Future Fuels: The Safe Effective Storage of Hydrogen In Fuel Cell Vehicles

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Background

This project is related to the research and development of hydrogen storage in fuel cell vehicles. It is concerned with selecting the most efficient storage medium and developing it into a design proposal based on the Product Design Specification.

Aims & Objectives

1) To research and evaluate what methods are available to store hydrogen safely in automotive applications
2) Compare the storage mediums on: safety, cost, efficiency, reliability and overall storage capacity
3) To research what methods are being utilized within industry
4) To produce a design proposal based on the PDS developed using 3d modeling and finite element analysis
5) Conclude if proposed design can meet the design requirements completely

Research Sources

- US DOE
- Birmingham University
- BIS GOV UK
- Department for Transport
- StorHy Consortium
- IET

Programs Used

- CES Selector
- ProEngineer
- Algor Fempro
- Solid Works
- Mechanica
- Ms Excel

Results

Parameter	Unit	StorHy Target 2010
Driving Range	km	600
Hydrogen Storage Mass	kg	6 - 10
System Gra. Energy Density	kWh/kg wt%	2.0 6
System Vol. Energy Density	kWh/l kg H_2/100l	1.5 4.5
Operating Temp.	°C	-40 to +85
Refuelling Rate	kg H_2/min	1.2
Delivery Rate (max.)	g H_2/sec	2.0 FC, 5.5 ICE
Min. Pressure	bar	6
Permeation Rate	H_2 Ncm^3/h per l internal volume	1
Loss of usable H_2 (boil-off)	g/h per stored kg H_2	1

Fig 1: StorHy Storage Requirements

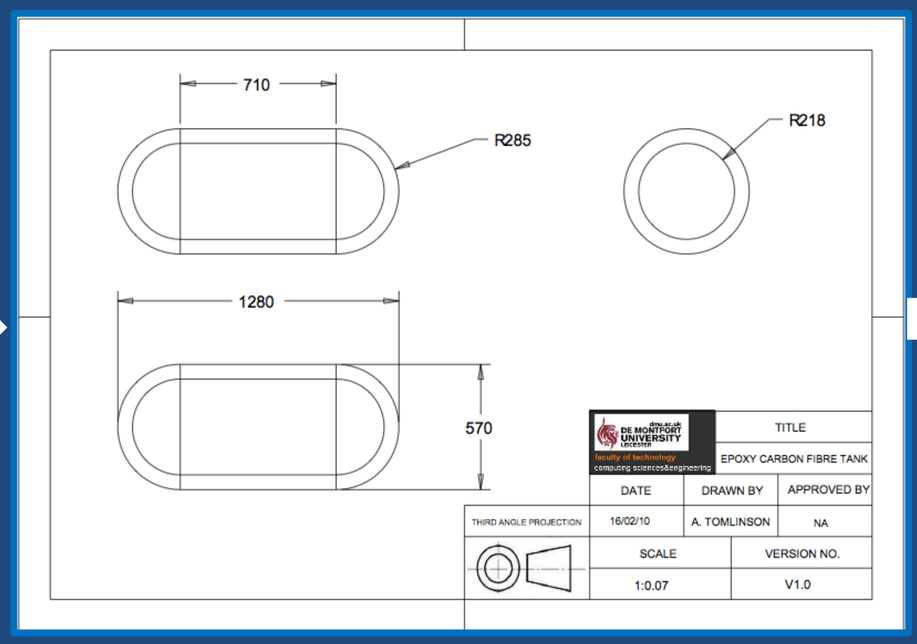

Fig 2: Dimensioned Engineering Drawing

Fig 3: Rendered ECF Tank

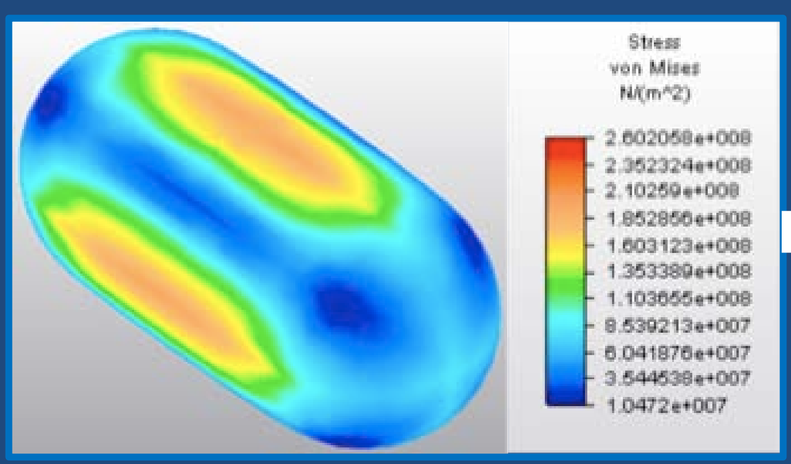

Fig 4: ECF FEA Internal Pressure Analysis

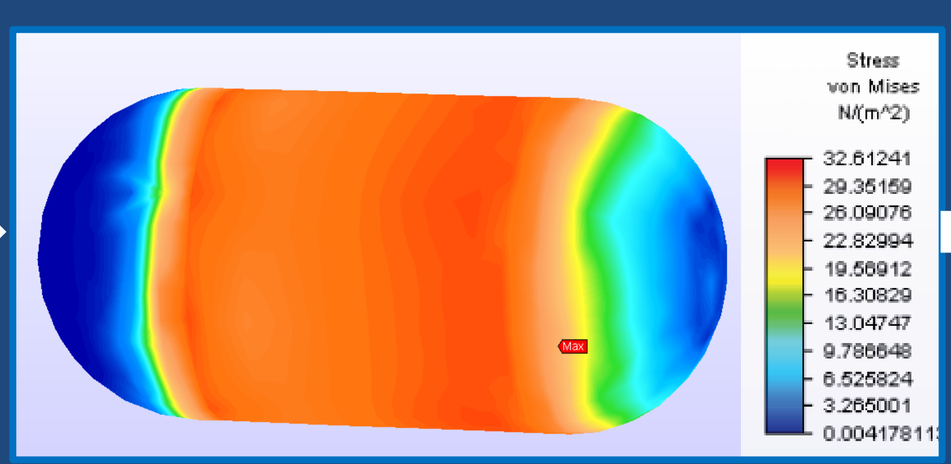

Fig 5: FEA External Pressure Impact Analysis

Fig 6: ECF Vehicle Tank Frame

Carbon Fibre Design Proposal	
Cylindrical Dimensions	
Radius =	0.218 m
Height =	0.71 m
Spherical End Caps	
Radius =	0.218 m
Total Storage Volume	149.4 L
Total Storage Capacity	6.13 kg

Fig. 7: Tank Dimensions

Achievements

- This project has successfully achieved the five objectives.
- Evaluated compressed gas storage as most efficient at present from comparison
- Successfully researched industry and academic research and products
- Produced a ECF tank design proposal that weighs196.5kg empty and has a material cost of £1965.00(GBP).
- Hydrogen Storage is very costly at present though as technology is improved cost should reduce down to be viable in the domestic environment.
- Hydrogen technology will not become the norm until government and industry get together to encourage its application.