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Size Dependence of the Filter Dust Composition of a Secondary Copper Smelting Furnace

Christof Lanzerstorfer
Process Engineering and Production/University of Applied Sciences Upper Austria
Stelzhamerstraße 23, Wels, Austria
c.lanzerstorfer@fh-wels.at

Abstract **-** In the copper industry dusts are generated in various processes and separated from the off-gas by filters. Depending on the dust composition different options for processing of the dusts can be taken into account: recycling into the metallurgical process and hydrometallurgical processes or pyrometallurgical processes. The main components in the dust from a secondary copper smelting furnace were Zn and Pb. But there was also some Cu contained in this dust. Air classification of this dust showed that Cu was enriched in the coarse fraction while in the finest fraction Cu was depleted. In contrast, Zn and Pb were enriched in the finest fraction. Thus, air classification could be considered for separation of the filter dust into two fractions: a coarse fraction for recovery of Cu and a fine fraction which is discharged for recovery of Zn.

Keywords**:** Secondary copper smelter, filter dust, dust composition

1. Introduction

Metallurgical industries generate high quantities of different types of residues from off-gas cleaning. Usually, hydrometallurgical and pyrometallurgical processes are employed for treating such residues. Another option is a partial recirculation of the residue back into the metallurgical process, which results in reduced amounts to be treated externally. Such recirculation is usually accompanied by an increase of the content of volatile components in the residue. For the conversion of dusts from secondary copper smelters into value-added products hydrometallurgical processes have been described [1,2]. For leaching processes the amount and composition of the material fed into the process are quite important for the treatment costs. Therefore, simple pre-treatment processes for up-grading of the material prior to the leaching process would be useful. Classification might be such a pre-treatment process. However, information on the size dependence of the composition of the material would be required.

In this study, the size dependence of the composition of the filter dust from a secondary copper smelting furnace was investigated. Because of the small size of the dust particles air classification had to be applied for the separation of the filter dust into size fractions.

2. Material and Methods

A dust sample of approximately 2 dm^3 was collected from the fabric filter for off-gas de-dusting of the melting furnace (shaft furnace) of a secondary copper smelter. Upstream of the filter the coarse dust is separated from the off-gas in a settling chamber. The dust samples were taken from the dust discharge system of the filter. For the reduction of the sample volume to a volume suitable for the various measurements sample dividers (Haver&Boecker HAVER RT and Quantachrome Micro Riffler) were applied.

For dry classification a Hosokawa Alpine laboratory classifier 100 MZR was used. In the first step of the sequential classification the finest size fraction, Particle Class 1, was separated from the bulk at a speed of 20,000 rpm. The remaining coarse fraction was used as feed material in the second classification step, in which the classifier was operated at 10,000 rpm to shift the cut size diameter of the classification to a coarser particle size. In this classification step the material was split into Particle Class 2 and Particle Class 3. A detailed description of a sequential classification can be found elsewhere [3].

The particle size distribution of the dust sample and the size fractions produced by air classification was measured using a HELOS/RODOS laser diffraction instrument with dry sample dispersion from Sympatec. The instrument was checked with a Sympatec SiC-P600'06 standard with a target value for the mass median diameter d_{50} of 25.59 µm. The measured value for the d_{50} was 25.62 µm.

The concentration of Cu, Pb, Sn and Zn in the dust sample and the size fractions produced was analysed by X-ray fluorescence spectroscopy with a Panalytical Axios Advanced system in an external laboratory.

3. Results and Discussion

Figure 1 shows the particle size distributions of the three size fractions produced by air classification. The mass fractions of the tree particle classes and their mass median diameter are given in Table 1.

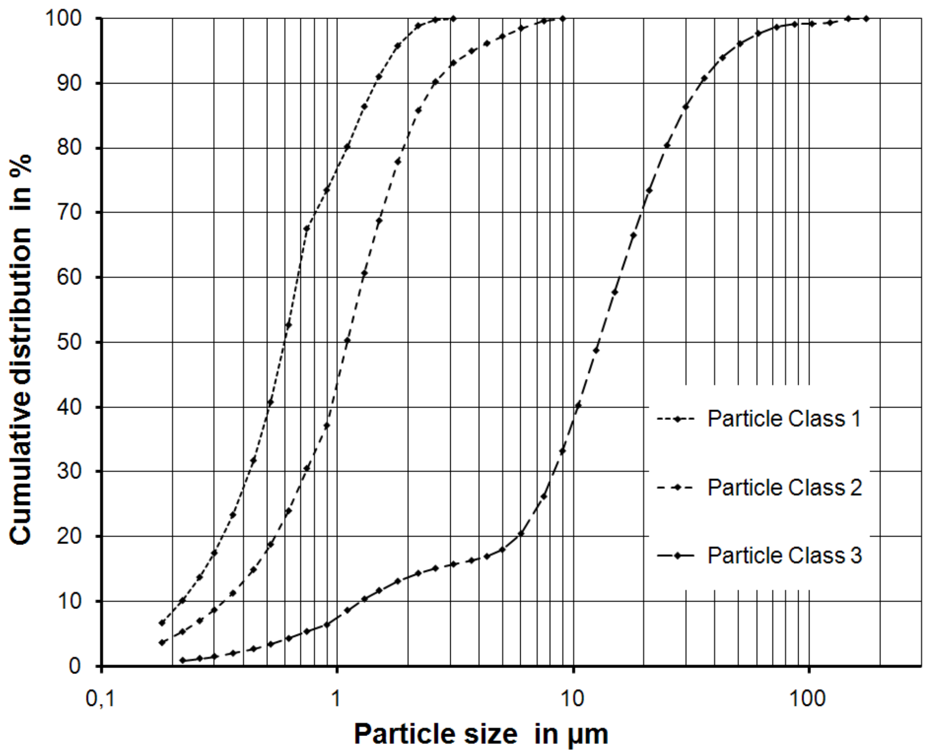

Fig. 1: Particle size distribution of the size fractions produced.

