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EAF Dust Treatment at Miike Smelting CO.,LTD.

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Abstract

MF is a half shaft blast furnace which has been developed at Mitsui Miike Smelter in the 1960's to treat vertical retort residue. The MF has also been tested for treatment of various recycling materials and wastes. Now various secondaries and wastes (EAF dust, zinc leaching residue, Cu sludge, etc.) are mainly treated. Powder materials are briquetted with reductant before being fed to the furnace. Products are crude zinc oxide, matte, non-hazardous slag and steam. Zinc and lead are recovered in oxide dust, and copper and silver are recovered in matte. The MF can be widely applied to many kinds of materials which contain such non-ferrous metal-valuables. In addition, the improvement in operation and technology has effectively made the unit capacity much larger. The MF now has many advantages for these treatment processes.

Introduction

According to our company's research, the amount of EAF dust produced in Japan is approximately 500,000 tons per year. There are six recycling treatment companies of EAF dust in our country, including Miike Smelting Co., which are treating 350,000 tons per year.

Miike Smelting Co., is recycling 110,000 tons of waste materials per year, mostly EAF dust, by its own technology using the half shaft blast furnace called MF Process and production capacity of crude zinc oxide is 35,000t/y.

Outline of MF Process

1. History of Residue Treatment Process at Miike Smelter

Since it started zinc smelting using horizontal retort furnaces in 1913, the Miike Smelter of Mitsui Mining and Smelting Company has equipped electrolysis plants and vertical retort furnaces in turn and produced 108,000 tons of zinc per year at its peak. The residue produced by these processes was partly treated in fuming furnaces; however, for the purpose of treating increasing residue and former piled-up residue, MF Process was developed, and the first MF furnace started operations for practical use in 1965.

During the 20 years from 1965 to 1985, the residue treated by MF Process reached 2,100,000 tons, and the treatment of almost all piled-up residue was completed.

After the production of zinc metal was stopped at Miike by the down-sizing of its zinc smelting department in 1985, it was decided to treat the recycle material outside our company, only one MF furnace is treating 110,000 tons of waste material per year.

Table 1 shows the history of zinc production process and residue treatment process.

Table 1 Process Changing in MIIKE SMELER

Year	Zinc Production Process	Residue Treatment Process
1913	Horizontal Retort Process start	
1917	Sulfide Acid Plant start	
1936	Electrolysis Plant start	
1952		Fuming Furnace start
1954	Vertical Retort Process start	
1965		No.1 MF Furnace (80t/d) start
1966	Horizontal Retort Process stop	No.2 MF Furnace (80t/d) start
1969		No.3 MF Furnace (120t/d) start
1970	Vertical Retort 32 Furnaces complete	
1973		No.4 MF Furnace (150t/d) start
1974		No.1,2 MF Furnace stop No.5 MF Furnace (200t/d) start
1975	Electrolysis Plant stop	No.6 MF Furnace (200t/d) start
1976		Fuming Furnace stop
1979		No.5 MF Furnace stop
1982	Vertical Retort from 32 Furnaces to 12 Furnaces	No.3 MF Furnace stop
1985	Vertical Retort Process stop	No.4 MF Furnace stop

2. Features of MF Process

Today MF is treating mostly EAF dust, but it is also treating the zinc leaching residue produced by other smelters, and copper recycling materials. Table 2 shows the typical construction of MF materials.

Table 2 MF Feed Material (t/year)

EAF Dust	Zn Leaching Residue and Other Waste Materials	Total
90,000	20,000	110,000

In Figure 2 is shown the flowsheet of MF Process. In MF Process, lump materials are fed straight to the MF furnace, and powder materials after being briquette.

In the briquetting process, such materials as EAF dust and leaching residue, silica as flux and coal are constantly fed and transmitted to the dryer, where sulfite liquor as binder is added, blended with the materials. and the moisture is regulated. This mixture, after being milled and mixed in the rod mill, is briquetted and constantly fed to the furnace.

