Supporting Information

Behavior of Cr, Ni, Pb, Zn, Cd and Hg in the blast furnace – A critical review of literature data and plant investigations

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Table S 1: Contribution of different input materials to the total Zn input into blast furnaces

Zn	Zhang et. al.[47]	Stepin et. al.[45 a]			Besta et. al.[40]	Mertins[31]	Besta et. al.[39]	Morf[46]	Own investigations		
	[%]	I [%]	II [%]	III [%]	[%]	[%]	[%]	[%]	2010 [%]	2011 [%]	2012 [%]
Sinter	64	97	98	92	71	40	77	72	70	64	72
Pellets/ Granules	33	0.96	0.09	3.4	7.9	42	6.4	6	11	17	14
Lump ore	1.1	0	0	0	3.6		2.7	4	2.8	2.5	2.6
Slag (recycling material)	-	-	-	-	6.5	18	4.7	-	0.02	0.03	0.06
Limestone	-	-	-	-	1.1	-	0.91	-	-	-	-
Coke	1.1	2.3	2.1	4.7	8.9	-	4.4	4	4.3	3.5	2.7
Coal/ Coal Powder	1.1	-	-	-	-	-	-	-	-	-	-
Alternative reducing agents	-	-	-	-	-	-	-	13	12	13	9.1
Sum	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Total Input [g/Mg HM]	645	416	340	279	116	-[b]	126	-[b]	127	143	168

[a] I: Balance for blast furnace No. 1 from Severstal, II: Balance for blast furnace No.4 from Severstal immediately before the blast furnace was shut down for an overhaul, III: Balance for blast furnace No.4 from Severstal after the overhaul

[b] not specified

Table S 2: Contribution of different input materials to the total Pb input into blast furnaces

Pb	Zhang et. al.[47]	Chernousov et. al.[48 c]			Morf[46]	Own investigations		
	[%]	I [%]	II [%]	III [%]	[%]	2010 [%]	2011 [%]	2012 [%]
Sinter	60				26	32	21	31
Pellets/ Granules	24	100	60	95	10	22	31	20
Lump ore	11				16	8.1	6.8	14
Slag (recycling material)	-	-	-	-	-	0.01	0.02	0.08
Limestone	-	-	-	-	-	-	-	-
Coke	4.6		40	5	20	15	13	15
Coal/ Coal Powder	1.8	-	-	-	-	-	-	-
Alternative reducing agents	-	-	-	-	28	23	28	20
Sum	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Total Intput [g/Mg HM]	370	10	75	21	-[d]	21	25	22

[c] Investigations for different integrated steel plants: I: Severstal (Russia), II: Tulachermet (Russia), III: EKO-Stahl (Germany)

[d] Not specified

Table S 3: Contribution of different input materials to the total Cr input into blast furnaces

Cr	Chernousov and Golubev [15 e]				Morf [46]	Own investigations		
	I [%]	II [%]	III [%]	IV [%]	[%]	2010 [%]	2011 [%]	2012 [%]
Sinter					43	52	59	71
Pellets/ Granules	94	95	90	98	25	30	28	17
Lump ore					21	11	6.8	6.6
Slag (recycling material)	-	-	-	-	-	0.6	0.45	0.76
Limestone	-	-	-	-	-	-	-	-
Coke	6	5	10	2	8	6.2	5.2	4.0
Coal/ Coal Powder	-	-	-	-	-	-	-	-
Alternative reducing agents	-	-	-	-	4	0.5	0.87	0.34
Sum	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Total Input [g/Mg HM]	265	110	165	430	-[f]	287	293	360

[e] Investigations for different integrated steel plants: I: Severstal (Russia), II: NLMK (Russia), III: Tulachermet (Russia), IV: EKO-Stahl (Germany)

[f] not specified

Table S 4: Contribution of different input materials to the total Ni input into blast furnaces

Ni	Chernousov et. al.[14 g]				Morf [46]	Own investigations		
	I	II	III	IV		2010	2011	2012
					[%]			
Sinter					54	50	61	65
Pellets/ Granules	69	81	77	88	10	16	10	14
Lump ore					14	14	8.7	6.8
Slag (recycling material)	-	-	-	-	-	-	-	-
Limestone	-	-	-	-	-	-	-	-
Coke	31	19	23	12	16	16	16	13
Coal/ Coal Powder	-	-	-	-	-	-	-	-
Alternative reducing agents	-	-	-	-	6.5	3.8	3.6	1.7
Sum	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Total Input [g/Mg HM]	65	80	65	170	-[h]	55	47	64

[g] Investigations for different integrated steel plants: I: Severstal (Russia), II: NLMK (Russia), III: Tulachermet (Russia), IV: EKO-Stahl (Germany)

[h] Not specified

Table S 5: Contribution of different input materials to the total Cd input into blast furnaces

Cd	Morf [46]	Own investigations		
		2010	2011	2012
	[%]	[%]	[%]	[%]
Sinter		4	15	4
Pellets/ Granules		0	5.6	0
Lump ore		1	0	0
Slag (recycling material)	100[i]	0	0	0
Limestone		-	-	-
Coke		0	0	0
Coal/ Coal Powder		-	-	-
Alternative reducing agents		95	79	96
Sum	**100**	**100**	**100**	**100**
Total Input [g/Mg HM]	-[j]	0.16	0.29	0.12

[i] No allocation to the different input materials was provided since the input of Cd into the blast furnace was derived from output measurements (see **Error! Reference source not found.**)

[j] Not specified

Table S 6: Contribution of different input materials to the total Hg input into blast furnaces

Hg	Fukuda et. al.[65]	Morf [46]	Own investigations		
			2010	2011	2012
	[%]	[%]	[%]	[%]	[%]
Sinter			0	0	2.8
Pellets/ Granules			0	0	0
Lump ore			0.6	1.8	0
Slag (recycling material)	100[k]	100[k]	0	0	0
Limestone			-	-	-
Coke			0	0	0
Coal/ Coal Powder			-	-	-
Alternative reducing agents	-	-	99	98	97
Sum	**100**	**100**	**100**	**100**	**100**
Total Input [g/Mg HM]	-[l]	-[l]	0.018	0.033	0.023

[k] No allocation to the different input materials was performed since total input of Hg was derived from output measurements (see **Error! Reference source not found.**)

[l] Not specified

Table S 7: Mean Hg concentration of the different blast furnace outputs (on the basis of Fukuda et. al.[65])

Hg	Fukuda et. al.[65]			
	Number of samples	[mg/kg]	[µg/l]	[µg/Nm³]
Hot metal	2	0		
Slag	3	0.0002		
Top gas dust	3	0.267		
Scrubber sludge	3	0.655		
Scrubber water	3		n.d.	
Blast furnace gas	3			3.34