KnE Materials Science

TECHNOGEN-2019
IV Congress "Fundamental research and applied developing of recycling and utilization processes of technogenic formations"
Volume 2020

Knowledge E
enriching | engaging | empowering

Conference Paper

Comprehensive Processing of Fine Metallurgical Dust

Anton A. Kovyazin[1], Vasilii A. Kochin[1], Konstantin L. Timofeev[2], and Sergey A. Krayuhin[2]

[1]JSC «Uralelektromed», Verkhnyaya Pyshma, Sverdlovsk Region, Russia
[2]Non-state Higher Educational Establishment «UMMC Technical University», Verkhnyaya Pyshma, Sverdlovsk Region, Russia

Abstract

The processing of fine metallurgical dust by pyrometallurgical methods leads to the accumulation of impurities and deterioration in the quality of blister copper. Fine dust contains copper, zinc, lead, arsenic and iron. A hydrometallurgical method for the separation of the main components into the following products is proposed: copper-zinc residue, iron-arsenic residue, lead residue. The hydrometallurgical scheme consists of three stages of leaching: neutral and using sulfuric and nitric acids. When processing metallurgical dust according to the proposed scheme, a solution containing copper, zinc, iron and arsenic is formed, as well as a lead containing precipitate. Arsenic and iron are removed from the solution in the form of iron (III) arsenate, after which zinc and copper are precipitated. Lead in sediment is in carbonated form. The developed technology allows the extraction of: 87% copper, 88% zinc, 83% iron, 83% arsenic, 99% lead in individual products.

Keywords: metallurgical dust, arsenic removal, nitric acid leaching.

Corresponding Author:
Anton A. Kovyazin
a.kovazin@tu-ugmk.com

Published: 31 December 2020

Publishing services provided by Knowledge E

© Anton A. Kovyazin et al. This article is distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use and redistribution provided that the original author and source are credited.

Selection and Peer-review under the responsibility of the TECHNOGEN-2019 Conference Committee.

The object of the study is technical zinc oxide (TZO) of a copper plant located in Kirovgrad (Sverdlovsk region, Russia). The production volume of TZO is 17 thousand tons per year. TZO has the following chemical composition: 6.0% Cu, 13.5% Zn, 8.1% Fe, 9.2% As, 17.5% As, 17.5% Pb, 1.3% Sb, 2.2% Sn, 4 g/t Au, 145 g/t Ag. The phase composition of TZO is shown in Figure 1. The involvement of TZO in copper production at the matte smelting stage will lead to a significant increase in dust formation, as well as to accumulation of impurities in all processed products, which will lower the quality of blister copper [1, 2]. The aim of the research was to develop a technological scheme for processing technical zinc oxide with the obtainment of concentrates suitable for involvement in the current production and removal of arsenic with waste products.

Based on the results of laboratory and enlarged laboratory tests, a technological scheme has been developed (see Figure 2), which consists of the following main operations: neutral leaching, sulfuric acid leaching, nitric acid leaching, precipitation

OPEN ACCESS

of arsenic, precipitation of copper and zinc, carbonization of lead residue. Ancillary operations: waste gas purification, preparation of calcium hydroxide solution.

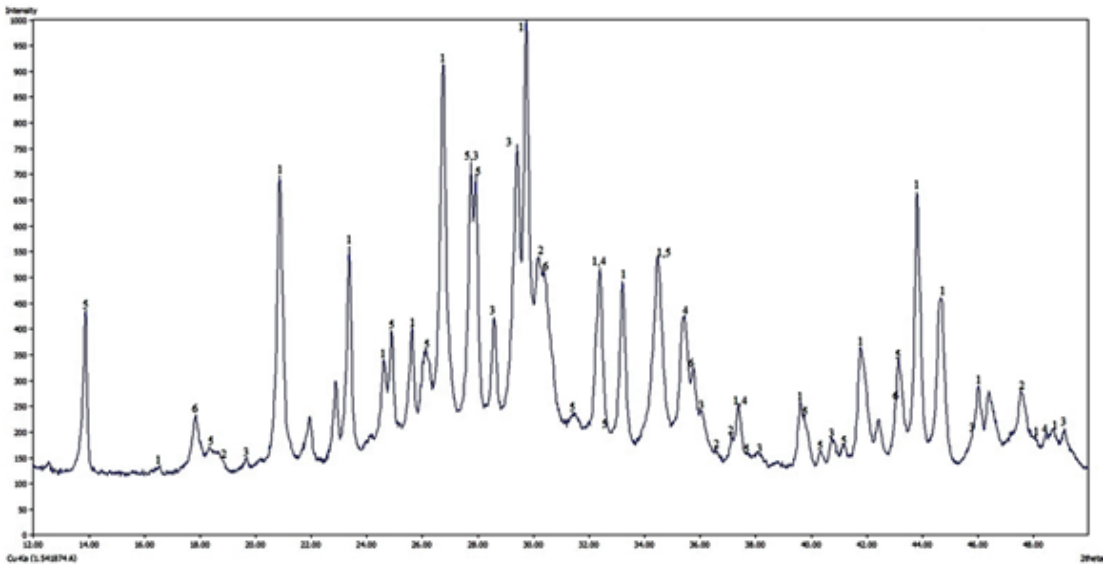

Figure 1: The phase composition of technical zinc oxide. Author's own work. 1 – $PbSO_4$; 2 – FeS_2; 3 – $CuFeS_2$; 4 – ZnO; 5 – As_2O_3; 6 – Fe_3O_4.

