Recycling of metallurgical secondary raw materials derived from primary steel mill dusts and slags

Recycling secondary raw materials from steel mill residues enhances sustainability by recovering valuable elements like zinc and phosphorus, while also conserving resources, and reducing CO_2 emissions. Innovative methods such as deep eutectic solvents (DES)-leaching and bioleaching, can contribute to a more efficient, and environmentally friendly steel industry.

Steel industry is facing the dual challenge of meeting a growing demand while reducing its environmental impact. Scrap recycling, though crucial, is insufficient to fulfill the global steel demand. As the industry gradually transitions to more sustainable production methods using natural gas – which could be gradually substituted by hydrogen – and electricity, there is also great potential in innovative recycling concepts for secondary raw materials.

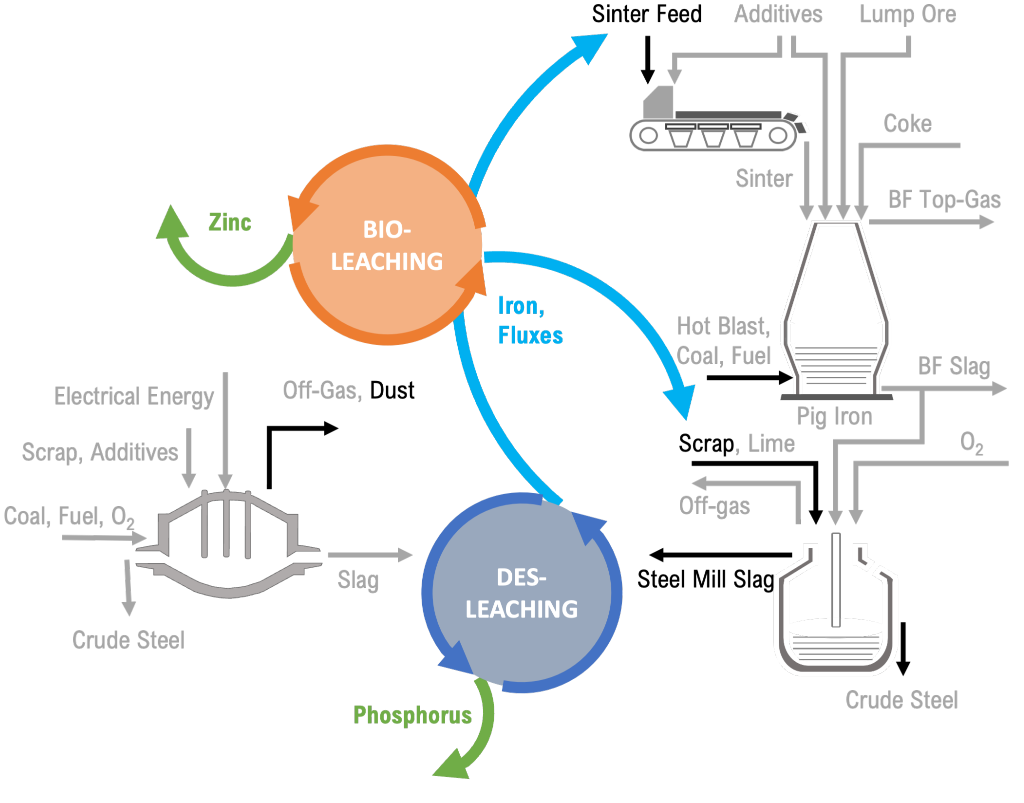

Figure 1: Possible reuse cases for the Fe-rich fractions in the context of the recycling (left) and the integrated (right) steel production routes. – product flow – recycling flow

Steel mill residues, which include dust, slag and sludge, are rich in valuable materials. These residues offer significant potential for resource recovery and environmental benefits. One primary focus is the extraction of valuable elements such as phosphorus and zinc. The microbial leaching of steel mill dusts is a process that specifically targets the extraction of zinc, leaving behind an iron-rich residue that can be reintegrated into the steel production process. DES-leaching of converter slag with solvents derived from the oxaline-class represents an innovative process route to remove phosphorus and recover metallurgical secondary raw materials.

The recycling of iron-rich secondary materials represents a significant step towards conserving natural iron ore resources. The iron ore substitutes can be utilised in an integrated steel mill, particularly in a sinter plant, blast furnace, basic oxygen converter or electric arc furnace, thereby enhancing resource efficiency. It is not uncommon for steel mill slags and dusts to contain other valuable metals, such as chromium or nickel. If these nonferrous metal-rich residues can be separated, they may be reused as secondary raw materials or recycled as alloying sources in the basic oxygen furnace or electric arc furnace. This not only reduces the dependency on virgin raw materials but also minimizes the waste generated by steel mills and alleviate the pressure on landfill capacities, which are becoming increasingly scarce. Additionally, the substitution of slag formers, such as lime, is of great interest. The conventional production of lime involves calcination, a process that emits a substantial amount of CO_2. By replacing lime with recycled materials, the steel industry can significantly reduce its carbon footprint.

Involved Partners

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