

# Appendix F3

## SEM/EDS Data for Test #4 Day-30 Galvanized Steel Coupons

### List of Figures

Figure F3-1: SEM image magnified 100 times for a Test #4 Day-30 unsubmerged galvanized steel coupon sample. (T4D30GalSusp014.bmp).....	F3-4
Figure F3-2: SEM image magnified 500 times for a Test #4 Day-30 unsubmerged galvanized steel coupon sample. (T4D30GalSusp015.bmp).....	F3-4
Figure F3-3: Annotated SEM image magnified 1800 times for a Test #4 Day-30 unsubmerged galvanized steel coupon sample. (T4D30GalSusp016.bmp).....	F3-5
Figure F3-4: EDS counting spectrum for the deposits (EDS1) on the coupon surface shown in Figure F3-3. (T4D30GalSusp08.jpg).....	F3-5
Figure F3-5: EDS counting spectrum for the flat coupon surface (EDS2) shown in Figure F3-3. (T4D30Galsusp09.jpg) .....	F3-7
Figure F3-6: SEM image magnified 100 times for a Test #4 Day-30 submerged galvanized steel coupon sample. (T4D30GalSubm017.bmp) .....	F3-7
Figure F3-7: SEM image magnified 500 times for a Test #4 Day-30 submerged galvanized steel coupon sample. (T4D30GalSubm018.bmp) .....	F3-8
Figure F3-8: Annotated SEM image magnified 1800 times for a Test #4 Day-30 submerged galvanized steel coupon sample. (T4D30GalSubm019.bmp).....	F3-8
Figure F3-9: EDS counting spectrum for the deposits (EDS3) on the coupon surface shown in Figure F3-8. (T4D30GalSubm10.jpg) .....	F3-9
Figure F3-10: EDS counting spectrum for the flat coupon surface (EDS4) shown in Figure F3-8. (T4D30GalSubm11.jpg).....	F3-11

## **List of Tables**

Table F3-1. Chemical Compositions for T4D30GalSusp08.jpg, Figure F3-4. ....	F3-6
Table F3-2. Chemical Compositions for T4D30GalSubm10.jpg, Figure F3-9. ....	F3-10
Table F3-3. Chemical Compositions for T4D30GalSubm11.jpg, Figure F3-10. ....	F3-12

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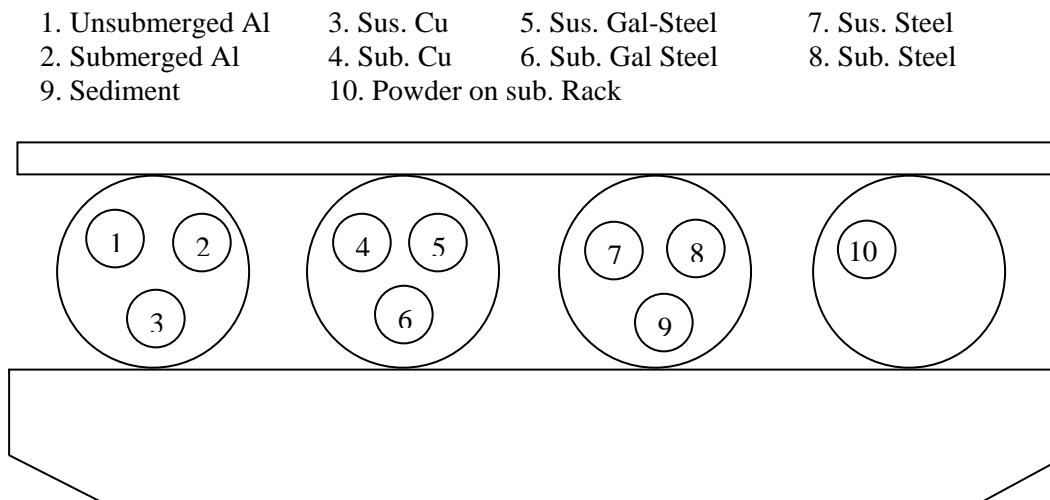
This appendix shows the SEM/EDS results for the metal galvanized steel coupons under two categories: (1) unsubmerged and (2) submerged. Unsubmerged refers to coupons held in the test tank gas space above the water level of the solution during ICET tests. Unsubmerged coupons were contacted by the solution only during the 4-hour spraying period at the initial date of the test. In addition, the surface of the unsubmerged coupons may also be affected by the moisture in the gas space during the test. Submerged refers to the coupons that were under the solution during the test.

