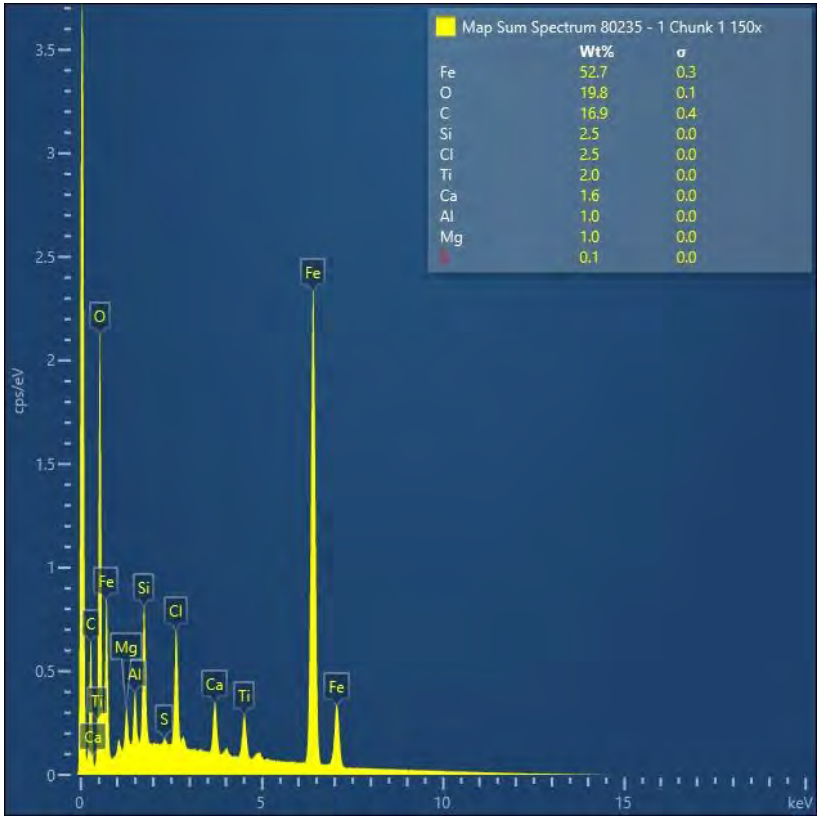
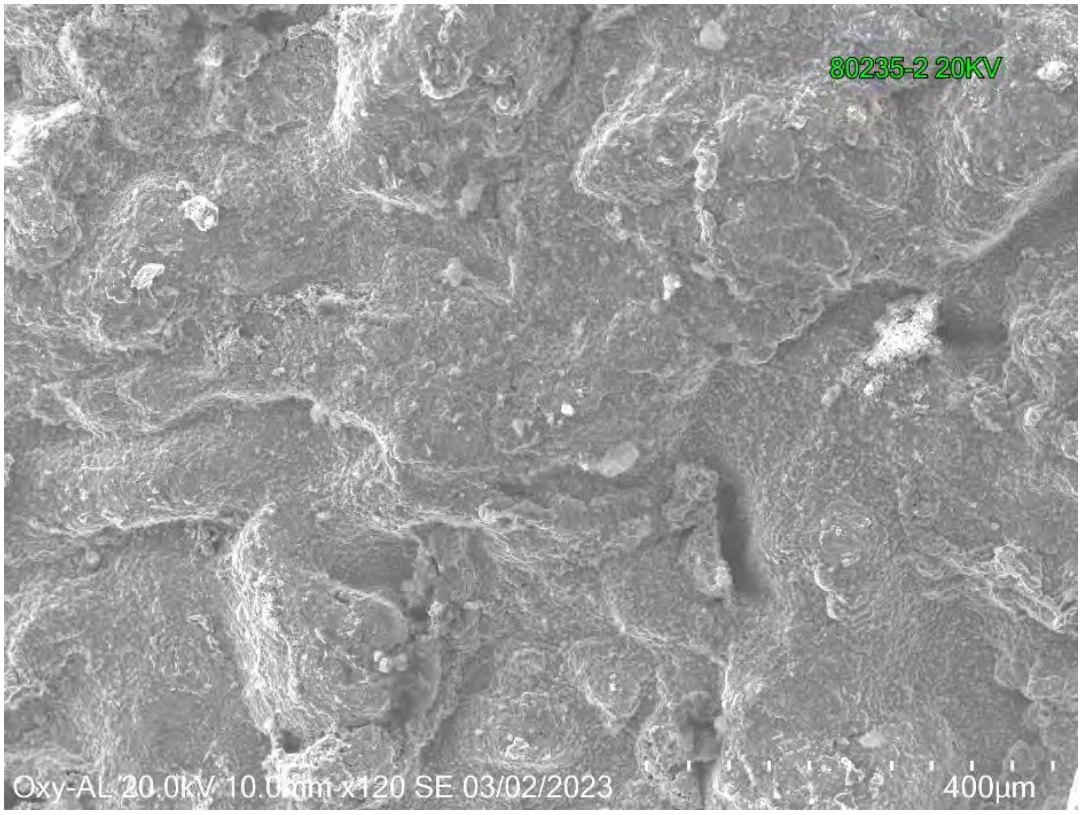


Figure 10. SEM and EDS of OCPX 80235 #2 Dome Plate Surface.