In the MF furnace, zinc and lead oxide dust, matte and slag are produced. This slag, stable and non-toxic, is sold as the material for cement. The oxide dust, carried out from the furnace with the exhaust gas, is collected in the boiler, cooler and the bag filter. The exhaust gas, after the dust has been collected, contains approximately 100ppm of SOx, which is decreased by desulfurization into less than 1ppm and emitted into the air. The oxide dust, after being washed, filtered in order to remove chlorine and fluorine, is transmitted to Zinc Smelter, as crude zinc oxide.

From the MF furnace slag and matte are taken out constantly; the matte, separated and recovered in the settler by its specific gravity, is sold as the material for copper.

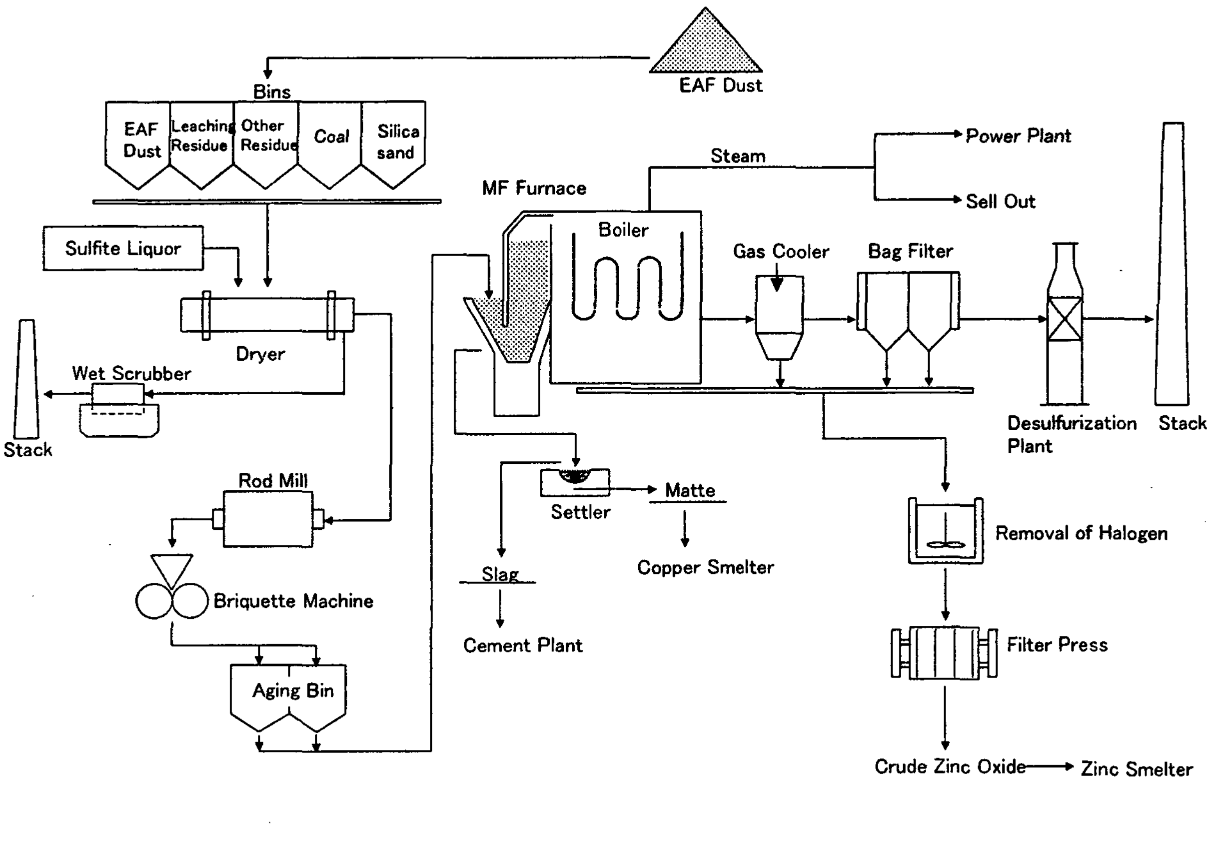

Figure 2 Flowsheet of MF Process

Figure 3 shows the conceptual figure of MF furnace.

