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≫ 연구논문 ≪

Development of Metal Recovery Process for Municipal Incineration Bottom Ash (MIBA)

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Abstract

The utilization of incineration ash from municipal waste must be promoted to solve the social problem on the shortage of final disposal site. In this research, metals should be recovered to avoid the damage of the crushing machine during the utilization of incineration ash in cement industry. In fact, incineration bottom ash from municipal waste contains iron in 3-5%. Nonferrous metal and stainless steel in 1% is also included. The research and development on the physical recovery process was performed not only to remove the metals but also to recover high grade products. Metals were separated from incineration ash in Maruya Co. Ltd.. In fact, iron scrap recovered by magnetic separation can be selled. After that, mixed metal was separated from incineration ash using screen. In this research, mixed metal tried to divided copper, aluminum, brass and stainless steel using drum type magnetic separation, eddy current separation and high magnetic separation. As a result, recovered iron had an 80% for the grade. Aluminum was recovered by eddy current separation without copper and brass.

Key words : municipal waste, incineration bottom ash, metal recovery, physical separation, mixed metal

1. Introduction

Municipal waste of 44.32 million tons a year is generated in Japan. The 76% was incinerated[1]. Incineration ash is divided into bottom ash and fly ash. Fly ash contains heavy metals, which must be strictly treated for neutralization of the landfills. Most of bottom ash is sent to final disposal site because it does not contain high fraction of heavy metals. As a result, life of final disposal site is about 20 years[1], so it is necessary to extend their life. For that reason, bottom ash is used as raw materials in cement industry.

Incineration bottom ash from municipal waste contains iron in 3 ~ 5%. Nonferrous metal and stainless steel in 1% is also included[2]. The metals in bottom and fly ash were tried to be detected or collected in the previous research[3,4]. In this work, the research and development on the physical recovery process was performed not only to remove the metals but also to recover high grade products.

2. Experimental

Metals were collected from incineration ash in Maruya Co. Ltd.. In fact, iron scrap recovered by magnetic separation can be sold. After that, mixed metal was separated from incineration ash using screen. In this research, mixed metal tried to be divided to copper, aluminum, brass and stainless steel using a drum type magnetic separation, an eddy current separation and a

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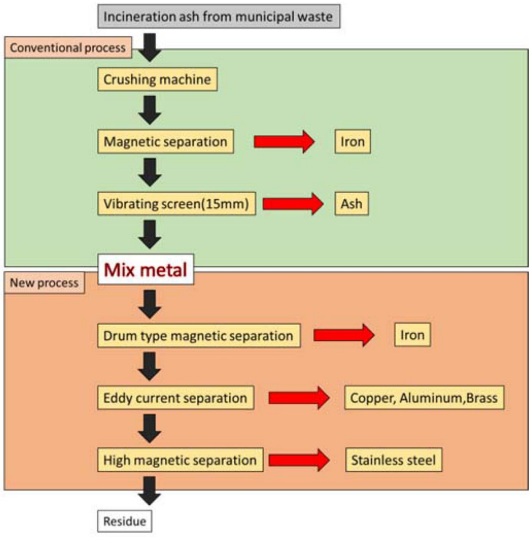

Fig. 1. Separation experiment flow.

high magnetic separation (Fig. 1).

Four different samples from different areas and incineration methodology were selected and are donated in Table 1. In this work, incineration bottom ash was used in the Iizuka City, this incinerator was a fluidized bad furnace. The incinerator in Okawa City was a stoker furnace. Optical sorting was added in the separation experiment flow to separate the remaining metal. A vibrating screen was also added to recover stainless steel of high grade. The improvement process is shown in Fig. 2.

The recovered material was analyzed to calculate the grade using X-ray fluorescence spectroscopy.