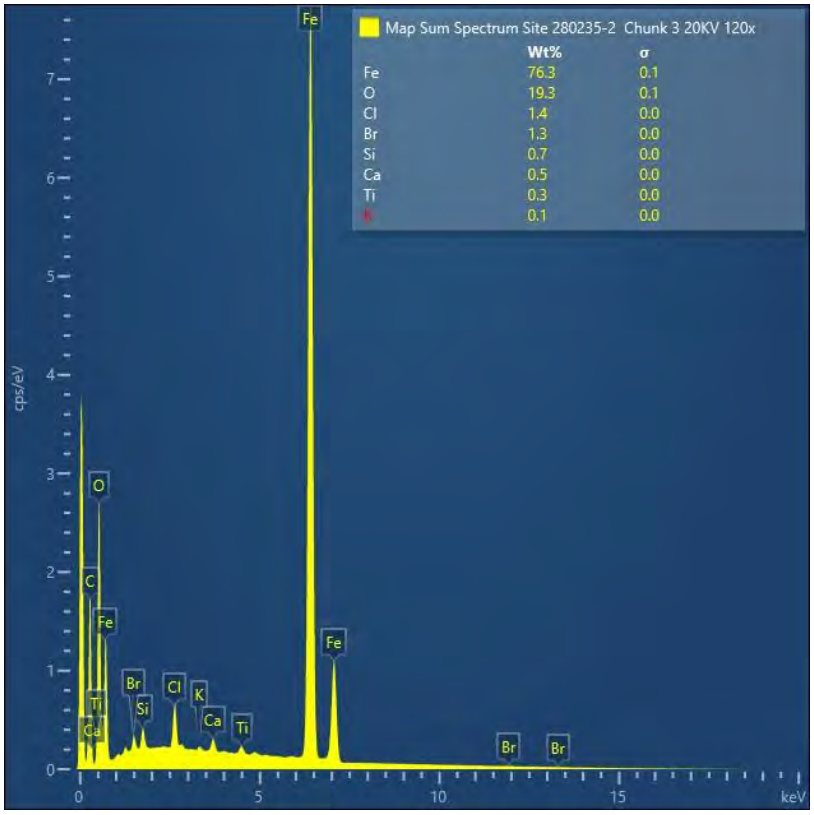
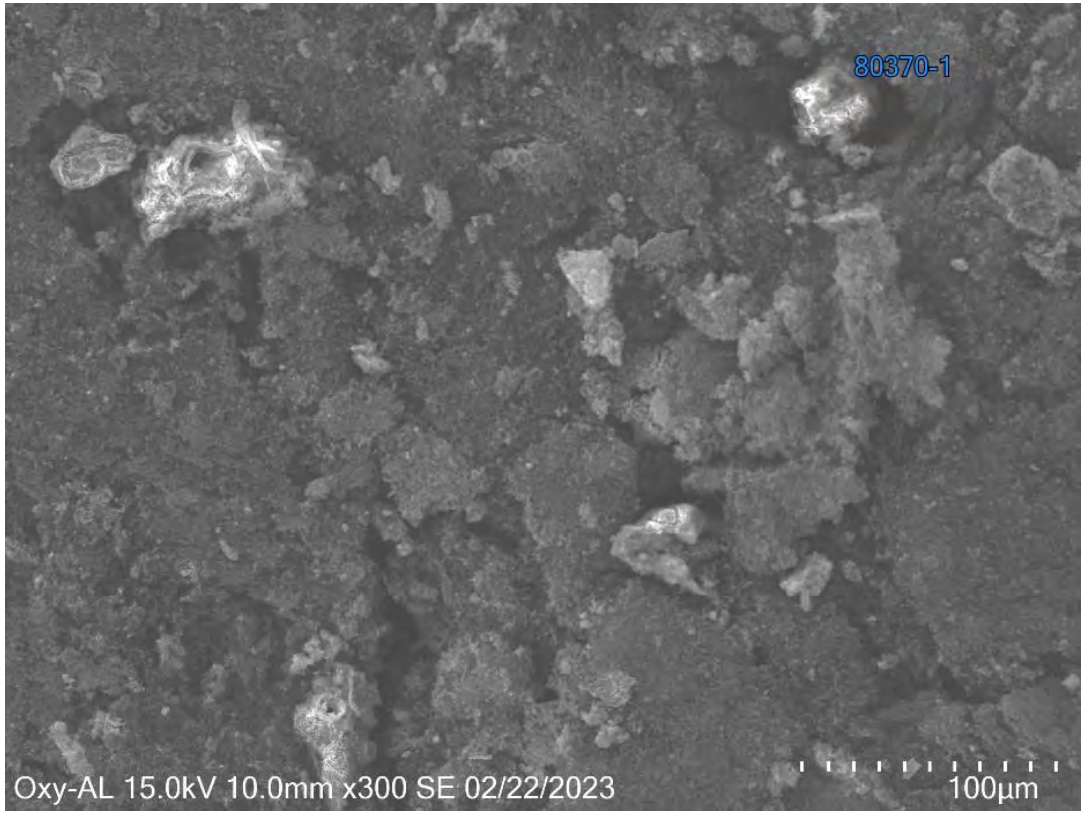


