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Material Value Chains

RESEARCH REPORT
NO 4.4-12
HELSINKI 2016

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Report on treatment of fine-grained bottom ash

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ISBN 978-952-7205-12-9
ISSN XXXX-XXXX

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ARVI-project

10.10.2016

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1 INTRODUCTION

Fine-grained waste incineration bottom ash from Lahti Energia RDF-plant was treated by Suomen Erityisjäte Oy in the year 2015. The aim of this trial experiment was to find out the possibility of extracting non-ferrous and ferrous metals from the fine-grained bottom ash and to improve the utilization possibilities of the residues (i.e. the minerals) as well. The treatment was done in co-operation with a Dutch company Inashco B.V. using their dry treatment technology called ADR (*Advanced Dry Recovery*).

2 MATERIALS AND METHODS

All together 3.000 tonnes of fine-grained bottom ash was treated in the summer 2015. The treatment installation comprised of a sieve, ballistic separator (ADR) and an Eddy Current separator. Some water was added into the ash during the treatment in order to prevent excessive dust emissions.

The minerals (two size fractions, approximately 0-2 and 2-10 mm) were sampled and analyzed during the treatment in order to find out their utilization possibilities.

3 RESULTS AND DISCUSSION

Table 1 summarizes the total amount of treated bottom ash and the production rates for different fractions generated during the process.

Table 1 Amounts of treated bottom ash and the different fractions generated during the process

Fraction	EWC	Amount (tonnes)
Raw bottom ash	19 01 12	2 998.46
Ferrous metal fractions	19 12 02	245.92
Non-ferrous metal fraction	19 12 03	21.20
minerals	19 12 09	2 731.34

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Figures 1 and 2 illustrate the grain size distributions of both fractions. In the 0-2 mm fraction, approximately 10 % were coarser grain sizes (>2 mm) (Figure 1), whereas the maximum grain size for larger fraction (2-10 mm) was approximately 6 mm (Figure 2).

