



PhD in CHIMICA INDUSTRIALE E INGEGNERIA CHIMICA / INDUSTRIAL CHEMISTRY AND CHEMICAL ENGINEERING - 38th cycle

PNRR_352 Research Field: BATTERIES RECYCLE BY HYDROMETALLURGY

Monthly net income of PhDscholarship (max 36 months)

€ 1400.0

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

In the past two decades, a variety of portable electronic devices have entered into every aspect of people's lives. Accordingly, a large number of rechargeable batteries were produced and applied. Among the rechargeable batteries, lithium-ion batteries (LiBs) have extensively been employed due to their superior performance and then have been widely applied in mobile phones, laptops, video cameras and other modern-life appliances. Moreover, there is also a huge need for some emerging fields, such as energy storage and electric vehicles. IDTechEx forecasts that by 2040, the global lithium-ion battery recycling market will be worth \$31 billion annually in accounting for more than 4.3 Mton/y of spent LiBs worldwide. It is obvious the recycling is the only feasible option because it provides a crucial solution to raw material supply insecurity and price fluctuations. Through recovering critical raw materials from LiBs, manufacturers can shield themselves from supply disruptions and also generate additional revenue streams. Two main technology options are available: the pyrometallurgical and the hydrometallurgical routes. This PhD research will be addressed to the hydrometallurgical process because it has some attractive advantages such as high metal recovery rates, high product purity, low energy consumption, and minimal gas emission. Moreover, the hydrometallurgical process it requires a simpler plant and it is more flexible to address the rapid evolution of the



	<p>battery technology (i.e., from NiH to Li/Co technology, to Li/Li iron phosphate, to Li replacement with Na). Technology short life time needs plants and processes easily adaptable to this evolution.</p>
<p>Methods and techniques that will be developed and used to carry out the research</p>	<p>The PhD formation will be based all on the application of chemical engineering and electrochemical methodologies applied to battery recycling. The starting engineering culture of the PhD candidate will be completed with the electrochemical culture to produce a PhD able to manage both aspects to a process design. The LCA concept in particular will be also exploited in order to validate the sustainability of the developed processes from the point of view of the environmental impact and of the economic sustainability. The approach to be followed will be the training on job, that conjugates experimental and modeling activities. A2A will be responsible for the training on job in an industrial R&D facility, to be acquainted on the assessment on the technical and economic feasibility of a future industrial plant</p>
<p>Educational objectives</p>	<p>To form a PhD able to drive the battery recycling industry into the new environmental goals avoiding all the misleading green washing claims. Moreover, PhD will be trained in an industrial environment on a project of industrial interest, where he/she will join engineering and management cultures.</p>
<p>Job opportunities</p>	<p>In IT about 1200 new jobs are expected to be created in the field of RAEE recycling, that needs high skilled chemical process engineers embedding the concepts of the process industry with those of the circular economy. A full employment is registered so far for the PhD graduates from Politecnico di Milano</p>
<p>Composition of the research group</p>	<p>5 Full Professors 5 Associated Professors 4 Assistant Professors 17 PhD Students</p>
<p>Name of the research directors</p>	<p>Prof. M. Masi Prof. L. Magagnin</p>

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<https://www.cmic.polimi.it/ricerca/elenco-gruppi-di-ricerca/cfalab/>

<https://www.cmic.polimi.it/ricerca/elenco-gruppi-di-ricerca/seelab/>

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	700.0 €
By number of months	6

National Operational Program for Research and Innovation

Company where the candidate will attend the stage (name and brief description)	A2A SpA -Corso di Porta Vittoria 4, Milano www.a2a.eu A2A is an Italian multiservice company, listed on the Milan Stock Exchange, which operates in the sectors of environment, energy, heat, networks and technologies for smart cities. It is active in the production, distribution and sale of electricity (second in Italy for installed capacity), gas, waste management, environmental services and the development of products and services for energy efficiency, the circular ec
By number of months at the company	6
Institution or company where the candidate will spend the period abroad (name and brief description)	Aalto University, School of Chemical Engineering - P.O. Box 11000 (Otakaari 1B) FI-00076 AALTO https://www.aalto.fi/en/school-of-chemical-engineering This university has competences on hydrometallurgy and leaching that complete those of Politecnico di Milano
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.

