HEAVEN

Cryogenic Hydrogen Tech Aircraft

NEWSLETTER 02

EDITORIAL

Dear readers,
the HEAVEN project has the pleasure to present to you the second newsletter and the first results, one year after the beginning of the project.

During the last year, all the HEAVEN partners have worked hard on the definition of requirements, specifications and the overall architecture of the whole system to be integrated in the aircraft. On this basis, the consortium has defined the mechanical and electrical interfaces between the different modules (fuel cell system, liquid hydrogen system, powertrain), and the detailed design of the system has started. Even though the path to delivery of the components is still quite long, the year 2020 should see interesting intermediate results from all the partners.

Fundación Ayesa

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This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under Grant Agreement No 826247. This Joint Undertaking receives support from the European Union's Horizon 2020 Research and Innovation programme, Hydrogen Europe and Hydrogen Europe Research.

2nd BIANNUAL CONSORTIUM MEETING

After the first year of work, the partners of the European project HEAVEN met in Stuttgart, in the premises of the partner DLR, for two days of intensive collaboration.
All 6 partners from industry and research have been able to share preliminary results and to set the basis of the upcoming work steps.
The challenge in this first phase of the project was to define precisely common technical specifications and requirements settings concerning system architecture and safety. Those are needed to ensure the smooth integration of the hydrogen storage and the battery subsystems together with the fuel cell system itself. The meeting was also the opportunity to initiate a joint reflection within the consortium on results' exploitation and dissemination.

FUNDACIÓN AYESA

Presentation

Ayesa Foundation (Fundación Ayesa) is a Spanish non-profit organization promoted by Ayesa, whose objective is to generate and transfer knowledge in a broad range of engineering and technology areas, such as information society, natural resources sustainability, civil infrastructures, industry, energy, telecommunications and architecture.
Since its creation, Ayesa group companies, have participated in more than 40 research projects in different national and international programs, and coordinated more than 20 research projects.
Among these projects, Ayesa Foundation is involved in the development of carbon-clean energy systems, implying fuel cells, as an efficient conversion technology, and hydrogen, as a clean energy carrier. To that end, Ayesa Foundation is currently coordinating the INNBALANCE project. The goal of this project is to boost hydrogen mobility by developing a new generation of highly efficient fuel cell system components and greatly improve the efficiency and the reliability of fuel cell powered vehicles, while reducing their cost.

Role in the project

Ayesa Foundation is the coordinator of the HEAVEN project. The role consists in monitoring project's progress and activities performed by the consortium with respect to the work plan, and communicating the results to the European Commission through the Fuel Cells and Hydrogen Joint Undertaking (FCH JU).

In addition, Ayesa Foundation is also responsible of the coordination of the Exploitation, Dissemination and Communication activities supported by the other HEAVEN partners. These activities are of high importance in order to raise awareness on achievements and to allow citizens, decision-makers and many other key audiences to receive a clear insight on how European funds are leading to concrete achievements.

Finally, Ayesa Foundation will be involved in the extrapolation of the technology for other type of applications and the analysis of the cost of ownership (including operational costs) of the technology.

HEAVEN PROGRESS REPORT

Defining system interfaces and protocols for the high power fuel cell and cryogenic technology

The mechanical and electrical interfaces were defined in addition to the preliminary specification of a range of technical parameters (pressures, temperatures, flow rates, humidity, power, …) based on a realistic mission profile. This mission profile includes the flight duration, climbing rates, altitudes, emergency procedures, … that the aircraft must perform during the future demonstration. These parameters are listed in several shared documents, and the boundaries and responsibilities of every subsystem are already well defined. The mechanical interfaces concern all fluid connections, while the electrical interfaces mainly define the communication protocols to the control unit and the required voltage and power to be supplied to the different modules.

Safety analysis

In addition to the parameters of the systems, the safety analysis has been started, involving all partners, starting from the aircraft level analysis which has been released by the partner Pipistrel Vertical Solutions d.o.o.. One of the project's ambitions is indeed to provide an in-depth safety analysis of the technology in order to pave the way for a future compliance demonstration to requirements of the aviation regulatory authority.

FOCUS ON: WHY USING LIQUID HYDROGEN?

The ambitious goal of the project is: *to reach a gravimetric index of about 15% for a hydrogen payload between 10 and 25 kg. This would provide an autonomy range to the demonstrator of 5-8 hours.*

But what does that mean?

The gravimetric index is the ratio of the mass of fuel carried on the sum over the mass of the tank full. 15% for 20kg means 133kg for the fuel storage system, including 20kg for LH2.

Is that so difficult?

Basically, the H2 (di-hydrogen) can be stored in two ways: gaseous or liquid.

- Gaseous storage needs a very high pressure (at least 350 bars, almost two times the pressure of a typical aluminium scuba tank of pressurized air for instance), that requires a very resistant and heavy tank. Moreover, the gaseous hydrogen, even at high pressure, occupies a very large volume in comparison to its weight (23 g per liter, compared to 1000g per liter for the liquid water). The gravimetric index of 15% is therefore not reachable with gaseous storage because of the weight of the tank and low density of hydrogen.

- Liquid storage increases sensibly the storage performance of the tank, because the liquid hydrogen has a much higher density (about 3 times higher than 350 bar gaseous hydrogen).

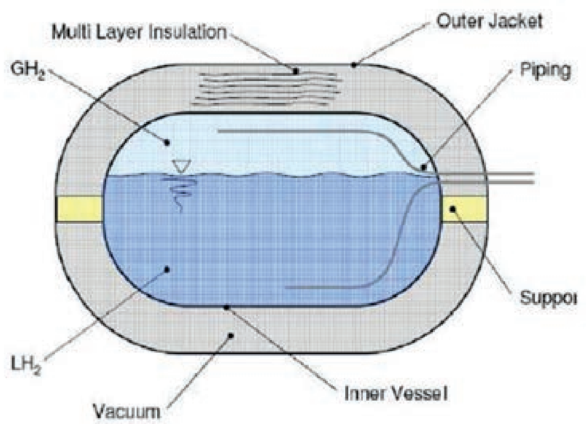

Figure 1: General principle of an insulated liquid hydrogen tank

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