

18-month research position

Determination of the thermo-mechanical properties of thermoplastic composites subjected to coupled loading - Application to the fire resistance of hydrogen storage tanks

Research laboratory :

This research work is proposed by the Institut P' (UPR CNRS 3346) in Poitiers. It is at the interface of the teams "Damage and durability" of the "Physics and mechanics of materials" department and "Heterogeneous combustion, transfers in porous media" of the "Fluids, thermal science, combustion" department.

Context :

Hydrogen can be considered as an energy carrier that can be used in alternative supply chains to fossil energy sources, but its exploitation requires to overcome some technological barriers, such as, for example, the vulnerability of its storage. The P' Institute has been working on this subject for several years and is involved in the European project THOR (Thermoplastic Hydrogen tanks Optimised and Recyclable), which aims to develop a tank that can be integrated into a vehicle at a cost compatible with large-scale production. One possible way to reduce costs is to explore the capabilities of thermoplastic matrix wound composites as an alternative to thermoset.

The mission of the consortium of this project is to identify the materials and manufacturing parameters that can be used, develop simulation tools, evaluate the performance and safety of the designed tank and finally predict its mass production.

The P' Institute will work in particular on the behaviour of the tank under fire conditions by trying to estimate the risks of burst and leakage. To do this, it is necessary to have tools to simulate the thermo-mechanical behaviour of the material subjected to both mechanical loading and thermal stress. The formulation and validation of these models must be based on tests carried out on benches allowing the simultaneous application of both types of loading at the sample scale. In this context, the purpose of this study is to develop these devices, carry out the tests and simulate the strength of a tank in the event of a fire.

Description of work:

In a first step, the candidate will carry out a test campaign to determine the combustion kinetics of the thermoplastic composite by means of calorimeter cone tests. These tests will be supplemented by ATG characterizations and microscopy or tomography observations to link the heat flux to the damage pattern.

In a second step, the effects of a mechanical load combined with thermal stress will be studied using a dedicated bench to evaluate the consequences of these loads on the evolution of the mechanical properties of the material. Finally, these data will feed a damage model, coupled with a pyrolysis model, to simulate the behaviour of structures

subjected to both types of loading and to predict tank failure, whether by bursting or hydrogen leakage. The candidate will be able to rely on the expertise of the P' Institute and its partners in the modelling of the different phenomena involved.

Prerequisites :

The P' Institute is looking for a candidate with a doctorate in mechanics or thermal science obtained less than two years ago. Knowledge of composite materials, structural design and combustion is required.

The candidate will be required to work and communicate in English with the industrial and academic partners of the European project Thor.

The contract will start in September 2019, for a period of 18 months. The researcher will be employed by the CNRS and paid from European funds (THOR project, funded by the Fuel Cells and Hydrogen 2 Joint Undertaking).

Remuneration: ~2200 euros net monthly

The recruitment board will be composed of:

D. Bertheau (IR CNRS)

C. Castagnet (DR CNRS)

D. Halm (Prof. ENSMA)

T. Rogaume (Prof. University of Poitiers)

Please send your application (detailed CV, cover letter) or requests for information to: damien.halm@ensma.fr