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# Highly efficient technologies for increased yields in steelmaking processes and reduced environmental impact

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The HIYIELD project leverages advanced technologies to promote circular economy practices in steel production by increasing scrap utilization and reducing dependence on pig iron from coal-fired blast furnaces. The project encompasses three industrial demonstration cases, each addressing a critical aspect of scrap processing and integration.

In Demo Case 1, industrial-scale trials were conducted to optimize scrap sorting through mechanical, physical, and sensor-based separation techniques. A hammer mill-based process achieved a ferrous yield of 99.5% purity, with a magnetic separation efficiency of 91%. Additionally, a laser scanner system enabled real-time scrap volume estimation, facilitating improved charge optimization for steelmaking. A deep learning (DL)-based classification model was developed to enhance automated scrap recognition by integrating electric arc furnace process data and real-time imaging for improved material characterization.

Demo Case 2 focused on optimizing the identification, classification, and processing of pre-consumer scrap through industrial trials employing X-ray fluorescence (XRF)-based separation and DL-based models. The implementation of the Digital Scrap Information Card (DiSC) enabled efficient data exchange between suppliers and consumers, ensuring precise scrap tracking. Furthermore, a DL-based scrap identification system utilizing self-supervised learning models was developed, enhancing automated scrap classification and assessment.

In Demo Case 3, a high-speed sampling (HSS) and analysis system was developed for direct on-site characterization of liquid steel. Comparative analysis between HSS and conventional lollipop sampling methods demonstrated strong agreement in chemical composition, validating the accuracy and reliability of the HSS system for real-time steel characterization.

The findings of the HIYIELD project support increased scrap utilization in steelmaking, improving process efficiency while reducing environmental impact. These advancements contribute to the European Union's long-term decarbonization and circular economy objectives.

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