Assessment of hydrometallurgical method for copper removal in steel recycling

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Abstract:

With the steel industry's push for sustainability, recycling steel scrap becomes vital. However, copper contamination in steel limits the use of recycled material. This study evaluates both pyrometallurgical and hydrometallurgical techniques to efficiently remove copper, with a particular focus on the scalability and environmental benefits of hydrometallurgical methods.

The pyrometallurgical approaches—high-temperature chlorination, sulfide slagging, and high-temperature solvent extraction—are effective in isolating copper by forming separable phases. Despite their efficacy in processing large volumes, pyrometallurgical methods require high energy inputs and can generate significant emissions, posing additional environmental and economic challenges.

In contrast, ammoniacal leaching, a hydrometallurgical technique is suitable for solid steel scrap to selectively leach out copper. This method not only offers advantages of higher selectivity, lower energy requirements and less emissions but also showcases significant potential for upscaling in modern recycling facilities. However, integrating the hydrometallurgical route into existing steelmaking processes might pose difficulties. Despite this challenge, the proven effectiveness of ammoniacal leaching in the non-ferrous industry—particularly in extracting metals from primary and secondary resources—suggests significant potential for its application in copper removal from steel scrap. Initial investigations will employ thermodynamic modelling to assess copper removal efficiency from steel scrap, exploring various parameters. Subsequent leaching experiments based on these findings will guide process optimization and industrial upscaling, integrating theoretical insights with practical application.