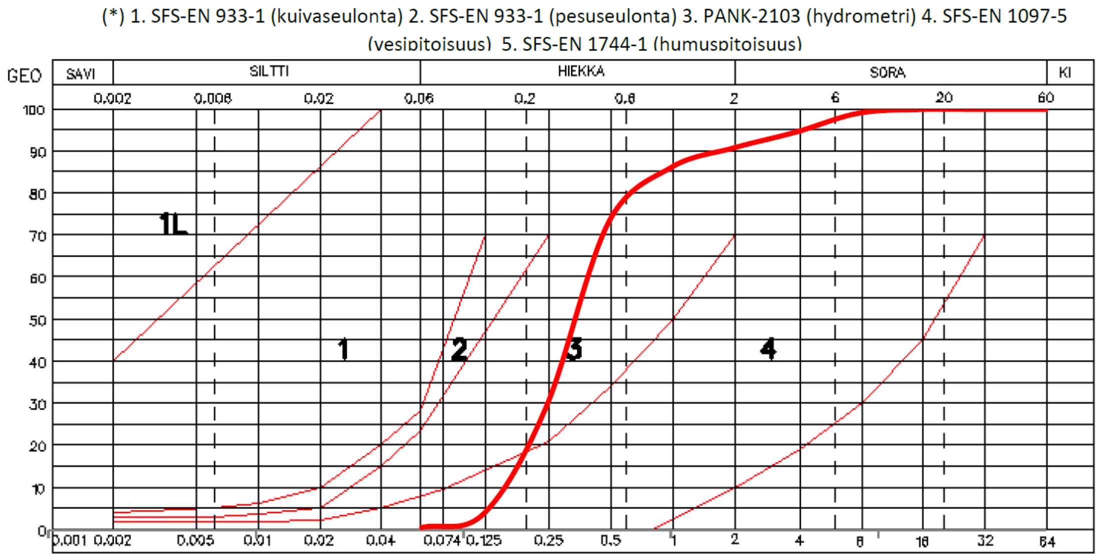

Figure 1 The grain size distribution of 0-2 mm fraction

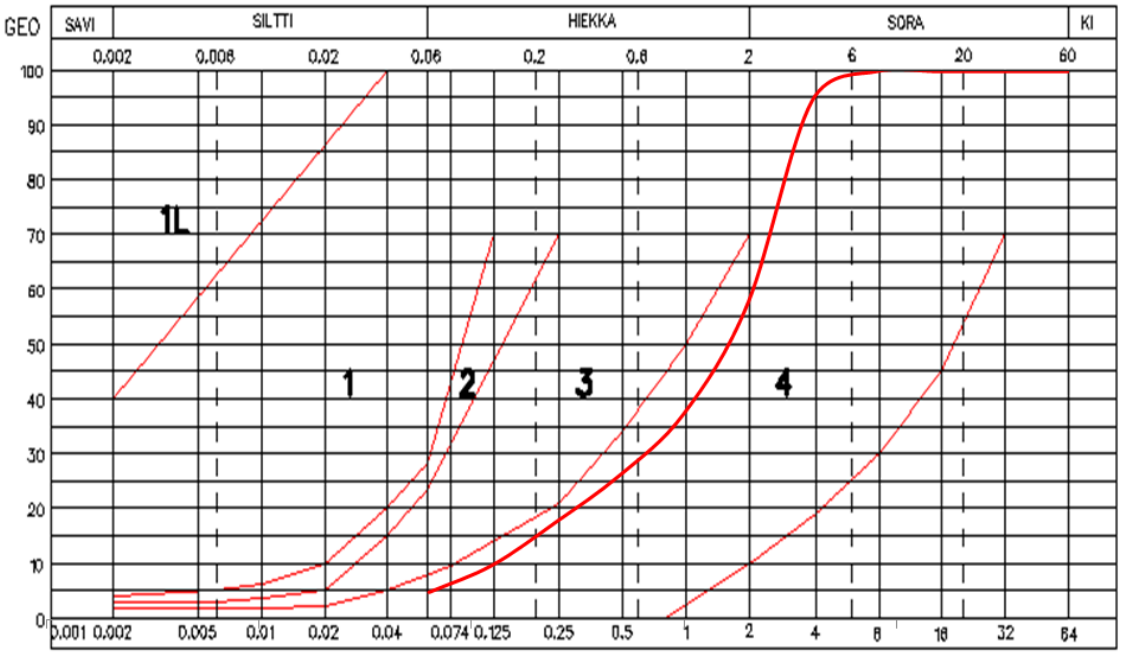

Figure 2 The grain size distribution of 2-10 mm fraction

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Table 2 summarizes the total concentration of different compounds and Table 3 the leaching test results for both mineral fractions before and after the treatment. The leaching test results were compared with the Finnish emission boundary values (403/2009) given for other ashes that are utilized in civil engineering. These emission boundary values were used since no national emission boundary values exist for waste incineration bottom ashes at the moment.

The total concentration of copper (Cu) decreased approximately 50 % in the smaller mineral fraction (0-2 mm), whereas in the larger mineral fraction (2-10 mm) the total concentration of Cu increased remarkably (Table 2). On the other hand, the solubility of Cu decreased approximately 85 – 89 % after the treatment in both mineral fractions, being below the Finnish emission boundary values given for other ashes (Table 3).

Table 2 The total concentration of different elements (mg/kg, average) for bottom ash minerals (0-2 mm ja 2-10 mm) generated from the process.

Compound	Untreated bottom ash	Samples obtained during the treatment			
		0-2mm	0-2mm	2-10 mm	2-10 mm
dry weight (%-w)		92,6	90,9	96,3	94,6
moisture (%)		8,2	10,0	4,3	5,8
Al		8100	-	9300	-
As	37	27	23	12	34
Ba	830	310	250	180	240
Cd	0,3	0,5	0,5	<0,4	1
Cr	130	180	74	65	81
Ca		95000	-	35000	-
Co		11	<10	<10	14
Cu	2500	1100	1200	2800	77000
Mg		3300	-	3200	-
Mn		180	-	200	-
Mo	7	<10	<10	<10	<10
Na		2200	-	2100	-
Ni	68	80	92	170	46
Ti		2200	-	1100	-
Pb	46	59	70	72	54
Si		160	-	100	-
S		790	-	460	-
Sb		28	17	20	51
Se		<10	<10	<10	<10
V	26	14	13	17	12
Zn	690	680	1400	620	720
Fe		7000	-	14000	-
K		1500	-	2600	-
P		590	-	390	-

