

Novel biohydrometallurgical process for recovery of gold from double refractory gold ores in west Africa

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Cyanidation has been believed to a royal road process to extract gold from gold ores for over 130 years in industrial gold mining because of the high efficiency and rate of formation of gold cyanide complex and the high recovery efficiency by adsorption of gold cyanide complex on activated carbon. Meanwhile, carbonaceous refractory gold ores are not targeted because gold cyanide complex is easily adsorbed on carbonaceous matter in the ores, resulting in risks to suffer high recovery loss. In this study, the flotation concentrates of a carbonaceous refractory gold ores were subjected to biooxidation at ambient temperature using a mixed culture containing iron- and sulfur-oxidizing autotrophs, followed by gold extraction using thiourea under strongly acidic conditions. The gold extraction efficiency reached ~100% in 12 h without re-adsorption of gold complex. The different affinities of these ligands to carbonaceous matter is also predicted by DFT calculation. Finally, the quantitative recovery of the gold thiourea complex was confirmed by adsorption on strongly cationic exchange resin. Biooxidation reduced the amount of Fe-containing metal sulfides, which minimized the decomposition of thiourea, and gold thiourea complex had a low affinity toward carbonaceous matter, different from gold cyanide complex. Since the process described in this study does not require roasting to remove carbonaceous materials in pretreatment and does not use cyanide for gold extraction, it is environmentally friendly and should be considered for practical applications in carbonaceous gold ore-producing mines.