

Supplementary Materials

Grain Size Effect in Elution Test of Electric Arc Furnace Slag

Alessandro Riboldi ¹, Giovanna Cornacchia ², Marcello Gelfi ², Laura Borgese ¹, Annalisa Zacco ¹, Elza Bontempi ¹, Marco V. Boniardi ³, Andrea Casaroli ³ and Laura E. Depero ^{1,*}

¹ Chemistry for Technologies Laboratory, INSTM and Department of Mechanical and Industrial Engineering, University of Brescia, Via Branze 38, 25123 Brescia, Italy; a.riboldi003@studenti.unibs.it (A.R.); laura.borgese@unibs.it (L.B.); annalisa.zacco@unibs.it (A.Z.); elza.bontempi@unibs.it (E.B.)

² Department of Mechanical and Industrial Engineering, University of Brescia, University of Brescia, Via Branze 38, 25123 Brescia, Italy; giovanna.cornacchia@unibs.it (G.C.); marcello.gelfi@unibs.it (M.G.)

³ Department of Mechanical Engineering, Polytechnic University of Milan, Via La Masa 1, 20156 Milan, Italy; marco.boniardi@polimi.it (M.V.B.); andrea.casaroli@polimi.it (A.C.)

* Correspondence: laura.depero@unibs.it

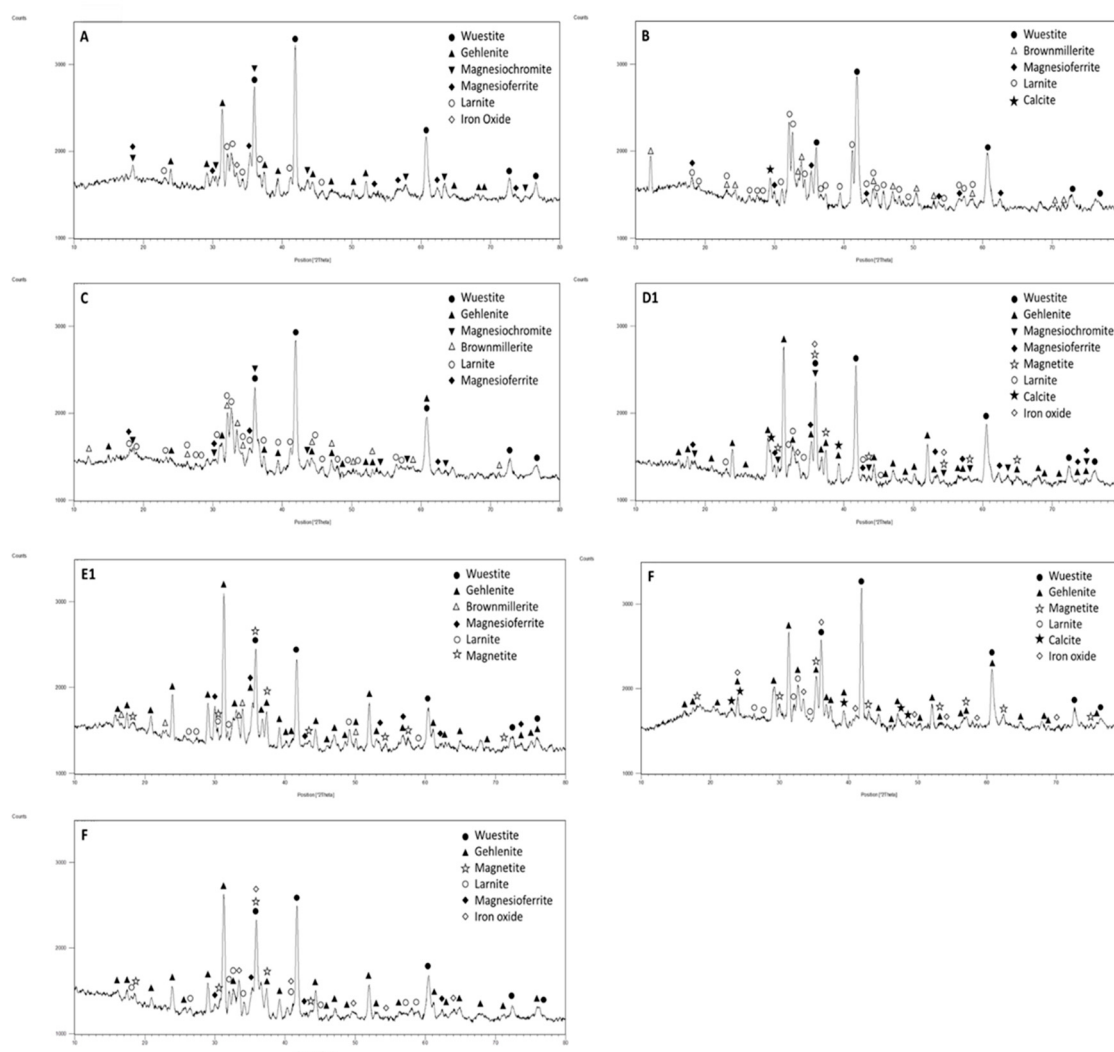


Figure S1. XRD patterns of samples A, B, C, D1, E1, F and G, with the corresponding phase identification. Reproduce in black and white.