Figure 11. SEM and EDS of OCPX 80370 #1. Dome Pressure Plate.



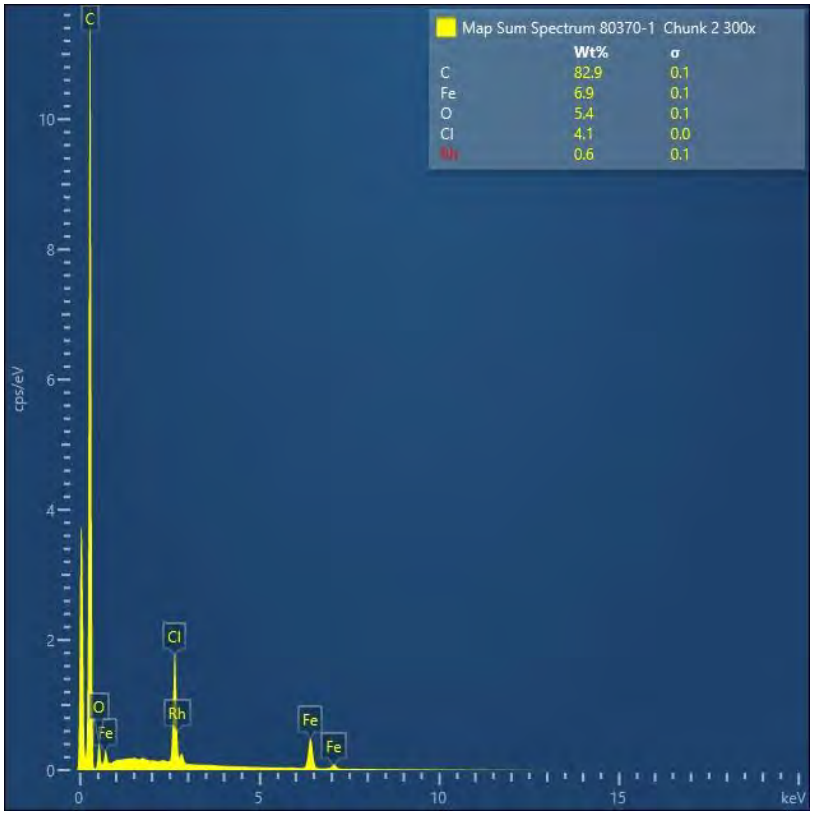
