Title: High performance thermoplastic advanced life-cycles

Problem statement

Today, one of the main challenges of the aeronautical sector is to lighten the structures in order to satisfy economic and ecological constraints. In order to meet these challenges, the aerospace industry is constantly looking for lighter materials while maintaining high thermomechanical properties.

Organic matrix composites reinforced with carbon or glass fibres have been developed with this objective. To date, the share of organic matrix composites represents up to 50% of the total mass of an aircraft such as the A350. If the polymer matrix composites were initially used in the so-called cold zones (exposed to temperatures lower than 150°C) of the aircraft, they are now able to compete with semi-structural or even structural metal parts in hotter zones (higher than 150°C), they are then called warm composites.

Picture of the TARMAC Aerosave site (Tarbes, France) where end-of-life aircraft are stored before being dismantled and

If the composite materials used in aeronautics were until now mainly thermosetting matrices, today thermoplastics are more and more integrated. Indeed, thermoplastics have advantages that allow them to compete with thermosets. They have a better resistance to shocks, can be welded, they do not require special storage conditions and offer the prospect of reduced cycle times because their manufacturing does not require post-cooking.

One of the great interests of their use is the possibility to reuse and recycle them because they can be remelted and thus remoulded contrarily to thermosets (epoxy for example). Today, this potential is not yet fully exploited. The aim here is to study the different possibilities of reusing and recycling these materials, to compare their performance and to evaluate their environmental impact.

Research question(s)

Which types of thermoplastic composite materials are, and will be, used on aircraft? What types of applications do they fulfil? What sources of "waste" thermoplastic materials can be identified, and at which volumes (e.g. manufacturing scraps, defective parts, parts that have flown on aircraft)? What are the reuse and recycling solutions? What is their performance in terms of functionality and environmental impact?

Expected type of work

State of the art, Interviews of stakeholders, Life Cycle Assessments.

References

- Towards sustainable structural composites: A review on the recycling of continuous-fiber-reinforced thermoplastics - ScienceDirect
- From aircraft to bikes, Airbus is breaking away to upcycle carbon waste | Airbus
- Airbus and partners to establish aircraft lifecycle centre in China | Airbus
- Yang, Y., Boom, R., Irion, B., van Heerden, D. J., Kuiper, P., & de Wit, H. (2012). Recycling of composite materials. *Chemical Engineering and Processing: Process Intensification*, *51*, 53–68. https://doi.org/10.1016/j.cep.2011.09.007

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