Viability analysis for use of methane obtained from green hydrogen as a reducing agent in copper smelters

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Abstract

This study explores the use of green hydrogen as a flexible and environmentally-friendly energy vector in copper mining. The refining of copper sulphide ores involves several stages, such as comminution, froth flotation and smelting. The latter produces a higher concentration of copper through chemical transformations of copper sulphide ores. Reducing agents such as coal, coke, ferrosilicon and diesel are typically used in this step, but these reagents unfortunately have a considerable environmental footprint. The main goal of this work was therefore to perform a techno-economic analysis for methane production from the use of green hydrogen as a reducing agent for the smelting stage. The methodology involved the evaluation of the project based on a Net Present Value calculation and a sensitivity analysis of the main parameters which were performed using Oracle Crystal Ball software. The main results show a Net Present Value of 5.459 M USD and an 11.8-year pay-back. Multiparametric analysis shows that NPV is positive with 97.32% of confidence and that the main variable affecting the NPV is the methane price (contribution to variance of 97,8%). We conclude that the use of green hydrogen in copper smelting is a technically viable solution with economic and environmental benefits. The economic evaluation could be further improved with the incorporation of the heat and oxygen by-product, further reducing the CO_2 emission.

Author keywords

Copper mining industry; Economic analysis; Green hydrogen; Renewable energy; Smelting process