

PhD Thesis

Corrosion often affects helicopters parts, so that various protection solutions are implemented. Corrosion processes depend on the materials, and the implemented protection, but also on the in-service conditions, directly linked to the physico-chemical environment on the material surface.

The PhD thesis will aim to describe the physico-chemical environment on the material surface, and to study the corrosion behaviour of a coated material in these specific conditions. It will take place in the framework of a collaboration between CIRIMAT and AIRBUS Helicopters. The experimental work will be performed on a 2024 T3 aluminium alloy, commonly used in the aeronautical industry and largely studied, in particular in the CIRIMAT. In order to be representative of in-service conditions, experiments will be performed on the alloy coated with a conversion layer, and for some tests with an organic coating.

For more details, first, the condensation/drying mechanisms in seawater environment will be studied, with specific attention paid to the evolution of the thickness and chemical composition of the aqueous film formed on the sample surface. This will be done by using both environmental and corrosivity sensors. Data from these sensors will be analysed in order to determine the composition of the aqueous film formed on the sample surface in specific environmental conditions. Then, the susceptibility to corrosion of 2024 aluminium alloy coated by a conversion layer, and for some tests by an organic coating, in the previously identified environments will be evaluated in order to identify the first order parameters and to propose damage mechanisms and/or a modelling approach. Various electrochemical techniques combined with observations techniques at different scales will be used. The development of a specific set up adapted to generate in-service representative environments on the material surface is planned in order to propose a validation of the mechanisms and/or modelling approach proposed. Data from the PhD thesis will be used to develop an artificial intelligence-based predictive tool of the corrosion damage affecting aeronautical structural parts in aluminium alloy. This last task will be performed in the framework of a european project supervised by AIRBUS Helicopters, in collaboration with CIRIMAT.

Four tasks can be identified:

- Task 1/T1: bibliography
- Task 2/T2: Analysis of the condensation/drying mechanisms in seawater environment, by using both environmental and corrosivity sensors
- Task 3/T3: Evaluation of the susceptibility to corrosion of 2024 aluminium alloy coated by a conversion layer, and for some tests by an organic coating, in the previously identified environments: identification of first order parameters and proposition of mechanisms and/or modelling approach
- Task 4/T4: development of a specific set up adapted to generate in-service representative environments on the material surface and validation of the mechanisms and/or modelling approach proposed in T4.

Keywords: aluminium alloy, microstructure, corrosion, predictive analysis

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To apply: Applicants must have a significant knowledge concerning material sciences and electrochemistry applied to corrosion phenomena. The PhD thesis corresponds to an experimental work.

Laboratory: CIRIMAT located in ENSIACET/INPT in Toulouse + some periods in Airbus Helicopters (Marignane, 13)

Salary: 1620 € net /month