

The Twelve Principles of Circular Hydrometallurgy: the Copper Leach–Solvent Extraction–Electrowinning Flowsheet as a Case Study

Kathryn C. Sole

Sole Consulting, Johannesburg, South Africa

In 2023, Binnemans and Jones proposed the Twelve Principles of Circular Hydrometallurgy, which describe the requirements for a hydrometallurgical process to support a sustainable global future with respect to minerals and materials stewardship. Hydrometallurgical processing of copper oxide and secondary sulfide materials typically employs the well-known leach—solvent extraction—electrowinning process. This flowsheet concept was first commercialised at large scale in Zambia the 1970s. Today, some 20% of world primary copper cathode is produced using this technology, with the dominant contribution from the African Copper Belt. This presentation draws on examples of developments and advances during the past five decades, and continuing in the modern era, to demonstrate how this copper processing technology conforms to the principles for a circular hydrometallurgical flowsheet, and can be considered to have been ahead of its time with respect to these ideas.