PhD Grant / 3 years – Centrale Lille Institut

Investigation of the ignition and flame propagation of duromer foams

Diploma awarding institution: Centrale Lille Institut (https://centralelille.fr/formation/doctorat/)

Graduate School: Sciences de la Matière, du Rayonnement et de l'Environnement SMRE ED 104 (https://edsmre.univ-lille.fr/)

Work place : Unité Matériaux et Transformations (CLI) - UMR-CNRS 8207, Villeneuve d'ascq (France) (https://umet.univ-lille.fr/)

Scientific expertise: material science, chemical engineering, chemistry, thermal science and physics

Keywords: Flame retardancy, polymer, thermal characterization, chemical characterization, duromer foams.

Description of the subject:

Duromer foams present excellent flame retardant properties without additional flame retardants. These foams meet the most important international fire safety standards but its behaviour regarding the first steps of the development of a fire i.e. the ignition and flame propagation are not totally understood. The lack of awareness of these phenomena can lead to problems regarding the European standardisation currently in place for building materials and thus it is crucial to investigate them.

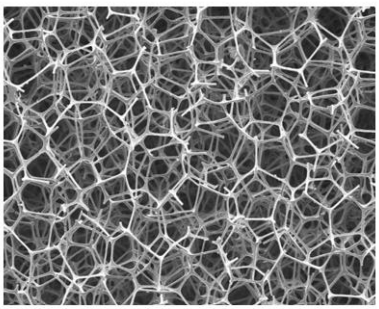

Figure 1. Open-cell structure of MF observed by MEB

The objective of the PhD thesis is thus to investigate the thermal and fire degradation of duromer foams in order to better understand its ignitability and the flame propagation phenomenon. Two main approaches will be followed during the PhD.

A first approach of the PhD will be dedicated to the development of testing methods that permit to mimic the ignition of duomer foams in standardized test. Building products are classified in classes (Euroclasses) from A1, A2, B to F. The main test methods for foam building products is the single burning item (SBI). In the USA, numerous federal regulations and state and local building codes refer to various fire tests and standards such as ASTM E84, UL 790, FM 4880, UL 1040, and UL 1715 but basically, the same fire parameters including flame spread, ignition, and smoke opacity are measured. A testing apparatus will thus be designed.

As a second approach of the PhD, the thermal and fire degradation of different types of duromer foams supplied by the industrial company will be studied to fully understand their behavior in particular when exposed to SBI and Steiner Tunnel. In that frame, SBI and Steiner Tunnel (ASTM E84) at the reduced scale developed in our lab will be used for evaluating the fire behavior of the foams. A comparison of the behavior of closed cell vs. open cell duromer foams will be considered in order to better understand the effect of the structural properties of the foams. It is expected to draw the mechanism of degradation based on different analytical tools and to determine the mode of action by using different types of fire scenarios (mini-SBI, mini Steiner tunnel, cone calorimeter…).

The project, performed in collaboration with BASF, a German industrial company, leader in chemistry, is multidisciplinary and requires expertise in material science, chemical engineering, chemistry, thermal science and physics.

Starting date: 1 October 2022

Funding: Industrial funding (BASF)

Presentation of host institution and laboratory:

UNITE MATERIAUX ET TRANSFORMATIONS / CNRS UMR 8207 – UNIVERSITE DE LILLE - CENTRALE LILLE

Website: https://umet.univ-lille.fr/

The laboratory "Unité Matériaux Et Transformations" hosts a large portion of the research in Materials Science of the Université de Lille. The laboratory includes approximately 80 professors and assistant professors, and CNRS researchers, 40 technical and administration staff, 60 PhD students, and 15 temporary contracts researchers or emeritus faculty.

There are six research groups: Matériaux Moléculaires et Thérapeutiques / Earth and Planetary Materials / Métallurgie Physique et Génie des Matériaux / Polymer Systems Engineering/Plasticity / Interface Processes and Hygiene of Materials.

The PhD position will be located in the Polymer System Engineering group (ISP), which have scientific pluridisciplinary approach and which is organized in 5 main topics : Reaction and resistance to fire / Recycling and life cycle analysis / Structure, plasticity, damage / Stimulable polymeric systems / Polymers for biomedical / Chemistry and physics of interfaces.

Candidate profile

Required education level: Master Degree in chemistry or formulation / French Engineer diploma in chemistry or equivalent

Main field education: Materials sciences, Chemistry

Skills / Qualifications: Strong skills in material sciences are mandatory. Motivated and competent to carry out experimental work. Curious and autonomous in problem solving, with scientific rigor, writing skills, analytical and synthesis skills and practical common sense. Ability for research management, good aptitude for teamwork in an international environment, dissemination, communication with colleagues and supervisors, strong teamwork spirit, creativity, problem solving and attention to safety.

Required Languages: English is mandatory, good level in French will be an advantage.

Supervisors:

- Prof. Sophie Duquesne (UMET, Centrale Lille Institut, http://umet.univ-lille1.fr/detailscomplets.php?id=49&lang=fr)

- Dr. Séverine BELLAYER (UMET, Centrale Lille Institut, https://umet.univ-lille.fr/detailscomplets.php?id=58&lang=fr)

Net salary: 1500 euros/month

Application procedure: The deadline for an application is June 15th 2022.

Applicants should submit detailed curriculum vitae, a personal letter describing your motivations to join this PhD project, a full list of credits and grades obtained in Master degree, including (if finished) a copy of your MSc thesis and the names, emails, and addresses of two professional references to:

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