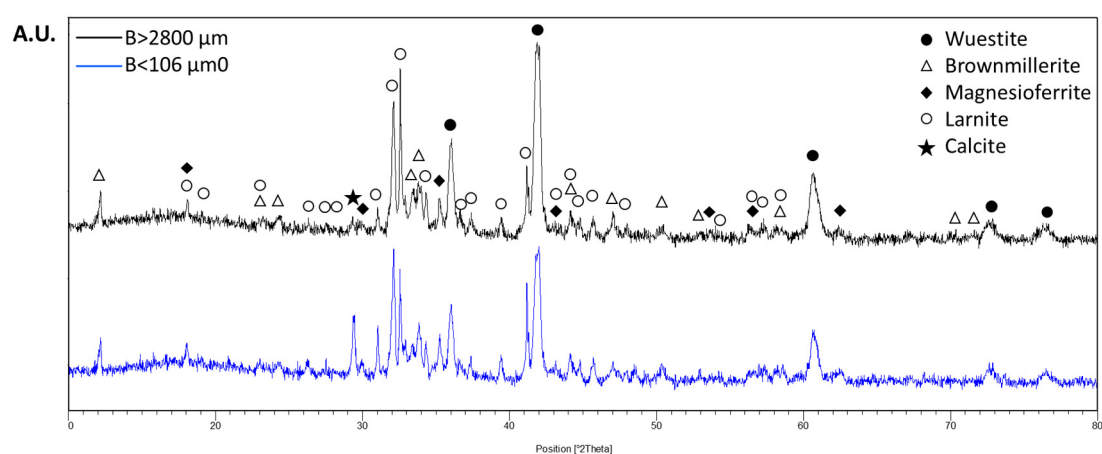


Figure S2. XRD patterns collected on Fractions of the lowest (blue) and highest (black) size fraction of sample B. Reproduce in Colors.

Table S1. Granularity fraction sizes

Fraction	Size range [μm]
F1	0-106
F2	106-300
F3	300-500
F4	500-710
F5	710-1000
F6	1000-1400
F7	1400-2000
F8	2000-2800
F9	2800-4000

Table S2. Intra-sample and inter-sample RSD% variability

	Concentration range	Intra-sample D	Intra-sample E	Inter-sample D-E	Inter-sample A, B, C, D, E, F, G
RSD% range	0-10 $\mu\text{g/l}$	6.6-141.4	23.4-141.4	6.6 - 141.4	72.5-128.5
	10-100 $\mu\text{g/l}$	0.5-129.2	7.6-141.4	0.5 - 141.4	31.3-110.3
	0.1-1 mg/l	15.9-25.4	22.8-39.1	15.5 -39.1	8.6-29.8
	>1 mg/l	1.8-21.2	8.9-46.6	1.8 - 46.6	86.9-84.4

Table S3. Leaching test results performed in different laboratories

Elements	B			C			D1			E1		
	lab.1 conc. [mg/l]	lab.2 conc. [mg/l]	RSD%	lab.1 conc. [mg/l]	lab.2 conc. [mg/l]	RSD%	lab.1 conc. [mg/l]	lab.2 conc. [mg/l]	RSD%	lab.1 conc. [mg/l]	lab.2 conc. [mg/l]	RSD%
V	0.02	0.03	19.6	0.03	0.01	59.0	0.12	0.12	2.1	0.1	0.1	10.0
Cr	0.02	0.02	20.7	0.005	0.004	16.4	<0,005	0.001	-	<0,005	-	-
Mn	<0,005	0.001	-	<0,005	0.001	-	<0,005	0.001	-	<0,005	0.001	-
Fe	<0,02	0.02	-	0.0271	0.03	2.0	<0,02	0.004	-	<0,02	0.005	-
Co	<0,005	0.005	-	<0,005	0.02	-	<0,005	-	-	<0,005	0.004	-
Zn	<0,010	0.01	-	<0,010	0.01	-	<0,010	0.006	-	<0,010	0.007	-
Se	0.002	0.009	91.0	0.003	0.01	89.1	<0,001	0.004	-	<0,001	0.01	-
Mo	0.09	0.06	30.6	0.05	0.07	15.2	0.04	0.05	20.2	0.16	0.17	4.1
Cd	<0,0005	-	-	<0,0005	0.000	-	<0,0005	-	-	<0,0005	-	-
Ba	0.2	0.2	19.9	1.1	2.0	41.9	0.5	0.5	10.0	0.81	0.83	2.1
Pb	<0,001	0.004	-	<0,001	-	-	<0,001	0.005	-	<0,001	0.003	-