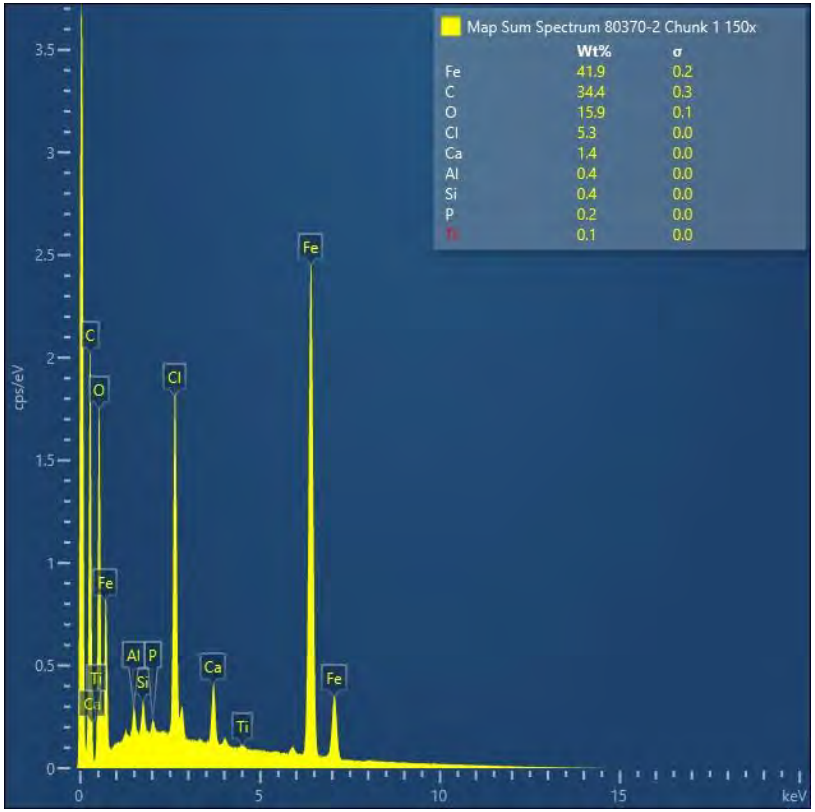
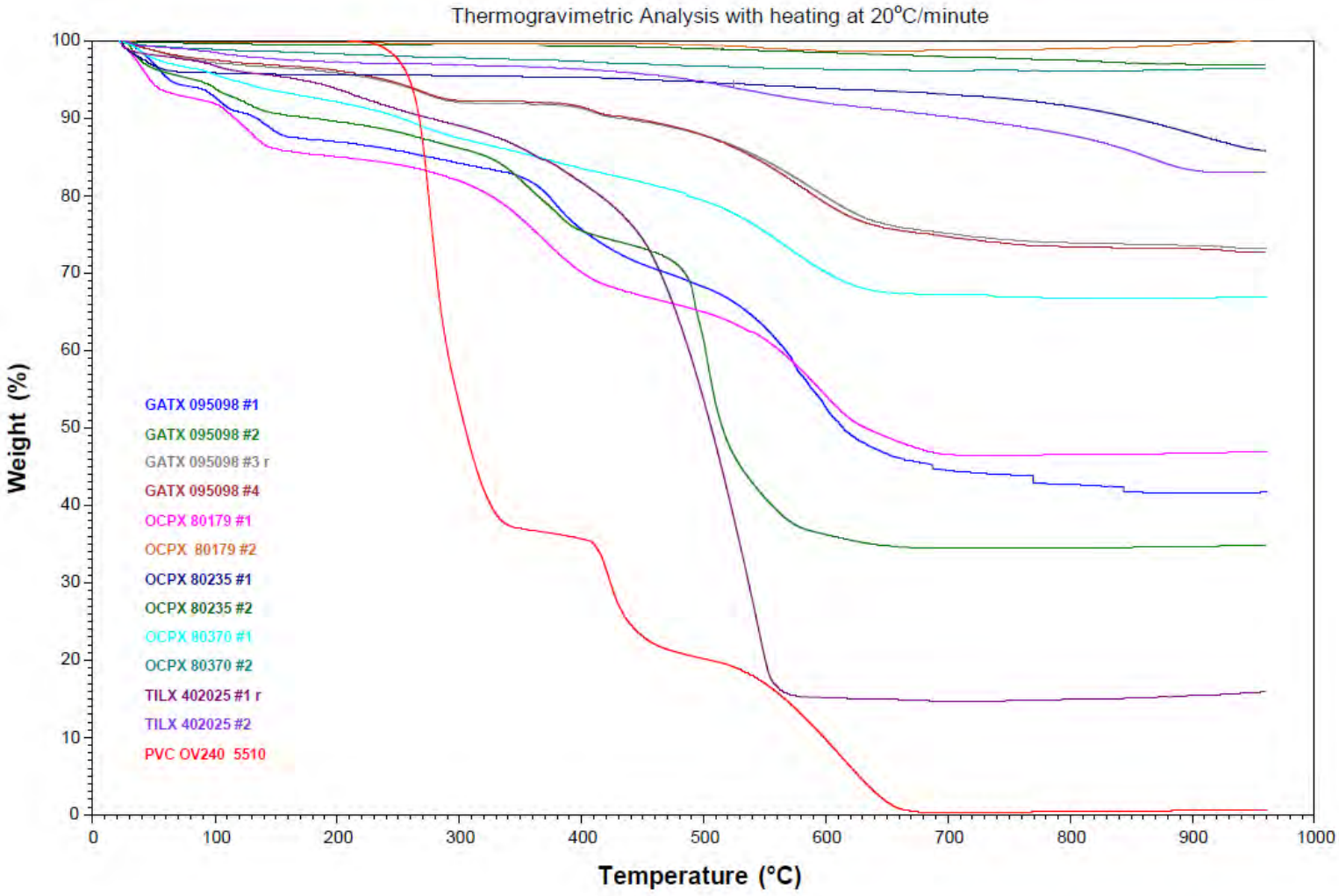


Figure 12. SEM and EDS of OCPX 80370 #1. Dome Surface Area.



