Advances in Non-ferrous Pyrometallurgical Processing

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The topic for this year's contribution to *JOM* from the TMS Pyrometallurgy Committee is Advances in Pyrometallurgy. Three diverse papers have been assembled that show the breadth of current technical activities in the field of non-ferrous pyrometallurgy.

Almost three-quarters of the approximately 17 million tonnes of copper produced each year is processed pyrometallurgically. In all but a few cases, copper mattes (copper sulfides) are produced as an intermediate product in the smelting stage. The matte is then oxidized through to blister copper in the converting stage suitable for electrorefining and ultimately fabrication into everyday products used by society.

The first paper, by J.W. Matousek, presents empirical methods for estimating key thermodynamic properties of copper mattes. For engineers working in operating plants, the simple tools summarized in this paper will be useful for quickly estimating thermodynamic properties of copper mattes for heat balances without deferring to more complex tools like FactSage™ and other thermodynamic modelling software packages.

For many years, smelting technology, and the underlying thinking that formed the basis for the various technical developments, developed in relative

isolation in the former Soviet Union (FSU). In most cases, the technical experts were well aware of developments in the West through various publications but there was only limited information presented in the West on the FSU technologies.

The second paper, by A.V. Tarasov and V.M. Paretsky, summarizes advancements made by their institute over

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a number of years to improve pyrometallurgical processes for the production of copper. Advances described by Paretsky and Tarasov include the modification of the smelting slag composition to reduce copper solubility in the slag and make it self-decrepitating on cooling to minimize grinding requirements prior to matte recovery in a flotation process, and a smelting technology that combines flash smelting with bath smelting that has been commercialized at the Almalyk copper smelter in Uzbekistan.

A key requirement for pyrometallurgical processes is to reliably keep the molten materials being processed

inside the furnace except when being tapped from the furnace in a controlled manner. Furnaces historically relied on uncooled refractories to contain molten materials. However, as pyrometallurgical process intensities increased, the steady state heat fluxes through furnace sidewalls required increased refractory cooling to prevent furnace run-outs. There are a range of refractory cooling techniques applied in industry today. Intensely cooled cast copper jackets are required for the most intense smelting processes like that practiced at Anglo Platinum's Polokwane Smelter.

However, water-cooled copper jackets can be corroded by various sulfur species in the furnace. In the case of the Polokwane Smelter, the interaction of labile sulfur compounds produced as the concentrate is smelted with the cast copper led to sulfidization of the copper. In time, this led to an unexpected structural failure of the cast copper jackets from the inside of the furnace to the outside.

The third paper, by Afshin Sadri et al., describes a key advance in monitoring techniques to measure the remaining thickness of the cast copper jackets. Now that reliable measurements can be made with time, furnace rebuilds can be scheduled proactively and improved combinations of materials can be safely tested in the operating plant.

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