Table S4. Comparison between leaching test results performed by ICP-AES and TXRF

Elem ents	Sample A			Sample B			Sample C			Sample D1			Sample E1			Sample F			Sample G		
	ICP-AES		RSD%	TXRF		RSD%	ICP-AES		RSD%	TXRF		RSD%	ICP-AES		RSD%	TXRF		RSD%	ICP-AES		RSD%
	Conc. [mg/]	Conc. [mg/]		Conc. [mg/]	Conc. [mg/]		Conc. [mg/]	Conc. [mg/]		Conc. [mg/]	Conc. [mg/]		Conc. [mg/]	Conc. [mg/]		Conc. [mg/]	Conc. [mg/]		Conc. [mg/]	Conc. [mg/]	
Si	1.3	<LOQ	-	0.98	<LOQ	-	0.2	<LOQ	-	8.0	<LOQ	-	11.8	<LOQ	-	7.8	<LOQ	-	0.7	<LOQ	-
P	0.01	<LOQ	-	0.005	<LOQ	-	0.005	<LOQ	-	0.01	<LOQ	-	0.008	<LOQ	-	0.008	<LOQ	-	0.006	<LOQ	-
K	0.26	0.33	1.3	0.08	<LOQ	-	0.2	<LOQ	-	0.7	0.66	-	5.3	4.0	2.9	1.0	1.0	2.8	3.0	2.1	2.1
Ca	58.2	<LOQ	-	84.6	<LOQ	-	152.2	<LOQ	-	27.6	<LOQ	-	21.9	<LOQ	-	29.7	<LOQ	-	66.5	<LOQ	-
V	0.10	0.07	5.8	0.03	0.02	-	0.012	<LOQ	-	0.12	0.08	2.1	0.06	0.05	33.8	0.2	0.17	2.3	0.03	<LOQ	-
Cr	0.002	<LOQ	-	0.02	<LOQ	-	0.004	<LOQ	-	0.001	<LOQ	-	-	<LOQ	-	0.006	<LOQ	-	0.001	<LOQ	-
Mn	0.001	<LOQ	-	0.001	<LOQ	-	0.001	<LOQ	-	0.001	<LOQ	-	0.001	<LOQ	-	0.001	<LOQ	-	0.002	<LOQ	-
Fe	0.02	<LOQ	-	0.02	<LOQ	-	0.03	<LOQ	-	0.004	<LOQ	-	0.005	<LOQ	-	0.004	<LOQ	-	0.02	<LOQ	-
Co	0.005	<LOQ	-	0.005	<LOQ	-	0.017	<LOQ	-	-	<LOQ	-	0.004	<LOQ	-	-	<LOQ	-	0.01	<LOQ	-
Zn	0.01	0.004	0.74	0.01	0.006	64.6	0.014	0.004	25.5	0.006	0.003	1.4	0.007	0.003	27.0	0.002	0.006	66.8	0.01	0.001	95.0
Ga	0.008	<LOQ	-	0.01	<LOQ	-	0.03	<LOQ	-	0.002	<LOQ	-	-	<LOQ	-	0.003	<LOQ	-	0.01	<LOQ	-
Se	0.007	<LOQ	-	0.009	<LOQ	-	0.013	<LOQ	-	0.004	<LOQ	-	0.01	<LOQ	-	0.007	<LOQ	-	0.01	<LOQ	-
Rb	0.01	<LOQ	-	0.02	<LOQ	-	0.013	<LOQ	-	0.02	<LOQ	-	0.03	<LOQ	-	0.01	<LOQ	-	0.02	<LOQ	-
Sr	0.15	0.11	74.2	0.12	0.09	0.8	0.52	0.367	5.2	0.13	0.1	1.4	0.2	0.17	4.2	0.1	0.12	3.1	0.1	0.08	1.3
Mo	0.07	<LOQ	-	0.06	<LOQ	-	0.07	<LOQ	-	0.05	<LOQ	-	0.17	<LOQ	-	0.06	<LOQ	-	0.16	<LOQ	-
Cd	-	<LOQ	-	-	<LOQ	-	-	<LOQ	-	-	<LOQ	-	-	<LOQ	-	-	<LOQ	-	0.000	<LOQ	-
In	0.003	<LOQ	-	0.001	<LOQ	-	0.002	<LOQ	-	0.003	<LOQ	-	-	<LOQ	-	0.002	<LOQ	-	0.002	<LOQ	-