The coupon samples were collected on June 23, 2005 (the date Test #4 was shut down) and examined by SEM/EDS on June 29, 2005. The galvanized steel coupon samples were dried in air before coating with Au/Pd for SEM examination. SEM results present the surface condition of the galvanized steel coupons. In addition, EDS results provide a semi-quantitative elemental analysis of the coupon surface and the corrosion products.

## Transcribed Laboratory Log

Laboratory session from June 29, 2005.

SEM Test #4 Day-30 Galvanized Steel Coupons.

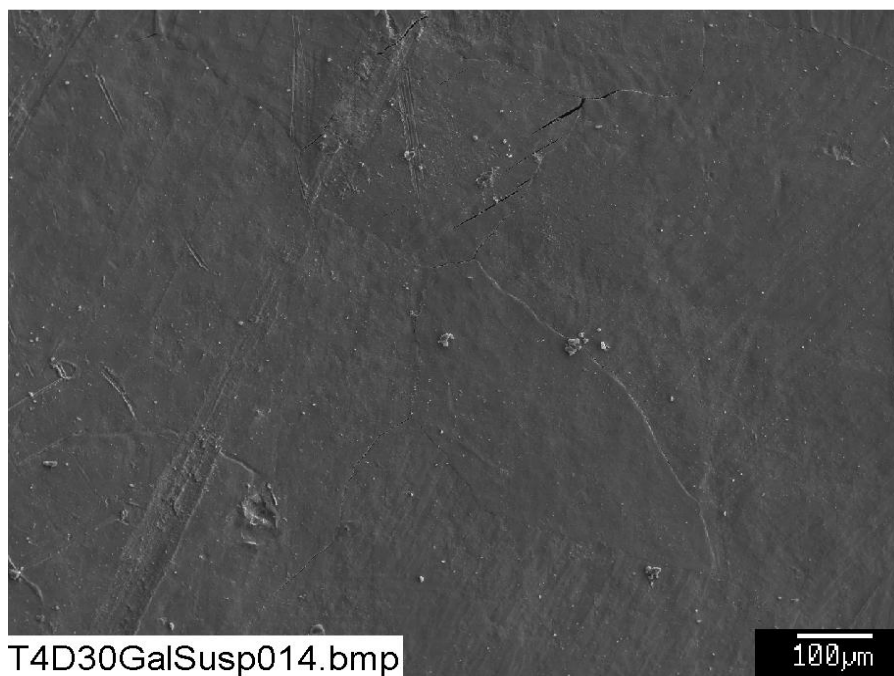


### Unsubmerged Galvanized Steel Coupon

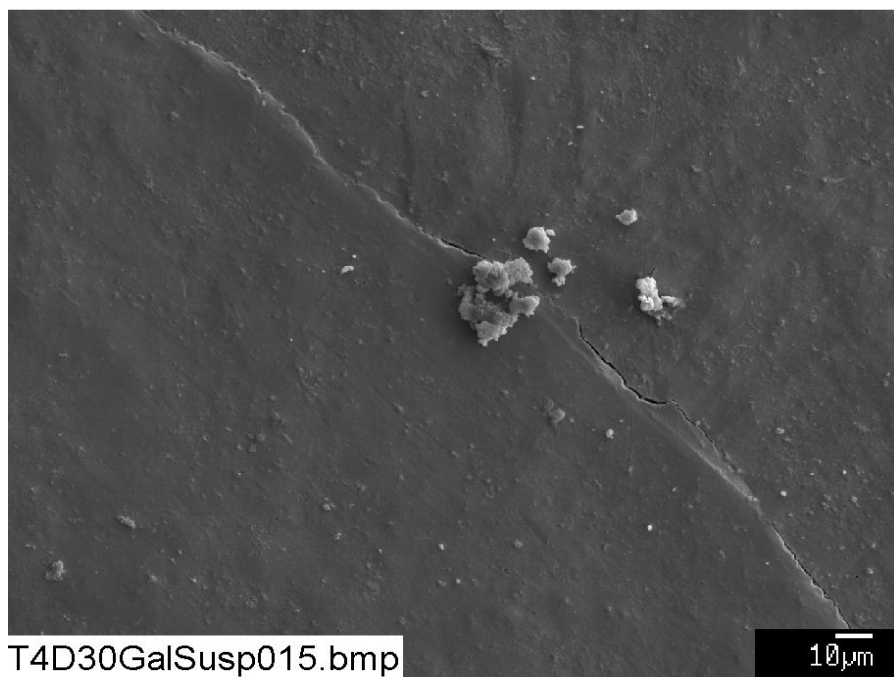
Image:	T4D30GalSusp014	100 ×	SEM image	Figure F3-1
	T4D30GalSusp015	500 ×	SEM image	Figure F3-2
	T4D30GalSusp016	1800 ×	SEM annotated image	Figure F3-3
