MECHANOCHEMICAL PROCESSING OF ENARGITE: FROM ARSENIC ELIMINATION TO NANOCOPPER PRODUCTION

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Enargite Cu₃AsS₄ belongs among refractory copper minerals with very low hydrometallurgical extractability of copper. An application of enargite leaching in acid solutions leads to simultaneous dissolution of copper and arsenic and the final leach solutions have to be treated for the separation of both elements. However, the alkaline leaching of enargite following the equation

\[2\text{Cu}_3\text{AsS}_4 + 3\text{Na}_2\text{S} \rightarrow 3\text{Cu}_2\text{S} + 2\text{Na}_3\text{AsS}_4\]

is selective. Arsenic passes into leach while produced copper sulphide represents the raw material suitable for pyrometallurgy.

The hydrometallurgical processing of mineral can be influenced positively by mechanochemical route [1, 2]. We have shown that more than 80 % of arsenic can be extracted from enargite concentrate by atmospheric alkaline leaching at 95 °C when mechanochemical pretreatment in an attritor is applied. The produced Cu₂S can be further treated with elemental iron following the equation

\[\text{Cu}_2\text{S} + \text{Fe} \rightarrow 2\text{Cu} + \text{FeS}\]

where mechanochemical intervention is applied in the second stage of enargite processing. The final product forms Cu/FeS nanocomposite from which copper nanoparticles can be easily separated.

The illustrated concept of copper obtaining from copper sulphide is an example of so-called “dry” processing, as reactions in gas and liquid phases are excluded. This concept of environmentally friendly metallurgical processing can be classified as an impetus for novel technology to produce copper from enargite concentrates.