Table 1: Characterization of the size fractions produced.

		Original dust	Particle Class 1	Particle Class 2	Particle Class 3	Recovery rate
Mass fraction	%	-	33.6	37.9	28.5	-
Mass median diameter	µm		0.6	1.1	13	-
Cu	g/kg	33.9	17.1	27.5	63.3	1.01
Pb	g/kg	134	144	142	113	1.00
Sn	g/kg	18.9	20.1	17.1	20.4	1.03
Zn	g/kg	460	504	500	372	1.01

The composition of the particle classes is also given in Table 1. Particle Class 1 and 2 do not differ very much. This is not surprising because also their particle size does not differ substantially. In contrast, the coarsest size fraction Particle Class 3 is enriched in Cu and depleted in Zn. The consequence of this on the composition of the coarse fraction and the fine fraction of a classification process of similar sharpness calculated according [4] are shown in Figure 2. When, for example, the dust is split in two size fractions of equal mass the Cu content of the coarse and fine fraction would be approximately 50 and 20 g/kg, respectively. The Zn content of the fine fraction would be approximately 50% and in the coarse fraction approximately 40%

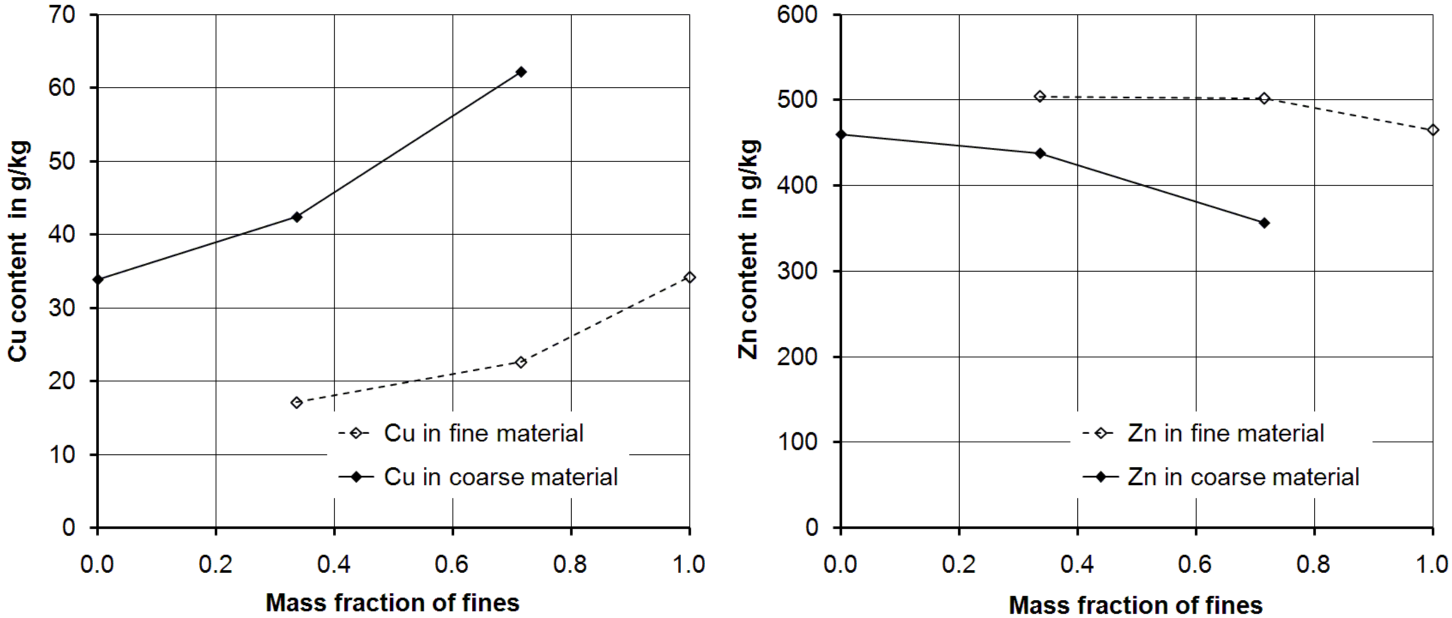

Fig. 2: Composition of coarse fraction and fine fraction in dependence of the mass split

4. Conclusion

The main components in the dust collected by the off-gas filter of a secondary copper smelting furnace were Zn and Pb. But there was also some Cu contained in this dust. Air classification of the dust showed that the Cu content was nearly twice as high in the coarse fraction while in the finest fraction the Cu content was significantly reduced. In contrast, Zn and Pb were enriched in the finest fraction. Thus, air classification could be considered for separation of the filter dust into two fractions: a coarse fraction for recovery of Cu and a fine fraction which is discharged for recovery of Zn.

Acknowledgements

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