EDS:	T4D30GalSusp08		Particles shown in 016	Figure F3-4
	T4D30Galsusp09		Surface shown in 016	Figure F3-5

### Submerged Galvanized Steel Coupon

Image:	T4D30GalSubm017	100 ×	SEM image	Figure F3-6
	T4D30GalSubm018	500 ×	SEM image	Figure F3-7
	T4D30GalSubm019	1800 ×	SEM annotated image	Figure F3-8
	T4D30GalSubm10		Particles shown in 019	Figure F3-9
	T4D30GalSubm11		Surface shown in 019	Figure F3-10



**Figure F3-1: SEM image magnified 100 times for a Test #4 Day-30 unsubmerged galvanized steel coupon sample. (T4D30GalSusp014.bmp)**



**Figure F3-2: SEM image magnified 500 times for a Test #4 Day-30 unsubmerged galvanized steel coupon sample. (T4D30GalSusp015.bmp)**

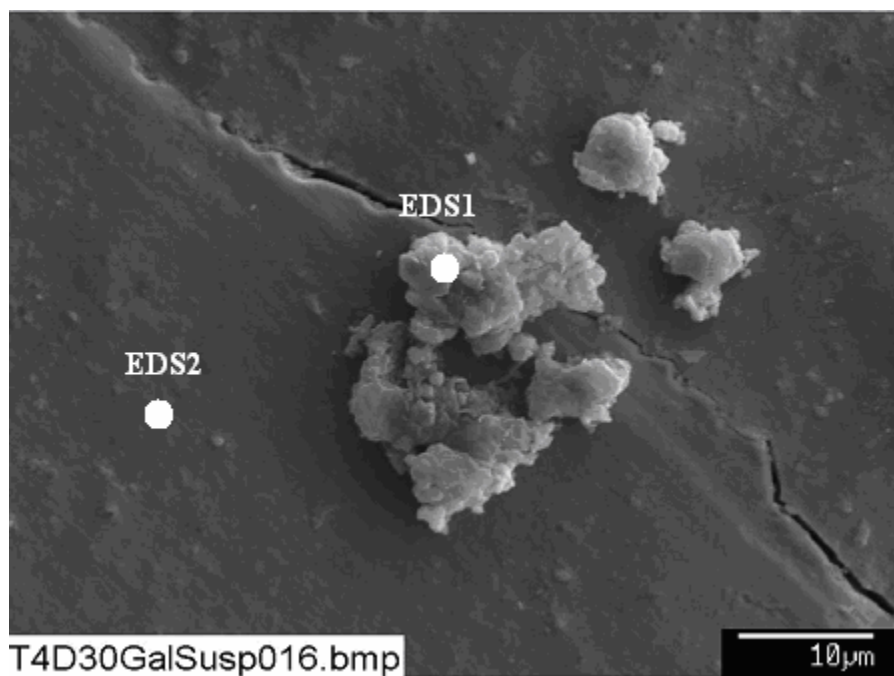


Figure F3-3: Annotated SEM image magnified 1800 times for a Test #4 Day-30 unsubmerged galvanized steel coupon sample. (T4D30GalSusp016.bmp)

