Master thesis proposal

Thermodynamic modelling of cryo-compressed hydrogen storage tanks for trucks

Background

Many countries of the world have ambitious goals for climate change mitigation and protection of the environment. For the transport sector, electric propulsion is a way to reduce energy use and emissions. Among feasible technologies, fuels cells can produce electricity from hydrogen on-board vehicles, with water vapor as the only emission. Storage of hydrogen on the vehicles is however a challenge in order to reach long driving distances without refueling. For fulfilling requirement for distance between refueling the hydrogen is either compressed to 700 bar, cooled to cryo-temperatures, or liquefied to increase the density of the hydrogen. When cryo-technology is used an additional complexity due to the pressure-temperature dependency is added. Extraction of hydrogen(driving) will decrease tank pressure and temperature while parking will increase pressure and temperature due to inevitable heat ingress.

Volvo AB is a global leading truck, off-road, bus and marine company, with research center based in Gothenburg. The company is in a transition phase and will produce large scale fuel cell vehicles for meeting the Paris agreement for heavily reduce the CO_2 emissions from the vehicles in operation.

Project description

The purpose of this project is to evaluate cryo-compressed tanks in different truck operation scenarios. The model output should be hydrogen mass flow, tank pressure and tank temperature based on a power requirement from the fuel cell system. The study should include a literature study to obtain the required values for a model built up. Questions that should be answered

- Quantification of blow off losses on a fleet basis (% of fuel)
- Quantification of average usable tank capacity in long-haul truck application (kg)
- Sensitivity analysis of heat ingress impact on dormancy time
- Sensitivity analysis of tank temperature on tank capacity
- Define max parking time at different SOC until full fill still can be achieved

The project will be conducted partly at XXX, Chalmers, and partly at VGTT, during the spring 2022.

Qualification

The project requires a collaboration between two students with good ability to work independently and multidisciplinary. Students are expected belong to master's programs in Sustainable Energy Systems, Mobility Engineering or Applied Mechanics. However, prior experience of thermodynamics and modelling is a strict requirement Experience of vehicle modeling, for example using Matlab/Simulink, is a plus.

Contact

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