PhD in CHIMICA INDUSTRIALE E INGEGNERIA CHIMICA / INDUSTRIAL CHEMISTRY AND CHEMICAL ENGINEERING - 41st cycle

THEMATIC Research Field: DETAILED MODELING OF SOLID FUEL GASIFICATION

Monthly net income of PhDscholarship (max 36 months)
1425.0 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 general context refers to the development of gasification technologies, which form the basis of many processes capable of recycling solid materials (such as biomass or waste plastics) through a gasification stage followed by subsequent chemical synthesis stages able to produce chemical industry building blocks such as methanol, olefins, or for the production of renewable fuels. Often, the development of efficient gasification reactors is limited by the formation of high amounts of tar or even carbonaceous particulates, and by impurities that can hinder the proper operation of downstream equipment connected to the gasifier. The objective of this thesis activity will focus on the development of predictive models capable of simulating the operation of gasification reactors both accurately and computationally efficiently, with the aim of optimizing their design and identifying the optimal operating conditions in terms of pressure, equivalence ratio, and the amount of added oxygen or water vapor. The goal is to include a detailed chemical description of all the processes associated with the thermal degradation of the solid, the subsequent gas-phase reactions, and the heterogeneous gasification or oxidation reactions of any residual solid formed.
Methods and techniques that will be developed and used to carry out the research	The thesis project involves the development of models capable of capturing the different descriptive scales of the

	solid gasification phenomenon in an industrial reactor, ranging from the chemical reaction scale, through the intermediate scale of solid particles, the scale of turbulent aggregates, up to the macroscale of the entire apparatus. Regarding the chemical kinetics of the processes involved, the following aspects are highlighted: •Characterization of the solid feedstock in terms of major constituents. •Homogeneous solid-phase pyrolysis leading to char formation. •Secondary gas-phase reactions of gasification and oxidation, resulting in tar and soot formation. •Heterogeneous oxidation/gasification of char by HO, CO, and O. Concerning reactor modeling, the thesis will address both computational fluid dynamics (CFD) simulations, which provide information on mixing and residence time distribution within the apparatus, and less computationally demanding approaches such as reactor network models. The latter allows the study of a larger number of operating conditions more efficiently, facilitating the optimization of operational parameters based on the variable types of feedstock used.
Educational objectives	This PhD will train the candidate in multiscale modeling, kinetic mechanism development, and reactor technology. Skills in detailed chemical kinetics, process modeling, and material characterization will be developed. It offers strong interdisciplinary training bridging chemical engineering, reactor fluid dynamics, and materials science.
Job opportunities	Graduates will be well positioned for careers in energy, advanced materials, and computational modeling sectors, including R&D roles in industry and academia. Previous PhDs from this field have joined national labs, chemical companies, and startups focused on clean energy and nanomaterials.
Composition of the research group	3 Full Professors 3 Associated Professors 2 Assistant Professors 16 PhD Students

Name of the research directors	Prof. Tiziano Faravelli, Alessio Frassoldati

Contacts
Telephone: 02.2399.3282 Email: tiziano.faravelli@polimi.it, alessio.frassoldati@polimi.it Web-pages of the research group:https:// www.creckmodeling.polimi.it/

Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents	--

Scholarship Increase for a period abroad	
Amount monthly	725.0 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
ConfidentialityIf the student participates in activities within an EU-funded project on the same or a closely related topic, the handling of any associated confidential information, results, and publications will be subject to the restrictions agreed with the funding body (EU). Upon accepting of the scholarship, the beneficiary could be requested to sign a specific commitment. **Educational activities** (funding for participation in courses, summer schools, workshops and conferences) - financial aid per PhD student per year: 1st year: around 1.900 euros per student 2nd year: around 1.900 euros per student 3rd year: around 1.900 euros per student **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.