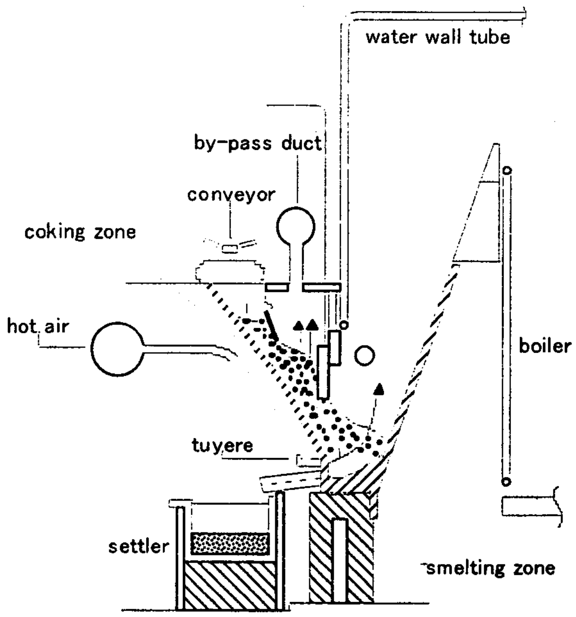

Figure 3 Conceptual Figure of MF Furnace

The briquettes fed from the feeding shoot, after being dried and preheated in the coking zone, enter the smelting zone. Zinc and lead are deoxidized there, and after reoxidization turned into oxide dust; copper and precious metals are concentrated in the matte. It is an important feature of MF furnace that these metals can be recovered in it at the same time.

Fed into the furnace, 85-90% of the zinc, 95-97% of the lead and 45-50% of the silver are recovered as oxide dust, and 70% of the copper and 35-40% of the silver as matte.

Table 3 shows the typical grade of each product.

In addition, the furnace and the waste heat boiler are constructed in one unit so that efficient recovery of heat is possible.

Table 3 Typical Assay of Product

	Zn %	Pb %	Cu %	Ag g/t	Fe %
Crude Zinc Oxide	65~ 69	8 ~ 10	0.1	100 ~ 200	0.8
Matte	2	0.3	40 ~ 55	3000 ~ 5000	10 ~ 15
Slag	3.5	0.1	0.5	30 ~ 40	38 ~ 40

Technological Progress in MF Process

1. Changes in MF Materials and the Steps Taken

As mentioned before, MF Process was developed for the purpose of treating the residue in a vertical retort. Later on, by the technological improvement of the vertical retort, the zinc grade contained in the residue was gradually lowered, and the trouble frequently occurred, resulting from the generation of a large amount of furnace iron produced by the excessive carbon caused when only the residue was fed. For the purpose of coping with this trouble and using effectively the excessive carbon, zinc leaching residue or some other residue containing zinc and the powder part of the said residue were mixed and briquetted, and then this briquette was treated together with the briquetted residue; thus proper Zn/C grade was maintained.

When the vertical retort process was stopped in 1985, the rate of treating the waste materials such as EAF dust outside our company increased, which previously had been treated in a small amount; thus kinds of MF materials greatly changed and such a change caused a problem. As the rate of feeding EAF dust increased, the chlorine contained in it increasingly corroded MF boiler tubes. For this reason, the step was taken to wash the EAF dust in a pellet form by a sprinkler and dechlorinate it in a storage bin and then feed it to the MF furnace. Figure 4 shows the conceptual figure of dechlorination of EAF dust, and table 4 , its effect. Figure 5 shows the effect of temperature and time at laboratory test.

