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The reality of non-thermal effects in microwave assisted leaching systems?

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Abstract: This work reports a fundamental study into the influence of microwave energy on the dissolution of sulphide minerals. Chalcopyrite and sphalerite were chosen as model materials due to their economic importance and the diversity of their heating behaviour in a microwave field. Leaching of both chalcopyrite and sphalerite in ferric sulphate under microwave conditions has shown enhanced recoveries of metal values compared to that produced conventionally. The enhanced copper recovery from chalcopyrite during microwave treatment is believed to be as a result of the selective heating of the mineral particles over the solution and also due to the superheated layer of the leaching solution close to the periphery of the reaction vesselwhich creates higher temperatures compared to the bulk solution temperature. The enhanced recovery of zinc from sphalerite seems to occur as a result of only the presence of the superheated layer. If leaching takes place within this layer, an apparent rate increase will be noted with respect to the measured bulk temperature. Negligible differences between the activation energy values under microwave and conventional conditions for both chalcopyrite and sphalerite. Furthermore, measurements of the dielectric properties of the leaching solutions have shown that such solutions are highly lossy and characterised by a penetration depth of an order of about 3 mm suggesting that most microwave power dissipate within the thin outer layer of the reactor. Finally, numerical electromagnetic simulations showed that chalcopyrite particles could be heated selectively when microwaved within highly lossy leaching solutions due to their high conductivity. It is concluded that the dielectric properties of both the solid and liquid phases, the dimensions of the reactor and the position of solid particles within the reactor determine the leaching outcome. More importantly, it is likely that the enhanced recoveries observed are not likely to be as a