PhD Program in Civil, Chemical and Environmental Engineering
Curriculum in Chemical, Materials and Process Engineering

Industrial Projects

June 2024 Call, XL cycle - Starting date: November 1 st 2024

The research projects submitted for the admission to the PhD program must be prepared in accordance to one of the projects listed below. Click on the Title to go to the Project.

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Project: Sustainable Refractory Solutions: Localizing Raw Material Sourcing for the Iron & Steel Industry (with Paul Wurth SMS Group)

Keywords: steel industry, refractory materials, sustainability, circular economy

Brief Description:

The Iron & Steel Industry is integral to modern infrastructure, yet it is also among the most energy-intensive and high-temperature operations, necessitating robust materials capable of withstanding extreme conditions. Refractories are therefore indispensable, serving as the backbone for thermal processes within the industry. However, the production and sourcing of refractory materials often come with significant sustainability challenges.

Traditional refractory manufacturing relies on specific raw materials that are geographically limited, leading to a heavy environmental toll associated with mining, transportation, and associated CO2 emissions. The logistical constraints of transporting these materials to remote locations further exacerbate the environmental impact, increasing costs and lead times that affect the industry's efficiency and carbon footprint.

This research proposes a novel approach to refractory production that centers on the concept of sustainability. By investigating the potential of locally-sourced, alternative raw materials, we aim to develop refractories that maintain, if not enhance, the desired properties for specific applications, such as those required in coke ovens and hot stoves, without compromising on quality or operational efficacy.

The focus on local sourcing not only promises a reduction in transportation emissions and costs but also encourages the utilization of industrial by-products and less environmentally damaging materials. This approach fosters a circular economy, where waste is minimized, and materials are kept in use for as long as possible, reducing the demand for virgin resources and diminishing the industry's environmental footprint.

In-depth case studies will be conducted to demonstrate that these alternative materials can achieve comparable properties to traditional refractories, making them viable for widespread use within the industry. The ultimate goal is to establish a more sustainable refractory supply chain that aligns with global environmental objectives, offering a replicable model for resource efficiency and reduced emissions in the Iron & Steel Industry.

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Relevant links: https://www.sms-group.com/

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Università di Genova | **DICCA** Ph.D. PROGRAM IN CIVIL, CHEMICAL AND ENVIRONMENTAL ENGINEERING

Project: Study of mechatronic systems, related materials and methods to provide haptic feedback during open surgery simulation.

Brief Description:
The project deals with the study of miniaturized mechatronic systems capable of providing force feedback suitable for the simulation of open carotid surgery. The objective of this study is to design and develop devices with realistic handles that correctly emulate real surgical instruments and are capable of providing tactile contact and grip feedback (i.e., providing force feedback to simulate the contact of the instrument with tissue and also the opening and closing forces of the instrument). The project also involves the optimization of geometries and materials to guarantee resistance, durability, compatibility and versatility of the mechatronic systems. The project will be carried out in collaboration with FOS and IIT.

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