Ba	0.56	0.50	90.5	0.18	0.15	4.7	2.0	1.773	3.9	0.53	0.5	3.5	0.8	0.8	4.6	0.2	0.24	3.8	1.1	1.15	1.8
Pb	0.005	<LOQ	-	0.004	<LOQ	-	-	<LOQ	-	0.005	<LOQ	-	0.003	<LOQ	-	0.004	<LOQ	-	-	<LOQ	-

RSD ICP-AES 10%

Table S5. Leaching test results performed by TXRF on the different granularity fractions

Sample	Elements	F1		F2		F3		F4		F5		F6		F7		F8		F9	
		Conc.	RSD	Conc.	RSD	Conc.	RSD	Conc.	RSD	Conc.	RSD	Conc.	RSD	Conc.	RSD	Conc.	RSD	Conc.	RSD
		[mg/l]	%	[mg/l]	%	[mg/l]	%	[mg/l]	%	[mg/l]	%	[mg/l]	%	[mg/l]	%	[mg/l]	%	[mg/l]	%
B	K	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Ca	266.4	3.2	290.2	4.5	276.4	2.5	275.5	6.4	266.9	7.2	215.4	5.2	152.3	2.0	183.7	8.4	87.5	11.1
	V	-	-	-	-	-	-	0.008	-	0.01	21.5	0.01	46.8	0.02	8.8	0.02	14.7	0.02	33.3
	Zn	0.008	25.0	0.01	41.9	0.02	11.9	0.05	27.8	0.034	17.8	0.05	6.9	0.04	8.4	0.04	13.6	0.01	27.2
	Sr	0.33	3.3	0.28	7.4	0.2	2.3	0.2	7.6	0.176	8.1	0.2	4.3	0.1	0.5	0.1	3.5	0.08	6.7
	Ba	0.69	3.5	0.67	3.7	0.6	1.2	0.5	5.5	0.411	9.8	0.3	1.6	0.2	5.5	0.2	6.1	0.10	14.4
C	K	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Ca	376.5	1.3	398.0	9.2	327.2	7.6	275.0	7.4	243.132	6.3	230.0	6.5	216.6	5.4	152.6	8.2	130.2	17.5
	V	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.05	16.8	0.07	11.9
	Zn	-	-	0.009	31.4	0.010	56.6	-	-	-	-	-	-	0.05	89.2	-	-	0.01	15.7
	Sr	1.6	0.1	1.2	6.1	0.8	5.2	0.6	5.9	0.525	8.1	0.5	1.2	0.4	2.6	0.3	6.3	0.3	5.2
	Ba	5.9	0.2	5.2	10.4	3.1	5.4	1.9	6.0	1.736	6.3	1.6	1.7	1.4	2.7	0.8	8.9	0.8	12.4
D	K	2.4	5.6	1.1	8.9	0.8	2.4	0.7	5.9	0.700	5.3	0.6	6.7	0.7	6.2	0.7	10.7	0.6	2.7
	Ca	50.1	2.9	37.3	0.5	34.3	0.7	35.8	2.7	47.108	1.7	49.1	6.2	49.3	3.2	55.8	6.6	52.2	1.8
	V	0.15	1.4	0.10	3.0	0.08	2.1	0.10	6.7	0.10	7.6	0.09	6.9	0.10	0.7	0.1	11.3	0.10	5.0
	Zn	0.02	0.0	-	-	0.008	65.7	0.007	32.6	0.03	13.9	0.02	14.5	0.04	18.6	0.04	10.0	0.03	38.6
	Sr	-	-	-	0.5	0.1	4.4	0.1	2.6	0.12	2.5	0.12	3.4	0.1	0.6	0.1	8.6	0.1	0.9
	Ba	0.19	5.1	0.34	15.1	0.4	1.4	0.4	2.1	0.38	11.2	0.3	2.6	0.3	15.7	0.4	1.1	0.4	16.2
E	K	32.9	16.5	7.3	9.9	7.1	8.3	4.8	3.3	4.0	12.3	3.4	1.9	3.4	7.9	3.4	5.8	2.7	7.4
	Ca	83.3	10.3	34.5	4.0	52.9	4.1	47.6	9.7	34.2	12.1	42.9	1.7	47.6	5.9	52.9	9.1	43.0	5.4
	V	0.22	9.7	0.07	5.6	0.08	4.4	0.072	5.3	0.1	9.1	0.06	6.3	0.05	11.2	0.06	6.4	0.004	-
	Zn	0.05	35.0	0.007	15.7	-	-	0.021	31.9	-	-	-	-	0.05	160.6	-	-	-	-

Sr	0.65	12.4	0.3	5.2	0.4	19.3	0.281	7.5	0.2	9.5	0.2	0.7	0.2	5.6	0.2	7.9	0.2	4.7
Ba	0.87	4.2	0.7	3.2	1.1	17.4	1.061	11.5	0.7	6.5	0.9	6.1	0.7	2.0	0.9	10.0	0.7	3.8