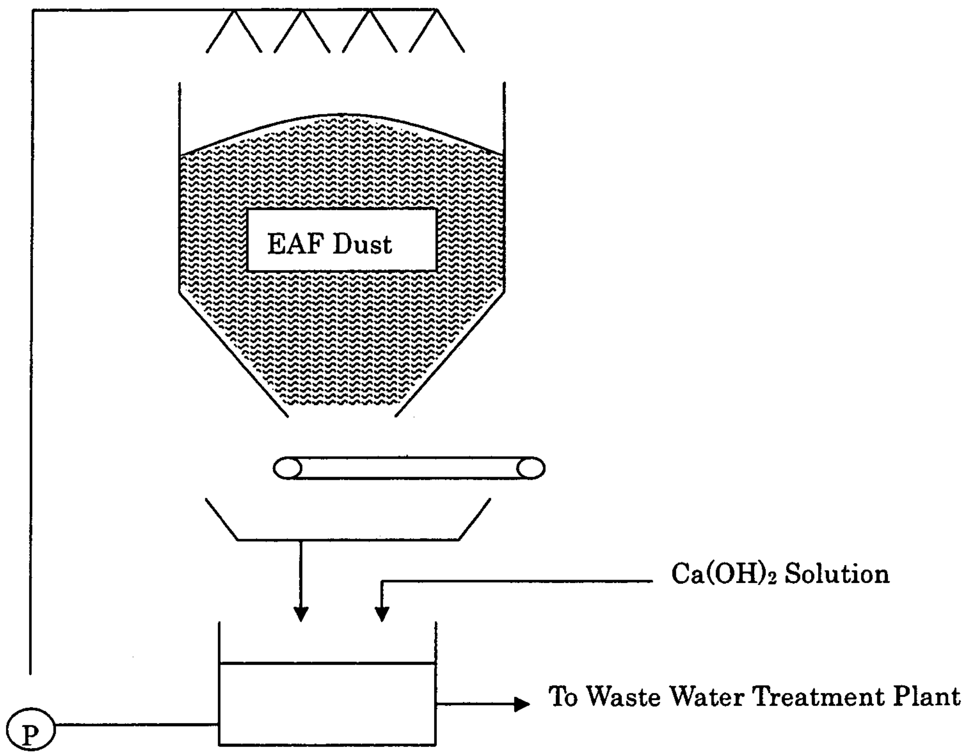

Figure 4 Conceptual Figure of Dechlorination of EAF Dust

Table 4 Chlorine Removal Treatment of EAF Dust

	Cl %	Zn %	Moisture %
Before Treatment	5.5	15~35	5 ～ 7
After Treatment	< 0.7	15~35	15

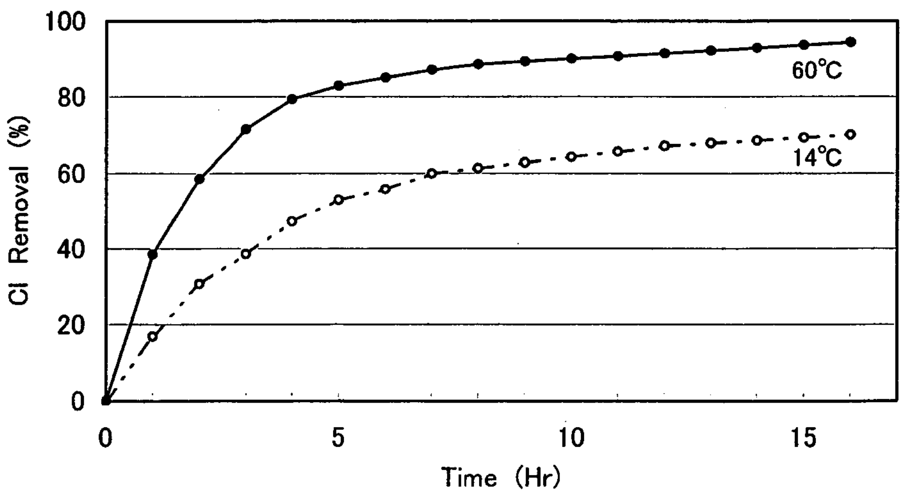

Figure 5 Effect of Time and Temperature on Dechlorination

2. Reinforcement and Improvement of the Boiler

As chlorine load in MF increased, the corrosion of the boiler tubes worsened, especially that of the Super Heater part exposed to high temperatures. Accordingly, the first improvement was introduced to decrease the heat load of the S.H. part by shifting the front half of the S.H. into a generating tube, decreasing its heating area and lowering the steam temperature, and at the same time to increase the amount of evaporation. By this improvement the amount of evaporation increased from 14.6t/hr to 16.3t/hr.

