# **Master Thesis**

## *An exploratory material study for type IV hydrogen vessel liners in cryo-compressed conditions*

## Task description

Hydrogen-based drives for heavy-duty transport solutions are essential elements for the decarbonisation of the economy. These commercial applications have high demands in terms of power and range, often in multi-shift operation around the clock. Purely battery-based drives are too heavy, take too much time to recharge and may be even more expensive to purchase.

In addition to the already proven solutions for hydrogen buses with compressed hydrogen (CGH2) and Type III and Type IV compressed gas storage systems made of composite materials (typical maximum working pressure p\_NWP of 35 MPa), cryogenic hydrogen, in liquid form (LH2) or cryo-compressed (CCH2), represents an attractive variant. Arguments in favour of cryogenic pressure storage include higher storage densities than compressed warm hydrogen, the potentially more efficient refuelling process, the avoidance of evaporation losses in intermittent operation, and possibly variable filling options (LH2, CGH2 or CCH2).

Type IV vessels are among the most novel developments, and consist on a pressure vessel made of polymeric liner fully-wrapped with a fiber-resin composite. The port is metallic and integrated in the structure (boss). If the material behavior of polymeric material in cryogenic-like conditions could be understood in depth, they can have potential of being the next solution for heavy duty transport industry.

## Goals

* Analysis of behavior during life cycle of the tank, and peak pressure/temperature conditions
* Translation of load cases of liner material. With this, we can get a better determination of the testing program, in order to test such load cases.
* Look at the benchmark and state of the art applications for cryogenic and warm gas storage. From this study, select the materials to be tested.
* Study of possible additives to the candidate materials, to withstand the load case conditions
* Perform the test, and eventual material selection.
* Further analysis of the possibility of liner manufacturing with the selected materials.

## Desired candidate profile

* Mechanical Engineering student with focus on material science, of Material Science student, ideally with experience in polymer materials (e.g. Internships, HiWis, etc.)
* Beneficial: experience with Hydrogen technology (preferably cryogenic conditions)
* Master's Thesis with a duration of 6 months (potentially extensible)
* “Out of the box"/Researcher mindset, given that the Thesis would involve both testing and prior research of possible materials

## Contact Persons

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