PhD Thesis Topic Offer

Modeling Continuous Ice Cream Freezing

Thesis name	Modeling Continuous Ice Cream Freezing
Thesis type / Salary	
Location	Campus Agro Paris-Saclay (AgroParisTech-INRAE, Palaiseau, 91, France) and Häagen-Dazs (Arras, 62, France)
Date	During 3 years, starting from November 2025
Description of the topic and the target	The manufacture of ice cream, a complex frozen dessert, relies on a continuous scraped surface heat exchanger (continuous freezer) that simultaneously induce air incorporation, ice crystallization, and fat destabilization. This critical process step dictates the final textural properties of the product. The objective of this doctoral research is to characterize and control the transformation of this multiphase food product during its freezing in a scraped surface heat exchanger. Despite numerous existing studies, this complex process involving a multiphase product—containing a concentrated liquid solution, ice crystals, air bubbles, and fat globules—remains poorly understood, and many research questions still persist. During the process, a strong coupling exists between the sheared flow, heat transfer, water crystallization, air incorporation (overrun), and fat globule coalescence. The central question is therefore the identification and control of the key process parameters that influence the final product quality (related to both the sensory perception and the physico-chemical properties of ice cream). Industrially, the objectives are to: • Ensure the same quality of the finished product regardless of the manufacturing site, production line, recipe, and seasonality. • Predict the process conditions to apply to continuous ice cream freezers and ensure effective scale-up between pilot plant and factory. • Develop and eventually use an inline tool on the production lines that, using data related to recipes, will be able to prescribe recommendations and adjust the freezer parameters to guarantee the quality of ice cream. To address this, the first step will consist of a state-of-the-art analysis. Then, the study will implement an experimental approach at the scale of a semi-pilot continuous process. A model will be developed to predict measurable quality parameters at the freezer outlet—initially for a reference formulation. This model will then be adapted to account for the effect of formulation. Finally, it will enable scale-up from the laboratory pilot scale to the industrial pilot scale.
Profile and requested skills	The ideal candidate will possess a degree from an engineering school and/or a Master 2 degree with a focus on food science and food processing, coupled with a strong

	interest in programming and modeling. A first research experience in food freezing processes will be appreciated. Furthermore, the candidate should demonstrate strong teamwork skills, ability to work independently, as well as confidence, analytical thinking, scientific rigor, communication skills, resilience, and adaptability. A proven capacity for innovation and a commitment to a scientific approach are also required. Fluency in both written and spoken English and French is necessary, along with demonstrated skills in scientific writing, data synthesis and analysis, and scientific oral presentation.
Laboratory who welcomes the student	UMR SayFood (INRAE-AgroParisTech-Univ. Paris-Saclay) – MODIC Team SayFood (Paris-Saclay Food and Bioproduct Engineering) is a joint research unit whose activities focus on the physical, biochemical and microbiological processes that govern food processing. Within this unit, the ModIC (Modelling and Computer based Engineering) team focuses on the developing mechanistic models and applying the developed models for engineering applications. The doctoral student will work part of the time at Palaiseau and will have open access to a wide range of leading experimental tools, modelling tools and associated expertise. The PhD student will be affiliated with the ABIES doctoral school.
Company who welcomes the student	General Mills / Häagen-Dazs : Arras Technical Center, 155 Route de Cambrai, 62217 Tilloy lès Mofflaines, France Häagen-Dazs, an ice cream brand within the General Mills International portfolio, operates its primary manufacturing site and R&D center near Arras, in northern France. As part of the Häagen-Dazs R&D Technology team, the student will play a key role in accelerating advancements in product design technology by integrating modeling and simulation solutions into core operational areas. The student will work the other part of the time at Arras in close collaboration with ice cream experts based in France and international experts in modeling and simulation.
General information:	Duration: 3 years Registration: Université Paris-Saclay, ABIES Doctoral School Location: Palaiseau, Ile-de-France Salary: gross 2300 € per month onwards Benefits: Reimbursed public transport (50%), flexible working hours, multidisciplinary scientific group Starting date: November 2025 Secularism: The recruited person will be subject to the charter on secularism in public services (French law 2021-1109 of 24 August 2021). In particular, no religious symbols may be worn in the workplace. Application deadline: 20 september 2025.
Application for this PhD thesis topic	Please send the following documents: - Curriculum Vitae - Letter of motivation To hayat.benkhelifa@agroparistech.fr