Figure 6 shows the structure of MF boiler.

The second improvement was to try spray coating nickel chrome alloy on the bending part of the lower part of the tube, as the damage of the S.H. concentrated on that part. As a result, little damage occurred to the spray coated part.

As the amount treated by MF reached 60,000t/y and the evaporating amount of the boiler drew near 16.3t/hr, its maximum power, the evaporating power of the boiler had to be controlled by controlling the amount of the blast air so as not to exceed its maximum power; this fact interfered with the increase of treatment by MF Process. So in 1989 the third improvement was introduced to reinforce the maximum evaporating power of the boiler into 23.3t/hr.

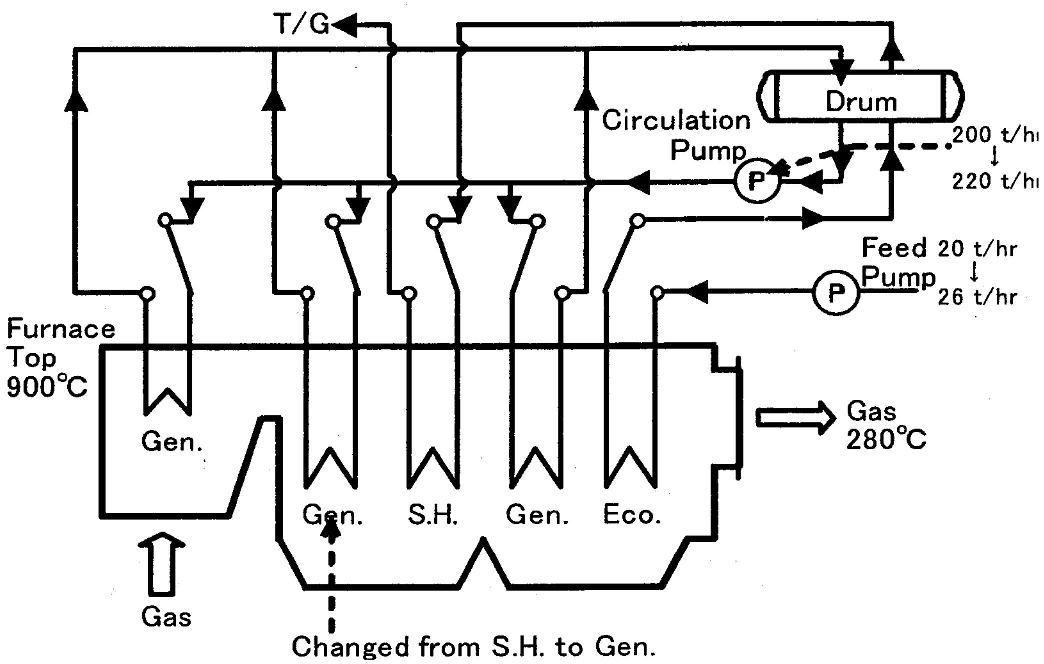

Figure 6 Structure of MF Boiler

Table 5 shows the heat balance of MF furnace and MF boiler. Approximately 75% of the amount of heat fed into the boiler is recovered as steam, which is used for private power generation.