Appendix B

Figure 13. Weight loss of samples upon heating compared to PVC (red).



Appendix C

Figure 14. FTIR spectrum of railcars compared to PVC (red).

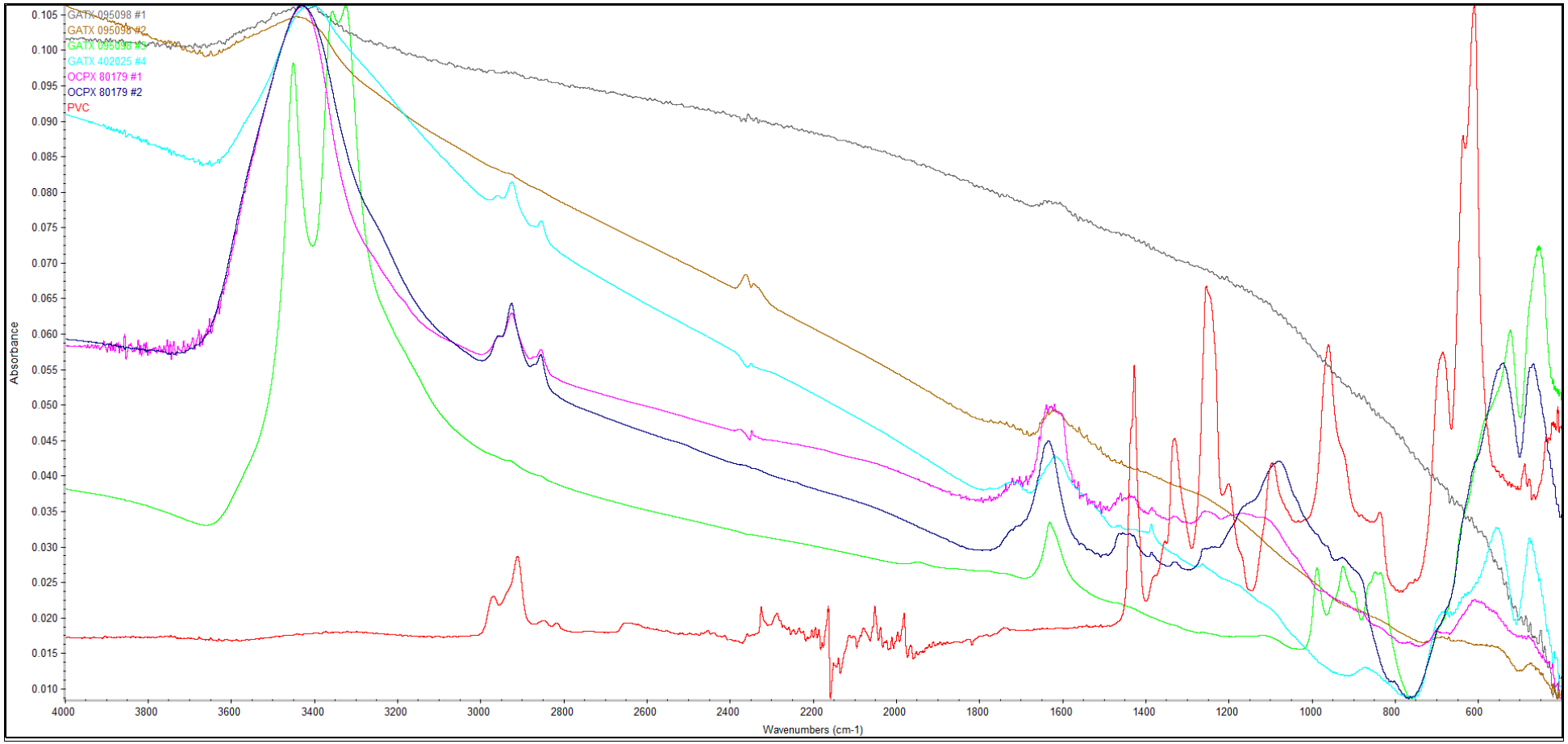


Figure 15. FTIR spectrum of railcars compared to PVC (red).