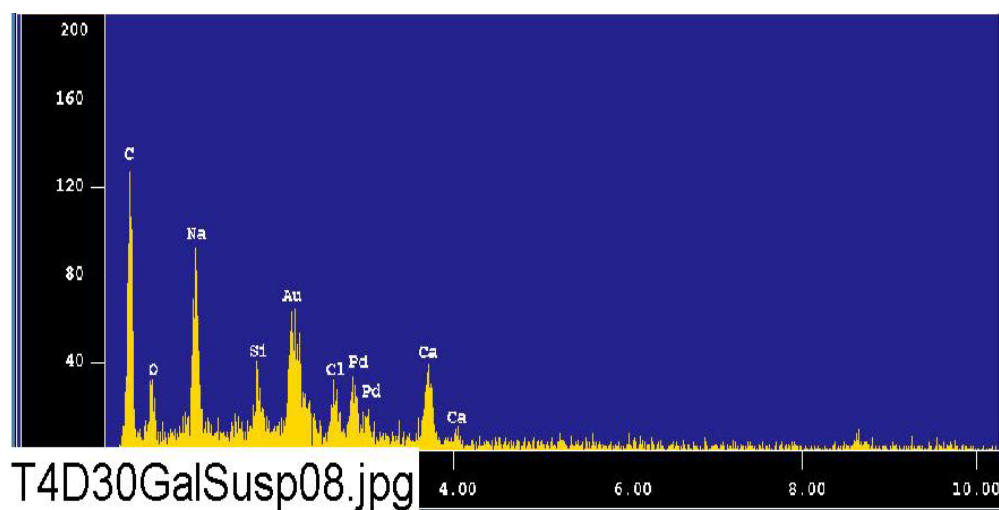


Figure F3-4: EDS counting spectrum for the deposits (EDS1) on the coupon surface shown in Figure F3-3. (T4D30GalSusp08.jpg)

The results from the chemical composition analysis for T4D30GalSusp08.jpg are given in Table F3-1.

