POLITECNICO DI MILANO

PhD in INGEGNERIA DEI MATERIALI / MATERIALS ENGINEERING - 38th cycle

PNRR_352 Research Field: STUDY OF PROCESSES FOR THE VALORIZATION OF WAELZ SLAGS.

Monthly net income of PhDscholarship (max 36 months)
€ 1325.0 In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity	
Motivation and objectives of the research in this field	The research activity is linked to the PNRR objective "RIVOLUZIONE VERDE E TRANSIZIONE ECOLOGICA".In Italy, more than 80% of steel is produced in electric arc furnaces (EAF) by remelting iron scraps. In 2020, the production of steel in the electric furnaces was 17.0 million tons. About 15-20 kg of EAF dusts are generated as by-product per each ton of steel produced. Due to the high content of Zn (15-25%), such valuable dusts are treated in the pyrometallurgical Waelz plants. The Waelz process generate a stream rich in crude zinc oxide called "Waelz oxide" and an enormous amount of slag, called "Waelz slag". In Italy there are two Waelz plants, one at Pontenossa and the other at Portovesme. The Waelz plant is considered as the best available technology for the treatment of EAF dusts, but in reality it is characterized by several drawbacks. The main disadvantages of the Waelz treatment plant are that a) most of the material entering as EAF dust is going out as slag and it is landfilled, b) a significant valuable amount of zinc remains in the slag. For this reason, several alternative processes - hydro and pyrometallurgical - have been studied and developed. This linear scheme: "EAFs ® Waelz ® landfill" is nowadays unacceptable. Such important issue leaves open the space for more sustainable routes. The aim of the challenging research field proposed for a PhD candidate is 1) to investigate how to improve the conduction of the Waelz process itself and mostly 2) to

	study about new alternative technologies suitable to solve the problems a) and b) mentioned above. Looking ahead, the high cost of raw materials, which we have witnessed in the last period, will lead the iron and steel slag processing industries (Waelz plants) towards a future in which the technological processes will recover zinc and lead more efficiently but also the iron units present in the Waelz slag, in order to achieve the increasingly sought-after goal of a "circular economy" in the steel supply chain. https://federacciai.it/wpcontent/uploads/2021/10/AssembleaAnnuale_2021_Relaz ione-Annuale_2020.pdf https://federacciai.it/rapporto-di-sostenibilita-2021 https://www.isprambiente.gov.it/it/pubblicazioni/rapporti/ilciclo-industriale-dell2019acciaio-da-forno
Methods and techniques that will be developed and used to carry out the research	The research activity will be carried out at Politecnico di Milano and at Pontenossa Spa. 1. The research activities will start with an in-depth overview of the dust recovery technologies of metallurgical plants. 2. A first part of the activity will be devoted to the analysis of the current performances of the Waelz process in order to introduce improvements in the management of the Pontenossa plant. 3. The researches will be based on laboratory experiences at Pontenossa and at Politecnico di Milano for the physical chemical characterization of materials (EAF dust, crude zinc oxide, slag). 4. Different pyrometallurgical and hydrometallurgical treatment processes of Waelz slag will be taken in consideration, under thermodynamic, kinetic, economical and technological points of view.
Educational objectives	The student will acquire engineering skills in the field of metal recycling. He/she will have to be able to tackle these problems from the point of view both of

	metallurgical chemistry and materials engineering.
Job opportunities	The topics covered in this project provide high potential for employment opportunities in steel and metallurgical plants producing companies, even though the natural outcome of the activity will be at the Pontenossa SpA.
Composition of the research group	0 Full Professors 3 Associated Professors 1 Assistant Professors 3 PhD Students
Name of the research directors	M. Bestetti, A. Vicenzo, S. Franz

Contacts
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Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--

Scholarship Increase for a period abroad	
Amount monthly	662.5 €
By number of months	6

National Operational Program for Research and Innovation	
Company where the candidate will attend the stage (name and brief description)	Pontenossa S.p.A. - Via Prealpina Orobica, 60 - 24028 Pontenossa (Bergamo) www.pontenossa-spa.it
By number of months at the company	6
Institution or company where the candidate will spend the period abroad (name and brief description)	The PhD student will spend a period of at least 6 months abroad to interact with researchers and participate in joint activities potentially foreseen in the project, according to specific needs. Indeed, the project is highly interdisciplinary, and this favors the collaboration with foreign research centers where the candidate can acquire in-depth knowledge on the theme.
By number of months abroad	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
Confidentiality: since this is a thematic scholarship, the management of Confidential Information,Results and their publication is subordinate to the restrictions agreed upon with the funding company. Upon acceptance of the scholarship, the beneficiary must sign a specific commitment. **Individual budget for research** (during the 3 years): about 5.400 euro

Teaching assistantship: availability of funding in recognition of supporting teaching activities by the PhD student. There are various forms of financial of for activities of support to the teaching practice. The PhD student is encouraged to take part in these activities within the limits allowed by the regulation.