As a result of processing TZO according to the proposed scheme, the following products were obtained: zinc-copper, lead and iron-arsenic residues. The chemical composition of these products is presented in Table 1. It is suggested to send obtained zinc-copper product to Waelz-process, lead product to smelting and iron-arsenic product to disposal. The recovery of the main components into the aforecited products is presented in Table 2.

Table 1: The chemical composition of products obtained after processing of technical zinc oxide

Product	Cu	Zn	Fe	As	Pb	Sb	Sn	Au	Ag
	%							g/t	
Zn-Cu residue	7,1	19,4	6,5	0,4	0,0	0,0	0,0	0,0	0,0
Fe-As residue	0,5	1,7	26,2	16,0	0,01	0,2	0,7	0,0	0,0
Pb residue	1,0	2,0	6,5	3,7	39,3	2,4	5,3	10,2	368,8

Table 2: The recovery of components into products obtained after processing of technical zinc oxide

Product	Cu	Zn	Fe	As	Pb	Sb	Sn	Au	Ag
	%								
Zn-Cu residue	87,0	88,2	1,9	2,7	0,0	0,0	0,0	0,0	0,0
Fe-As residue	5,2	6,1	82,8	83,0	0,02	27,1	4,0	0,0	0,0
Pb residue	7,8	5,7	15,3	14,3	99,9	72,9	96,0	100	100

The proposed technology will reduce the amount of waste affecting the environment from 17 to 9 thousand tons per year. The combination of neutral leaching, leaching

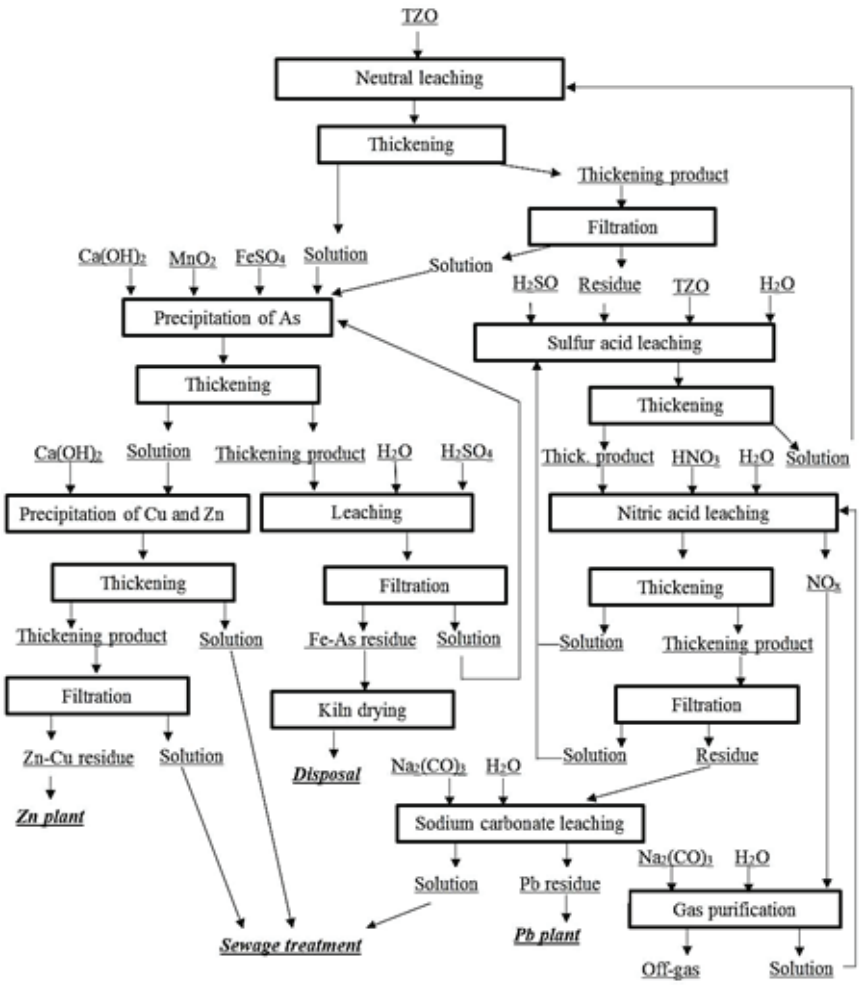

Figure 2: Proposed technological scheme of technical zinc oxide processing

with sulfuric and nitric acids leads to an increase in the number of technological equipment. However, this can significantly reduce the consumption of reagents due to their more complete use, and, as a result, lower final concentrations of acids in productive solutions. The resulting products are suitable for involvement in existing technologies. The withdrawal of arsenic into a separate product allows reducing the load on the smelting units. Currently, research is underway in the field of gas purification and regeneration of nitric acid [3], which should further reduce the cost of processing.

References

[1] Montenegro, V., Sano, H. and Fujisawa T. (2008). Recirculation of Chilean Copper Smelting Dust with High Arsenic Content to the Smelting Process. *Materials Transactions*, vol. 49, pp. 2112–2118.

[2] Montenegro, V., Sano, H. and Fujisawa, T. (2013). Recirculation of High Arsenic Content Copper Smelting Dust to Smelting and Converting Processes. *Minerals Engineering*, vol. 49, pp. 184–189.

[3] Rogozhnikov, D. A., *et al*. (2011). Methods of Disposal of Exhaust Nitrous Gases. *Modern problems of science and education*, vol. 6, p. 81.