**Table F3-1. Chemical Compositions for T4D30GalSusp08.jpg, Figure F3-4.**

Jun 29 14:17 2005 /tmp/eds\_pout.log Page 1

```

Group       : NRC
Sample      : T4D30 ID# : 8
Comment     : particle on suspended Gal-steel
Condition   : Full Scale : 20KeV(10eV/ch,2Kch)
              Live Time  : 60.000 sec   Aperture #   : 2
              Acc. Volt  : 15.0 KV      Probe Current : 1.064E-09 A
              Stage Point : X=44.143 Y=59.814 Z=10.786
              Acq. Date  : Wed Jun 29 14:12:20 2005

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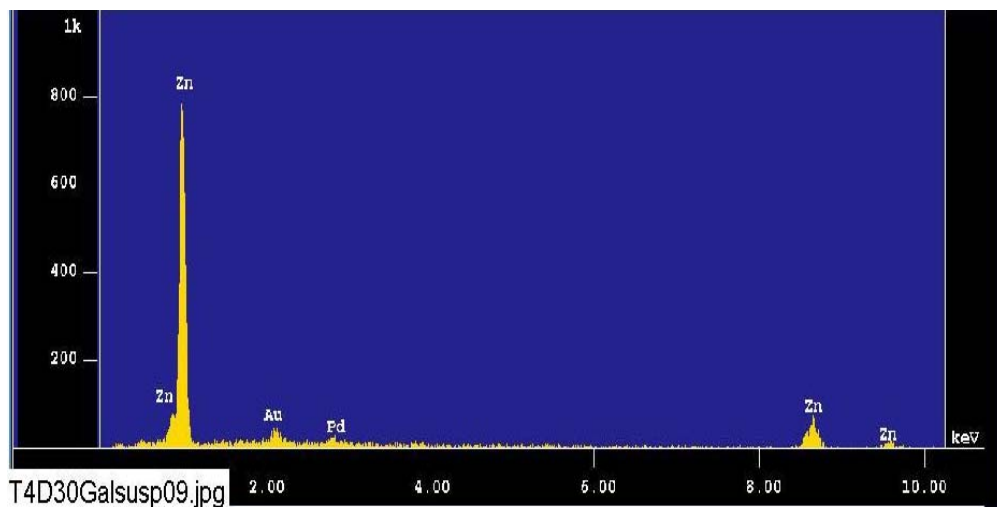
Element	Mode	ROI (KeV)	K-ratio(%)	+/-	Net/Background
C K	Normal	0.09- 0.46	17.7108	0.0003	868 / 7
O K	Normal	0.25- 0.77	7.9933	0.0009	264 / 43
Na K	Normal	0.81- 1.27	4.1179	0.0007	391 / 7
Si K	Normal	1.50- 2.07	1.2113	0.0004	155 / 14
Cl K	Normal	2.34- 3.06	3.7051	0.0005	324 / 14
Ca K	Normal	3.40- 4.30	5.1818	0.0037	322 / 5

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Chi\_square = 6.7756

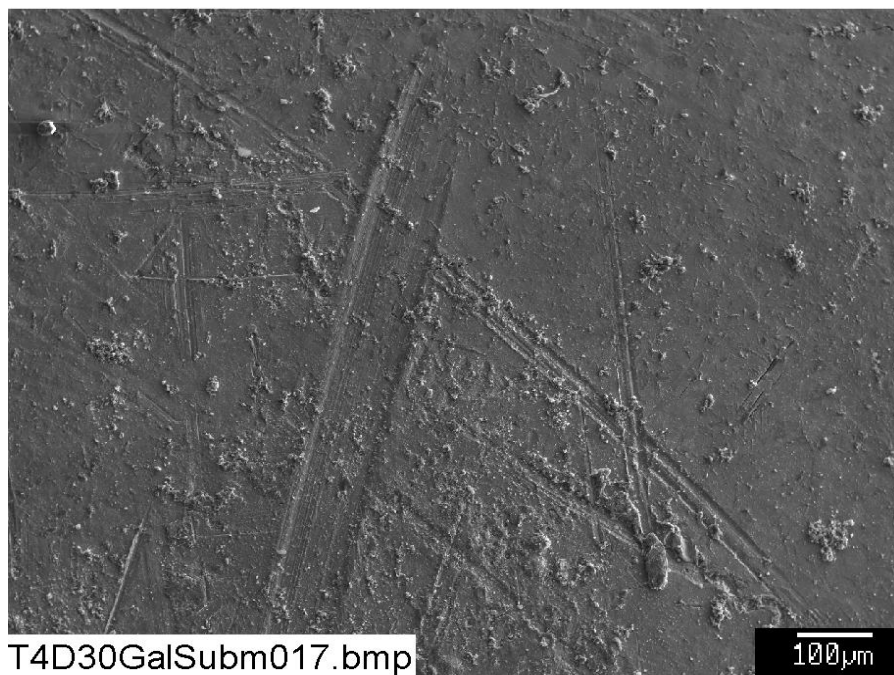
Element	Mass%	Atomic%	ZAF	Z	A	F
C	57.624	69.8633	2.4583	1.0116	2.4303	1.0000
O	22.840	20.7886	2.1589	0.9652	2.2368	1.0000
Na	6.485	4.1080	1.1900	1.0197	1.1668	1.0002
Si	1.750	0.9073	1.0916	0.9716	1.1247	0.9989
Cl	4.786	1.9657	0.9759	1.0255	0.9552	0.9963
Ca	6.515	2.3671	0.9500	0.9837	0.9657	1.0001