Table 1. Experimental condition

Experiment number	Emissions area	Incineration technique	Sample amount [ton]
1	Iizaka	Fluidized bad furnace	3.0
2	Iizaka	Fluidized bad furnace	2.0
3	Okawa	Stoker furnace	6.5
4	Iizaka	Fluidized bad furnace	2.4

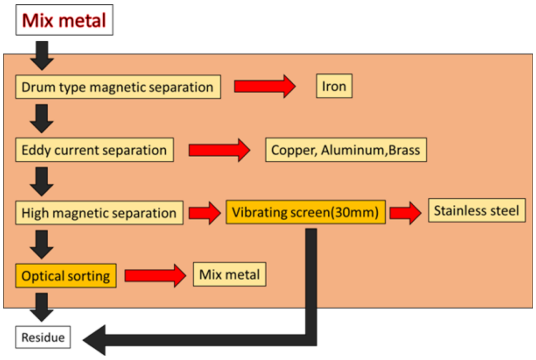

Fig. 2. Separation experiment flow (Improvement process).

3. Results and Discussion

The recovered materials are shown in Table 2. The recovered materials were analyzed on the grade using X-ray fluorescence spectroscopy to obtain the composition

Table 2. Recovered materials and mass fraction

Separation method	Recovered materials	Recovered component	Mass fraction [%]			
			1	2	3	4
Magnetic separation	Magnetic material	Iron	2.67	3.00	2.15	4.58
Vibrating screen	15 mm under	Ash	87.0	91.6	95.6	76.3
Drum type magnetic separation	Magnetic material	Iron	2.00	0.550	0.266	2.08
Eddy current separation	Flying material	Aluminum, Copper, Brass	3.67	0.850	0.0594	7.50
High magnetic separation	Magnetic material	Stainless steel	3.00	1.05	0.387	4.58
Optical sorting	Flying material	Mix metal			0.210	2.08
–	Residue	Grass, ceramics waste	1.67	2.95	1.33	2.92

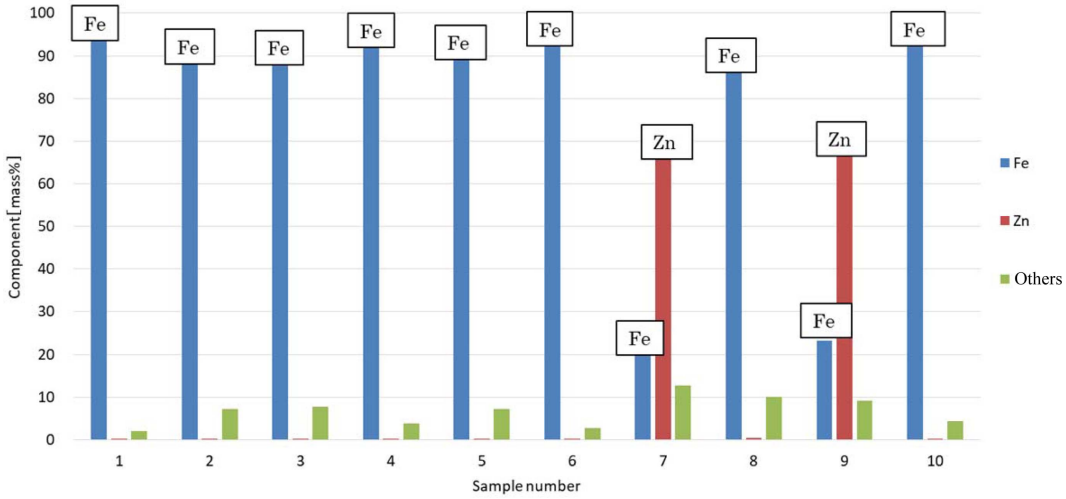

Fig. 3. XRF analysis result of magnetic material recovered by magnetic separation.

of the materials. Most of the samples were iron except for sample 7 and 9. Zink was detected in sample 7 and 9 but it is the zinc from the zine steel plate used to put the sample. Magnetic separation was effective to recover iron in high grade from MIBA.

The analysis result of magnetic fraction component recovered by drum type magnetic separation is shown in Fig. 4. It is worth to note all metals were recovered by drum type magnetic separation. Aluminum was detected in sample 3. Copper was detected in sample 7. Sample 1, 8 and 9 must be stainless steel because chromium was detected with iron. This separation method was not effective to recover iron.

The analysis result of flying component recovered by eddy current separation is shown in Fig. 5. In all the samples, high aluminum content was detected. On the other hand, these flying fractions did not contain copper and brass. Aluminum was able to be collected for frying substance without copper and brass.

The analysis result of the magnetic fraction recovered at 30 mm above by high magnetic separation is shown in Fig. 6. Moreover, the material recovered at 30 mm

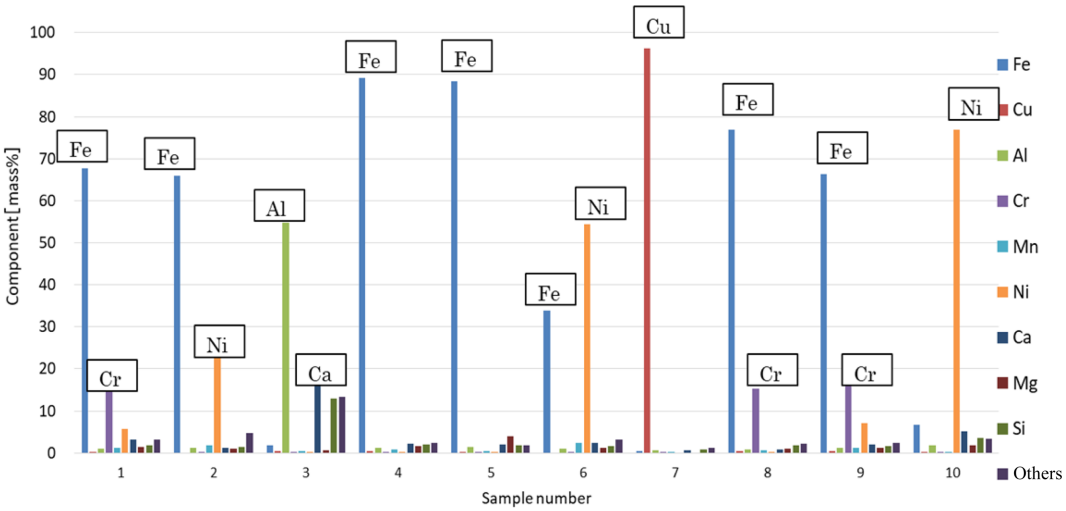

Fig. 4. XRF analysis result of magnetic material recovered by drum type magnetic separation.

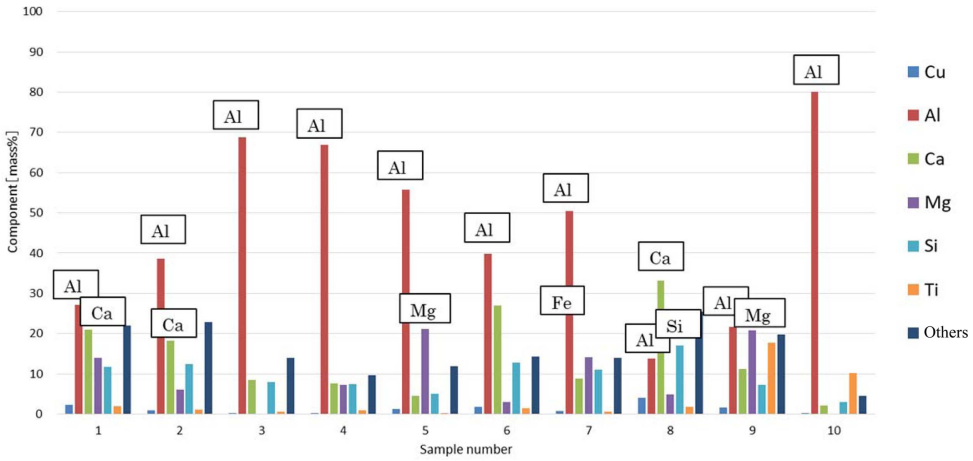

Fig. 5. XRF analysis result of flying substance recovered by eddy current separation.

