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Editorial

Editorial for Special Issue "Water within Minerals Processing"

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The products of mining are key to the technology development of the future. However, mining has a poor reputation when it comes to environmental impact, especially in terms of the contamination of water bodies. How do we navigate the negative environmental impact to ensure metal product delivery with the associated positive economic and technological benefits? With so many mining operations located in water-scarce regions, as well as worldwide water shortages, tighter environmental restrictions and developing corporate sustainability strategies, mining operations have been forced to reduce their on-site water intake where necessary and possible. For this reason, water reduction, reuse and recycling within minerals processing is currently a highly topical issue.

By way of example, let us consider South Africa. South Africa has a long legacy in mining, with historic conflict between mining companies and surrounding communities around the usage of water and land [1–3]. South Africa is a water-stressed country, with 100% of available water supplies fully allocated. The mining sector only consumes around 3% of the country's water supply; however, the processing of minerals generates water of an inferior quality which either ends up in tailings dams or requires treatment before it can be discharged to the environment [4–6]. Stricter regulations on water usage and discharge of water from mining sites has made it necessary for mines to reduce, reuse and recycle their on-site process water [7,8]. To achieve an effective zero intake of fresh water, operations also employ the use of partially or poorly remediated 'grey' water sources for the supplementation of recycled process waters to top up the water lost during processing. This brings with it challenges in terms of processing methods and conditions optimised for high-quality water use. Recycled water, on average, has a higher ionic strength and more dissolved solids and biological contaminants than fresh water, all of which may interact with the mineral surface and impact the flotation recoveries and grades. This Special Issue considers the impact that changes in water chemistry have on the mineral concentration process, with special focus on research that considers flotation as the primary process, with related processes and fit-for-purpose water treatment also considered.

Papers in this Water within Minerals Processing Special Issue consider the presence of microbial communities [9,10], a novel dissolution protocol for estimating how water quality will change on closing the water loop [11], the use of ion-exchange resins for targeted cleaning of sulphate from on-site water [12], the challenges associated with the assessment of mine water quality [13], the impact of high-ionic-strength water on froth stability [14], the action of reagents within water of a high ionic strength [10,15] and a novel ion-spiking method for testing the impact of individual ions present in process water on flotation outcomes [16].

Traditionally, the measurement of chemistry on site is done with only environmental measures in mind; this does not consider the accumulation of ions which may enter the pulp during processing or any biological components that may be present. An investigation into the analytical techniques used currently for mineral slurries [13] was conducted and confirmed that for the two case studies given, the current analysis techniques were found

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to be lacking in correctly determining the chemical nature and composition of the complex plant water matrices. Further to this, it is important to understand the accumulation of species on the recycling of water on site; this was investigated by the development of the dissolution testing protocol [11], in which the same ore and water were cycled through milling a number of times, while measuring the composition and chemical character of the water. This protocol has shown that while an increase in overall ionic strength of the water is seen, it is specific components that increase over time, and these should be investigated further to fully understand their impacts. Anecdotally, certain ions have been considered more detrimental to flotation than others; however, the majority of studies that consider individual ions have been conducted on either pure mineral samples or with a single salt to consider the ion in isolation. A novel spiking method [16] was used to consider the impact of Ca^{2+} and Mg^{2+}, while maintaining a complex background water matrix as would be found on site. While these spiking tests were found to have little impact on recoveries, there was an impact noted on the grades of the concentrates for the sulphide minerals and it was determined that there may be threshold concentrations below which the ions would be of little concern to flotation outcomes. The use of water with as high an ionic strength as seawater has become necessary, particularly where operations are located close to the coast and have easy access to seawater [15]. Such operations use adjusted reagent suites in order to account for this high-ionic-strength water; however, it is vital to appreciate the impact of changing ionic strength of specific ionic components on froth stability, which in turn impacts flotation performance in terms of recoveries and grades of the valuable minerals [14]. Microbial components may be present in the mineral slurry naturally or enter via the incoming water [9]; however, little attention has been given to their impact on flotation and, in particular, when they may accumulate through recycling of on-site waters. Owing to the electrochemical nature of the collector mineral interaction, the impact of microbes on the adsorption of collectors can be measured, and it was noted that the microbes changed the surface character of the minerals, limiting the effectiveness of the collector [10]. When direct reuse of on-site water is not possible, water treatment may be required in order to remove or reduce one or more of the harmful water components. Ion-exchange resins [12] offer the option of partial targeted water treatment, providing an economical water treatment option as the resins can be regenerated and reused.

This Special Issue and the papers herein showcase the variety of research currently ongoing within the area of water within minerals processing. As more minerals processing operations close their water circuits, this type of research becomes invaluable to ensure that operations remain sustainable and profitable. Although metal recovery through ore mining has a negative public perception in most parts of the world, the one misconception is that we can continue our technology-driven future without the valuable metals recovered from mining. The challenge of the future is to find alternative sources of metals. This challenge has already been taken up by many researchers through the recovery of metals from waste streams. None of these alternative recovery methods will be water-free; thus, the issues covered in this Special Issue remain highly topical for alternative sources of metals and recovery methods.

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