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Total 100.000 100.0000  
Normalization factor = 1.3235

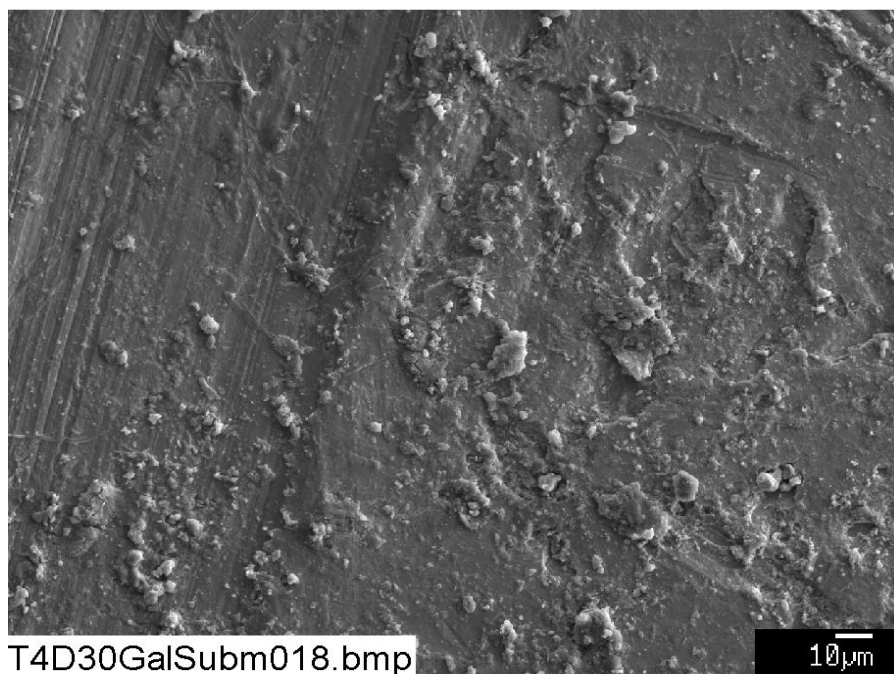




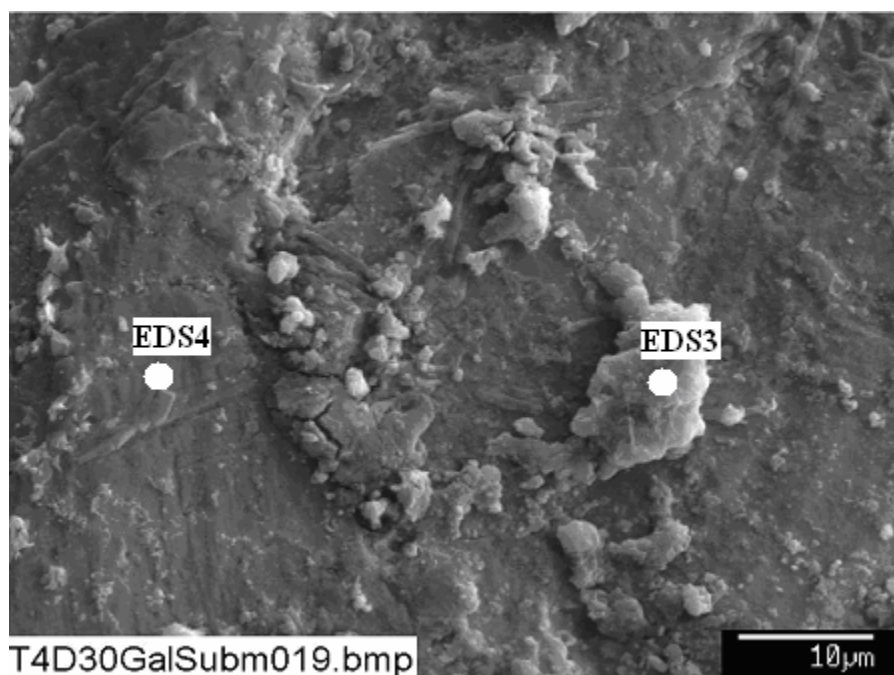
**Figure F3-5: EDS counting spectrum for the flat coupon surface (EDS2) shown in Figure F3-3. (T4D30Galsusp09.jpg)**



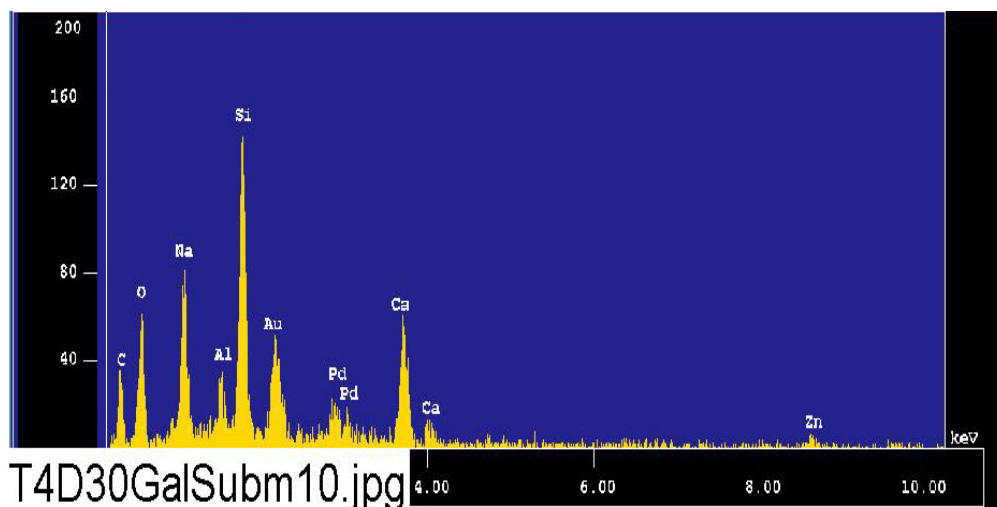
**Figure F3-6: SEM image magnified 100 times for a Test #4 Day-30 submerged galvanized steel coupon sample. (T4D30GalSubm017.bmp)**



**Figure F3-7: SEM image magnified 500 times for a Test #4 Day-30 submerged galvanized steel coupon sample. (T4D30GalSubm018.bmp)**



**Figure F3-8: Annotated SEM image magnified 1800 times for a Test #4 Day-30 submerged galvanized steel coupon sample. (T4D30GalSubm019.bmp)**



**Figure F3-9: EDS counting spectrum for the deposits (EDS3) on the coupon surface shown in Figure F3-8. (T4D30GalSubm10.jpg)**

The results from the chemical composition analysis for T4D30GalSubm10.jpg are given in Table F3-2.

Table F3-2. Chemical Compositions for T4D30GalSubm10.jpg, Figure F3-9.

Jun 29 14:33 2005 /tmp/eds\_pout.log Page 1

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Group       : NRC
Sample      : T4D30 ID# : 10
Comment     : Particle on submerged Gal-steel
Condition   : Full Scale : 20KeV(10eV/ch,2Kch)
