

PHD POSITION AT IFP ENERGIES NOUVELLES (IFPEN) in *Physical Sciences / Mechanical Engineering*

Development of an experimental methodology for characterizing liquid cooling systems for electric motors

The social, political and environmental context demands significant emissions reductions in regulated pollutants and greenhouse gases, especially CO₂ in the transport sector. IFP Energies nouvelles develops innovative technological solutions with a view to reducing CO₂ and exhaust gas pollutant emissions.

The present PhD position falls within the scope of IFPEN research activities on the development of electrified powertrains. The introduction of electric motors for passenger car applications introduces new constraints, including the need to optimize compactness / power density of the e-motor. Indeed the increase of the current power density and rotational speed can cause overheating which degrades engine performance and durability. Thus, major research and development efforts are being made to design innovative cooling systems, among which liquid cooling strategies seem promising. Their development requires a good understanding of the heat transfer mechanisms.

The objective of the PhD is to study the physical phenomena that come into play in coil cooling systems for electrical motors: spray / wall interactions, formation and evolution of liquid films in contact with hot surfaces (flow, evaporation ...), local and global heat exchanges. The experimental approach adopted here consists in designing a thermal characterization test bench able to fundamentally explore different liquid coil cooling strategies. This bench will have to be sufficiently representative of real conditions, while at the same time simple enough to allow measurements and analyses of the complex physical phenomena occurring. These measurements will be performed thanks to the expertise in thermal characterization and in optical diagnostics for fluids available at IFPEN. The candidate will implement measurement techniques such as laser-induced fluorescence or Schlieren imaging to characterize liquid films and evaporating sprays. The candidate will be expected to perform a detailed analysis of the physical phenomena that will guide future efforts required for numerical simulation and the development of such cooling systems.

The novelty of this subject will provide the selected candidate with a wide vision in different fields, such as physical measurements and electrical machines, in which IFPEN is a recognized research institute. The collaboration with the IVG laboratory of the University of Duisburg-Essen will give the candidate the opportunity to further deepen the understandings of the obtained results, and to discover a complementary research environment.

Keywords: electric motor, heat transfer, optical diagnostics, temperature measurement

Contact: Dr. Guillaume PILLA, guillaume.pilla@ifpen.fr / Dr. Baptiste CHAREYRON, baptiste.chareyron@ifpen.fr

Academic supervisor	Prof. Dr. Sebastian KAISER (University of Duisburg-Essen) / Dr Gilles BRUNEAUX (IFPEN)
Doctoral School	University of Duisburg-Essen / Université Paris Saclay (double diploma)
IFPEN supervisor	Dr. Guillaume PILLA, Research Engineer, Mobility and Systems Division
PhD location	Mobility and Systems Division, IFP Energies nouvelles, Rueil-Malmaison, France
Duration and start date	3 years, starting preferably on October 1 st , 2019
Employer	IFP Energies nouvelles, Rueil-Malmaison, France
Academic requirements	Master of Science degree in relevant disciplines (Optical Diagnostics, Physics, Thermodynamics, electrical motors)
Language requirements	Fluency in French or English, willingness to learn French
Other requirements	Software (MATlab, Office,...), skills in experimental Physics

For more information or to submit an application, see theses.ifpen.fr or contact the IFPEN supervisor.

IFP Energies nouvelles is a French public-sector research, innovation and training center. Its mission is to develop efficient, economical, clean and sustainable technologies in the fields of energy, transport and the environment. For more information, see www.ifpen.fr.

IFPEN offers a stimulating research environment, with access to first in class laboratory infrastructures and computing facilities. IFPEN offers competitive salary and benefits packages. All PhD students have access to dedicated seminars and training sessions.