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Table 3 The leaching test results (mg/kg, L/S 10) for bottom ash minerals (0-2 mm ja 2-10 mm) generated from the process.

Compound	Untreated bottom ash	Samples obtained during the treatment				Finnish Emission boundary values
		0-2mm	0-2mm	2-10 mm	2-10 mm	
pH (L/S8)	12,5	12,7	13	12,4	12,6	-
EC (L/S8, mS/m)	8,55	8,4	8,0	4,3	8,0	-
As	<0,01	<0,2	<0,2	<0,2	<0,2	1,5
Ba	31	49	47	16	20	60
Cd	<0,003	<0,01	<0,01	<0,01	<0,01	0,04
Cr	0,02	<0,1	<0,1	<0,1	<0,1	3
Cu	24	4,9	2	2,7	2,6	6
Mo	0,39	0,2	<0,2	0,3	<0,2	6
Ni	<0,01	<0,1	<0,1	<0,1	<0,1	1,2
Pb	0,83	6,4	12	8,1	2,9	1,5
Sb	0,13	0,07	0,05	0,09	0,06	0,18
Se	0,01	<0,01	0,04	<0,01	<0,01	0,5
V	<0,1	<0,1	<0,1	<0,1	<0,1	3
Zn	3,5	2,0	1	1,8	2,2	12
Hg	<0,002	<0,002	<0,002	<0,002	<0,002	0,01
F	3	<5	<5	<5	<5	50
Cl	540	790	790	320	390	2400
SO4	34	<20	<20	28	<20	10000
DOC	<1	15	6	<5	6	500

The total and soluble concentrations of lead (Pb) were low in the untreated bottom ash (Tables 2 and 3). In addition, the total concentration of Pb after the treatment was in the same level as in the untreated bottom ash. On the other hand, the solubility of Pb increased in both mineral fractions after the treatment (Table 3). This result was unexpected and was checked twice in order to verify the result. Differing results were obtained and therefore a pH-static leaching test was performed for Pb, since it is known that the solubility of lead is very much dependent on pH. Table 4 summarizes the leaching behaviour of Pb in different pH values (4, 6, 8, 10 and 12). These results showed that the solubility of Pb is the lowest in the pH range 8-10 and increases when pH is below 8 or above 10. The pH of bottom ash decreases when it reacts with carbon dioxide (this is called material aging). Therefore Pb is most likely not a problem when considering the utilization of this material since even with small pH decrease, the solubility of Pb will be below the national emission boundary values.

Table 4 Summary of pH static leaching test results for lead (Pb) in the mineral fractions.

pH	Solubility of Pb mg/kg (dry weight)				
	4	**6**	**8**	**10**	**12**
0-2mm	20,4	0,14	<0,1	<0,1	0,6
2-10mm	4,7	0,14	<0,1	<0,1	0,6

4 CONCLUSIONS

This trial experiment on the treatment of fine-grained bottom ash showed that the total amount of Cu and its leaching can be decreased in order to improve materials utilization possibility. The leaching of Pb varied to some extent. Most likely the leaching of Pb is, however, not problematic in regards of the utilization of fine-grained bottom ash especially when the material is allowed to react with atmospheric carbon dioxide and the pH value of bottom ash minerals decrease.

Technically ADR process can be used to treat fine-grained bottom ash but the total amount of Cu was quite low in the fine-grained bottom ash. Therefore the economical balance needs to be calculated carefully before planning large scale treatment. In addition, it is necessary to moisten the material in order to prevent excessive dust emissions.

Suomen Erityisjäte Oy

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