              Live Time  : 60.000 sec   Aperture #   : 2
              Acc. Volt   : 15.0 KV      Probe Current : 1.067E-09 A
              Stage Point : X=50.108 Y=68.926 Z=10.786
              Acq. Date   : Wed Jun 29 14:30:34 2005

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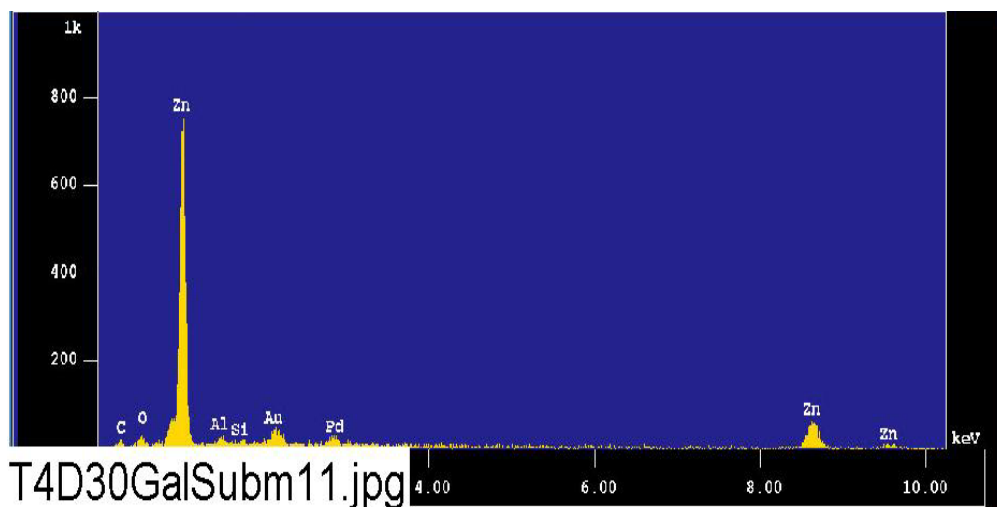
Element	Mode	ROI (KeV)	K-ratio(%)	+/-	Net/Background	
C K	Normal	0.09- 0.46	4.3159	0.0001	212 /	6
O K	Normal	0.25- 0.77	17.0145	0.0011	564 /	10
Na K	Normal	0.81- 1.27	6.3047	0.0007	600 /	6
Al K	Normal	1.26- 1.78	1.7139	0.0004	236 /	56
Si K	Normal	1.50- 2.07	7.1958	0.0006	923 /	25
Ca K	Normal	3.40- 4.30	8.1648	0.0042	509 /	2

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Chi\_square = 2.5440

Element	Mass%	Atomic%	ZAF	Z	A	F
C	23.363	34.2953	3.7436	1.0268	3.6461	1.0000
O	38.077	41.9614	1.5476	0.9794	1.5802	1.0000
Na	11.659	8.9415	1.2789	1.0340	1.2371	0.9998
Al	2.933	1.9165	1.1835	0.9960	1.1924	0.9965
Si	12.465	7.8251	1.1980	0.9844	1.2173	0.9997
Ca	11.503	5.0602	0.9743	0.9944	0.9797	1.0001

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Total 100.000 100.0000

Normalization factor = 1.4460



**Figure F3-10: EDS counting spectrum for the flat coupon surface (EDS4) shown in Figure F3-8. (T4D30GalSubm11.jpg)**

The results from the chemical composition analysis for T4D30GalSubm11.jpg are given in Table F3-3