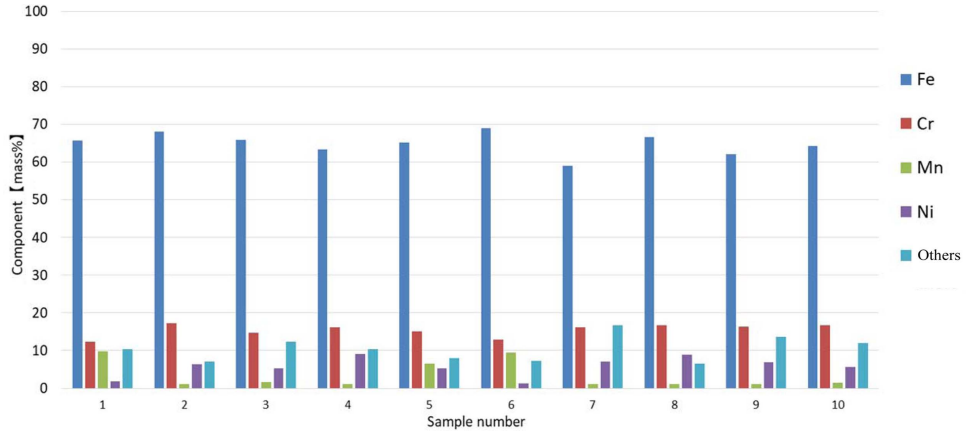

Fig. 6. XRF analysis result of magnetic material recovered by high magnetic separation (30 mm above).

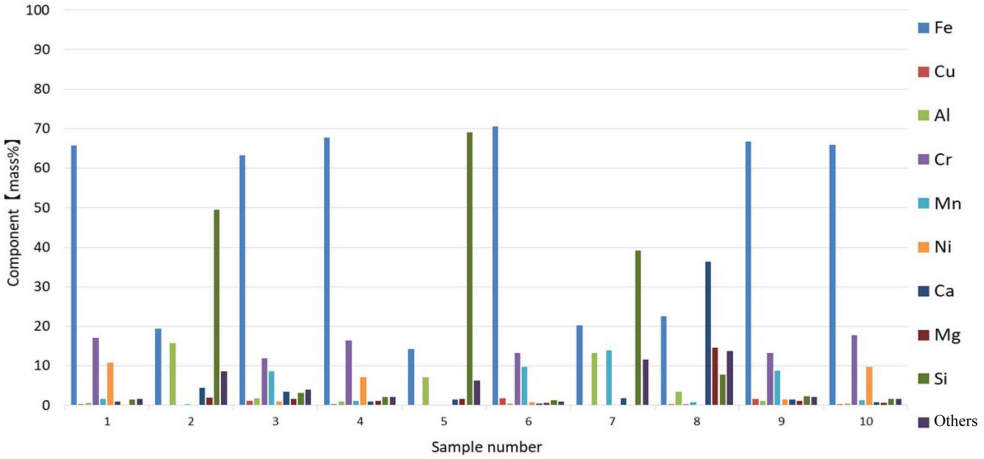

Fig. 7. XRF analysis result of magnetic material recovered by high magnetic separation (30 mm above).

under is shown in Fig. 7. Iron and chromium were detected in all samples above 30 mm. High grade stainless steel can be collected in the 30 mm screen process. However stainless steel was contained in the samples in samples under 30 mm. The recovery rate of stainless steel is a future subject would be controlled by the size of samples.

4. Conclusions

Magnetic separation was effective for recovering iron from municipal incineration bottom ash (MIBA). Magnetic material recovered by drum type magnetic separation contained dry batteries and other substances. This separation method was not effective to recover iron. Copper, aluminum and brass are typically collected by eddy current separation. Copper and brass were not detected in the analysis of these flying materials. Aluminum was able to be collected for frying substance without copper and brass.

Ceramic waste was included in the magnetic material recovered by high magnetic separation because of the trajectory. This ceramics waste was smaller than stainless steel. High grade stainless steel could be recovered by using a 30 mm screen. In addition, this metal recovery process can separate stainless steel in a mix of metals and obtain it in high grade.

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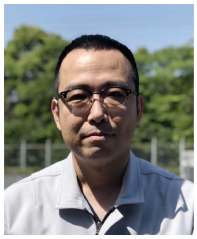

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