Table 5 MF furnace and MF boiler Heat Balance

Inlet			Outlet		
Object	1,000 kJ/h	Ratio	Object	1,000 kJ/h	Ratio
Coal	23,040	76	Slag	4,370	15
Air	1,950	7	Reduction of Zinc-Oxide and Ferrite	570	2
Binder	2,710	9	Boiler Inlet Gas	20,358	67
Oxidation of Zinc	2,540	8	Cooling Water	2,735	9
			Radiation Loss	2,207	7
Total	30,240	100	Total	30,240	100
Boiler Inlet Gas	20,358	100	Steam	15,145	74
			Waste Gas	4,260	21
			Radiation Loss	953	5
Total	20,358	100	Total	20,358	100

3. Production of High Grade Matte

When the operation started, MF matte was in such a low grade as to contain Cu 3-4% and Ag 500-600g/t. As Figure 7 shows, the copper grade in MF matte depends greatly on the Cu/S ratio in the materials.

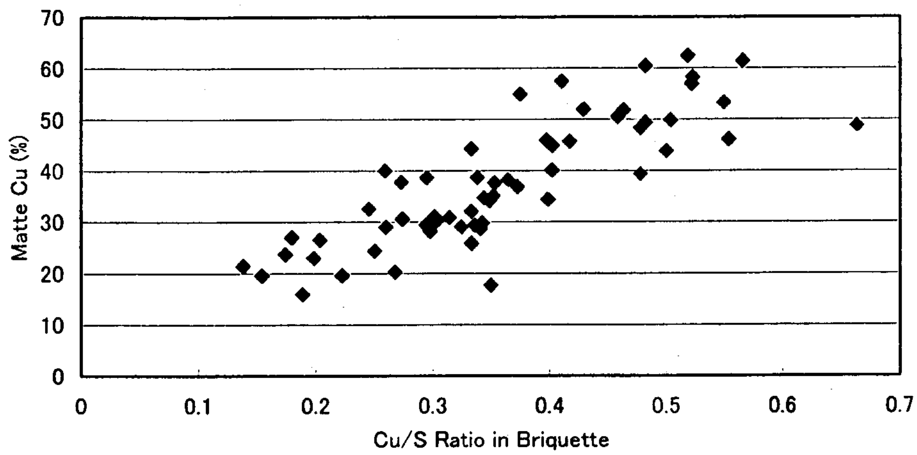

Figure 7 Matte Cu% v.s. Cu/S Ratio in Briquette

4. Increase of MF Treatment

Since 1985, only one MF furnace has been in operation, and improvements have been made to increase its treating capacity.

Our briquetting plant, which previously was feeding briquettes to four MF furnace, is supposed to have enough producing capacity to cope with the increase of MF treatment. So improvements were made to feed at a stable rate homogeneous and strong briquettes to MF furnace. In 1989 the computer system was renewed, and the monitoring and controlling system of the plant was strengthened. As a result, MF materials of no less than 15 kinds of waste materials, coal and silica were fed steadily from the bin at a fixed rate; moisturing control was improved; the composition and moisture of briquettes became stable; thus the production of homogeneous and strong briquettes was realized.

In MF Process the improvement of the blast air was introduced to raise its treating capacity. The strength of briquettes and the decrease of draft resistance in briquette layers in the furnace made an increase in the amount of blast air possible. At present the blast rate was increased to $400Nm^3/min$ and blast temperature was kept to 300℃, the treating capacity of MF Process increased markedly, and its treating amount reached 110,000 t/y. Figure 8 shows the increase of the treating amount of MF Process.

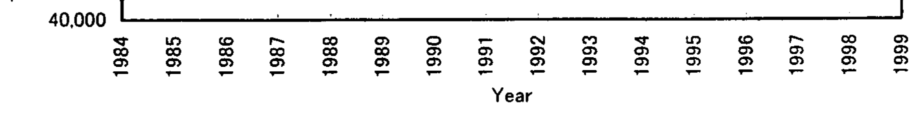

Figure 8 Increase of the Treating Amount of MF Process

Summary

As environmental problems continue to grow more serious, MF Process, by its original technology, will contribute greatly to the recycling treatment of waste materials, especially those containing nonferrous metals. Our company earnestly hopes to develop MF Process into a more efficient and more economical process.