**Table F3-3. Chemical Compositions for T4D30GalSubm11.jpg, Figure F3-10.**

Jun 29 14:37 2005 /tmp/eds\_pout.log Page 1

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Group       : NRC
Sample      : T4D30 ID# : 11
Comment     : Surface of submerged Gal-steel
Condition   : Full Scale : 20KeV(10eV/ch,2Kch)
               Live Time  : 60.000 sec   Aperture #   : 2
               Acc. Volt  : 15.0 KV      Probe Current : 1.066E-09 A
               Stage Point : X=50.108 Y=68.926 Z=10.786
               Acq. Date   : Wed Jun 29 14:35:16 2005

```

Element	Mode	ROI(KeV)	K-ratio(%)	+/-	Net/Background
O K	Normal	0.25- 0.77	7.3244	0.0010	243 / 18
Al K	Normal	1.26- 1.78	0.9436	0.0004	130 / 16
Si K	Normal	1.50- 2.07	0.4713	0.0003	60 / 22
Zn K	Normal	8.22-10.03	118.8961	0.0077	1137 / 2
C K	Normal	0.09- 0.46	2.8301	0.0001	139 / 2

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Chi\_square = 0.5995

Element	Mass%	Atomic%	ZAF	Z	A	F
O	4.987	12.5657	1.0235	0.8341	1.2272	0.9999
Al	1.235	1.8457	1.9679	0.8447	2.3300	0.9999
Si	0.520	0.7459	1.6575	0.8339	1.9877	1.0000
Zn	83.279	51.3537	1.0528	1.0538	0.9991	1.0000
C	9.979	33.4891	5.2998	0.8754	6.0542	1.0000

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Total 100.000 100.0000  
Normalization factor = 0.6653