IMT Nord Europe
École Mines-Télécom
IMT-Université de Lille

Asphalt Pavements and Urban Air Quality in the Context of Climate Change

Discipline : CERI EE

Line Manager : Nadine LOCOGE

Location : IMT NORD EUROPE, CERI EE, 941 rue Charles Bourseul, 59500 Douai

Type of contract: PhD position (36 months)

General description of the research unit

The Centre for Education, Research and Innovation in Energy and Environment (CERI EE) of the IMT Nord Europe institute, is a research center employing around 80 people including 30 faculty members. The main research activities of CERI EE deals with experimental atmospheric chemistry and physics of outdoor and indoor environments, by means of laboratory studies and field measurements. The centre has a significant expertise in the study of pollutant's degradation in the gas and heterogeneous phases deploying photochemical reactors, atmospheric simulation chambers and indoor experimental rooms, as well as pollutant and particle monitoring in outdoor and indoor environments. CERI EE is included in the list of Shanghai with top universities/research centers working in atmospheric science domain. CERI EE is also European topical center unit for reactive trace gases in-situ measurement (CiGas) within ACTRIS, equipped with cutting edge instrumentation for air pollutants monitoring, particles characterization, and a unique expertise in analytical development and methods evaluation. Furthermore, CERI EE takes part in many regional and multidisciplinary projects related with air quality and climate change, e.g. Labex CaPPA, CPER CLIMIBIO, CPER ECRIN.

Scientific context of the PhD

Urban environments are dominated by impervious surfaces such as paved roads, parking lots, and rooftops, which can cover 60% of a city's area and up to nearly 100% in dense downtown districts. This extensive coverage makes cities especially vulnerable to climate change and air pollution challenges. These surfaces are not passive: they can both emit and absorb pollutants, acting as dynamic players in urban air chemistry. Among them, asphalt pavements are particularly significant, representing nearly 40% of urban surface area—a proportion that continues to rise with ongoing urbanization.

Asphalt is a petroleum-derived material rich in organic compounds capable of releasing a wide range of volatile and semi-volatile organic compounds (VOCs). These emissions occur not only during road paving at elevated temperatures but also continuously at ambient conditions, making asphalt a persistent source of urban air pollutants. Despite this, the capacity of asphalt pavements to uptake or transform atmospheric pollutants has received little attention. Their potential "sponge effect" may substantially influence pollutant lifetimes and the formation of secondary pollutants such as ozone and new particle formation. Neglecting these interactions in air quality models limits our ability to accurately represent concentrations of NOx, O_3, VOCs, and other key species in cities.

The EBQAIR PhD relies on controlled experiments in atmospheric simulation chambers that reproduce urban conditions and use representative, real-world asphalt formulations. These experiments will yield the kinetic and mechanistic parameters needed to quantify when—and to what extent—asphalt pavements act as sources or sinks of pollutants. Results of the PhD will be integrated into air-quality models for Paris and Lille to quantify pavement contributions and identify practical levers to make paving materials part of the solution.

Looking ahead, this research supports the development of sustainable, resilient urban infrastructure. It aims to (i) reduce the environmental impacts of asphalt, (ii) inform strategies for the large-scale integration of

depolluting materials, and (iii) deliver actionable solutions for cleaner urban air. In doing so, it directly addresses the needs of policymakers and socioeconomic stakeholders in urban planning and air-quality management.

Missions

This PhD will aim to:

1. Identify the potential of asphalt to form secondary pollutants including gaseous compounds and secondary organic aerosols (SOA).
2. Evaluate the uptake and reactivity processes of asphalt pavements with respect to inorganic urban pollutants (such as O_3, NO, NO_2) and organic pollutants (such as formaldehyde, methanol, toluene, and benzene).
3. Propose and assess innovative asphalt formulations incorporating adsorbents and/or catalysts to reduce primary and secondary emissions associated with these materials.

The PhD candidate may participate in teaching activities up to 64 hours of tutorials (TD equivalent) per year.

Conditions

We seek a motivated PhD candidate with strong written and oral communication skills.

- **Education:** Master's degree (or equivalent, Bac+5) in Analytical Chemistry, Atmospheric/Environmental Sciences, or Materials Science.
- **Research interests & skills:** Genuine interest in experimental, collaborative, and multidisciplinary work. Skills in one or more of the following are valued: air-pollutant metrology, physical chemistry, gas–surface interactions, and data processing/analysis.
- **Languages:** Working proficiency in French or English (minimum B2). C1 in English is preferred for international collaboration but not mandatory.
- **Professional abilities:** Organization and autonomy, teamwork, critical thinking, and clear written/oral communication.
- **Dissemination (optional/plus):** Experience with scientific dissemination (e.g., conference presentations, articles) is appreciated but not required. The candidate will be supported to disseminate results during the PhD.

Expected starting date: December 2025, January 2026

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