Use of a dynamically controlled column to assess the impact of temperature on copper extraction and microbial activity during copper sulfide bioleaching

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During the process of heap bioleaching, heat is generated through oxidation of sulfide minerals. Heaps can be self-heating, resulting in temperature increases when heat is trapped by the surrounding mineral matrix [1]. Ore mineralogy and sulfide mineral grade and liberation play key roles in self-heating heaps.

A dynamically controlled insulated column, charged with ore known to generate 'hot' heaps was used to simulate this phenomenon. Data from a temperature probe located in the center of the ore sample relayed changes in temperature to the external column jacket via computer control. Microbial cells in column effluent were monitored. Ancillary tests targeted the effects of heat on microorganisms, such as iron(II) or sulfur oxidation kinetics. The column data were compared with data from a test heap furnished with temperature probes.

Initially, heat generation was slow, the rise in temperature trailing behind increases in planktonic cell numbers and solution redox potential. The temperature remained stable for a period of 28 days before rising rapidly to more than 80 °C. At the elevated temperatures cell numbers dropped and microbial Fe(II) oxidation ceased. After 7 days at more than 80 °C the column was cooled to room temperature. Cell numbers increased immediately, with the population present in the PLS providing inoculum for further growth. The results are discussed with reference to microbial succession, activity and heat tolerance, and comparisons made to available industrial data.

[1] Watling *et al*. (2010) *Environ. Technol*. **31**, 915–933.