Process concept based on pyrolysis for integration of Shredder light fractions (SLF) in the Recycling of Waste Electrical and Electronic Equipment

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Abstract (300 word limit)

Yearly production of rest fractions like shredder light fractions (SLF) in the preconditioning of waste electric and electronic equipment (WEEE) accounts almost the 4.22% in a state of the art preprocessing company for this sort of wastes. This amount together with other shredder residues e.g. automobile recycling industry accounts the 4% of the total waste generated in Europe (2.5 billion tons). Considering not only the hazard to human health due to risk of exposition to different toxic materials like dioxins, furans and heavy metals due to wrong handling, but also taking into account the content of valuable metals like Cu, Ag, Au, Pd, is making recycling of such a wastes an important issue. Therefore, a research has been conducted in the last five years at IME-RWTH Institute, trying to find an economical, technical and sustainable solution. In this particular case, as indicated in Figure 1, a process concept based on an autothermic smelting stage of printed circuit boards, followed by a slag reduction stage using pyrolysed SLF from WEEE as reducing agent has been evaluated. Results has indicated that pyrolytic materials follows a different reduction path compared to commercial coke that makes the material appealing to the process. This mechanism uses the still presented organic carbon after pyrolysis with some oxides like Cu, Ni, Al oxides as catalyst materials to undergo e.g. the so called steam and dry reforming reactions to generate free hydrogen that acts as alternative reducing agent. This increases the kinetics and effectiveness of the reduction process in general by at least 30%. The process has been validated in demo-scale by treating 250 Kgs of SLF. The PCBs autothermic smelting as well as reduction process were conducted in the pilot Top-blown-rotary converter available at IME Insitute.

These results opens the opportunity to use SLF materials not only as energy carrier but also as an effective reducing agent for the copper industry.

Image

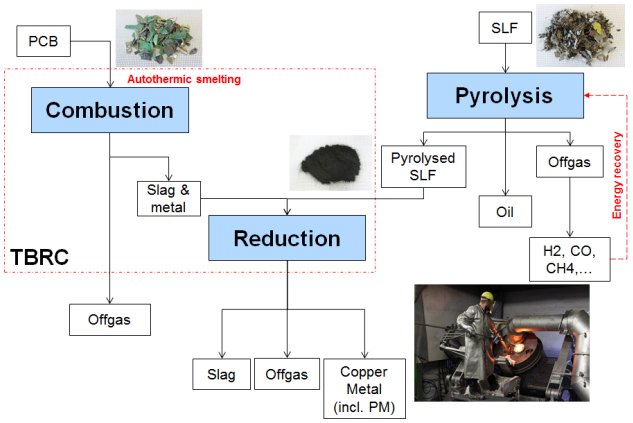


Figure 1. Process concept to use SLF as an effective reducing agent in the copper production route

Recent Publications (minimum 5)

1. F. Diaz, Y. Wang, R. Weyhe, B. Friedrich, Gas generation measurement and evaluation during mechanical processing and thermal treatment of spent Li-ion batteries, Waste Management 84 (2019) 102–111.
2. F. Diaz, Y. Wang, T. Moorthy, B. Friedrich, Degradation Mechanism of Nickel-Cobalt-Aluminum (NCA) Cathode Material from Spent Lithium-Ion Batteries in Microwave-Assisted Pyrolysis, Metals 8 (2018) 565.
3. F. Diaz, B. Flerus, S. Nagraj, K. Bokelmann, R. Stauber, B. Friedrich, Comparative Analysis About Degradation Mechanisms of Printed Circuit Boards (PCBs) in Slow and Fast Pyrolysis: The Influence of Heating Speed, J. Sustain. Metall. 4 (2018) 205–221
4. F. Diaz, S. Florez, B. Friedrich, Mass Flow Analysis and Metal Losses by the Degradation Process of Organic-Containing WEEE Scraps, Chemie Ingenieur Technik 87 (2015) 1599–1608.
5. N. Borowski, A. Trentmann, F. Brinkmann, M. Stürtz, B. Friedrich, Metallurgical Effects of Introducing Powdered WEEE to a Molten Slag Bath, J. Sustain. Metall. 4 (2018) 233–250.



Biography (150 word limit)

Mr. Diaz has completed his bachelor degree in the field of Electronic Engineering at the Universidad Pontifia Bolivariana in Colombia and later his master in Metallurgical Engineering at the RWTH- Aachen University in Germany 2013. Since August 2013 he has been working as research assistant at the institute IME Process Metallurgy and Metal Recycling in the field of WEEE recycling.

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Notes/Comments: