COst & PERformaNces Improvement for Cgh2 composite tanks COPERNIC

(GA 325330)

Fabien NONY (Coo.)
CEA
http://project-copernic.com

Scan me:

PROJECT OVERVIEW

- Call topic : SP1-JTI-FCH.2012.1.3 / CGH2
  Application Area : Transportation & Refuelling Infrastructure)
- Start / End date: 01.06.2013 - 31.05.2016
- Budget
  total budget: 3,445,217 €
  FCH JU contribution: 2,005,396 €
  External funding: None

- Consortium overview: 7 active partners:
- Short summary/abstract of project

CGH2 tanks have achieved a certain maturity level, but major issues still remain to be addressed considering automotive targets. COPERNIC will provide real scale demonstration on a pilot manufacturing line and **quantitative assessment of strategies including evolution of materials, components, processes and designs.**

- Stage of implementation (M29/36 ~80%)

PROJECT TARGETS AND ACHIEVEMENTS #1/3

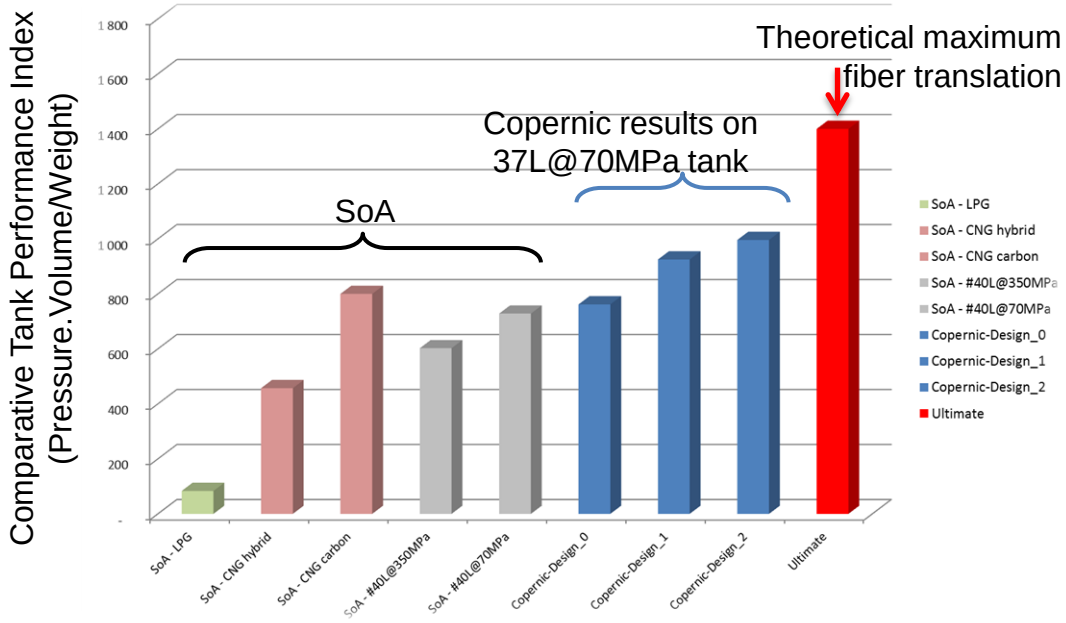
Programme objective/target	Project objective/target	Project achievements to-date	Expected final achievement
MAIP			
Design/ test criteria for CGH2 tanks	Contribute to advancement of relevant test methods	- **Thermal gradient in -40°C cycling** - Benefit from embedded SHM	Recommendations to community & committees
AIP			
Development activities on materials	Assess alternative materials to improve performance/cost ratio	- Liner material and interfaces **improvement for -40°C behaviour** - Alternative CF selected - **Alternative resins selected** (cost -37%) - Cost competitive CF prepreg identified - **Optimized laminate architecture** (-20% CF)	 Resin cost -30% ☑ **CF use** -15% ☑
Lower cost production processes	Assess manufacturing technology improvement strategies	- Costs metal boss: -50% - **Filament winding time**: -45% ☑ - Prepreg study with suppliers	Metal boss cost /5 **FW time** -30% ☑ **Increased repeatability** ☑
Improved complete **tank systems and components**	Reduced weight and volume. Fully integrated OTV	**OTVR weight** -75 %w ☑ OTVR cost : -10 % **Part number** -30 to 40 % OTVR Power -30%	OTVR weight -50 %w OTVR cost -20-30% Part number -50% OTVR Power -30-40 % ☑
On or off/board **diagnosis systems** for containers	Develop and assess NDE methods for SHM of COPV	- Benefit from SHM for inline Qcheck and/or robust design demonstration; - SHM strategy to provide integrity check prior or during filling (HRS link)	Confirmation of SHM benefits in operation (pressure cycling)

PROJECT TARGETS AND ACHIEVEMENTS #2/3

What advancements have been achieved with respect to state-of-the-art?

- Benchmark of alternative/enhanced materials :
  - **liner materials** and **interfaces** for increased resistance to extreme T° C
  - **carbon fibers** exhibiting higher perf/cost ratio
  - **resin** systems with improved perf.processing / cost
  - cost competitive CF **prepreg** systems

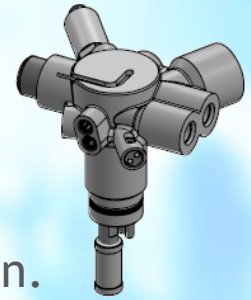
- >20% CF weight savings achieved through architecture optimization



- **Prospective tank prototypes on novel geometries** to increase CF efficiency

PROJECT TARGETS AND ACHIEVEMENTS #3/3

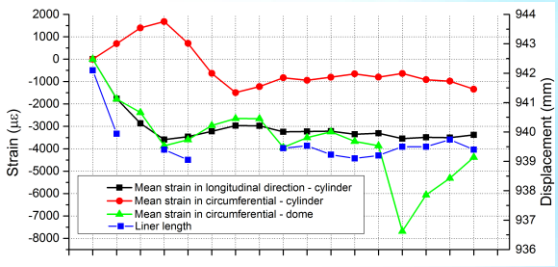
Tank Component achievements:



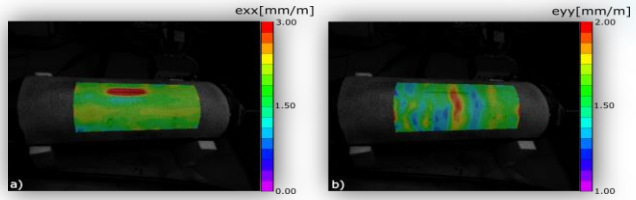
- Delays: management of **partner replacement**
- **Fully integrated OTV** with built-in pressure regulation designed (OTVR)
  Weight ~1 kg, Height < 40 mm including the pressure regulator,
  Power consumption < 10 Watt to open, 2/3 watt PVM Signal to keep open.

SHM achievements :

Liner strain monitoring during production



- **SHM strategy** defined and applied on tank prototypes (hydraulic tests of COPV with and without programmed defects, comparison of FO with DIC)
- Advantages/limitations under assessment within **monitoring of tank production**, testing in accordance with EC79,(extreme and ambient T cycling, chemical exposure, ASRT, burst)



Perspectives /Copernic:

- **Push forward** the optimization strategies
- **Combine** the different optimization strategies in 1 storage system.
- **Pursue** the assessment of optimized tank design through complementary testing

RISKS AND MITIGATION

- Objective no.2 “**Development activities on materials** “

Among the different **cost reduction strategies**, the strategies to replace part of the carbon fiber by a **cheaper one** (with performance and cost) appears not relevant as the carbon market review reveals no significantly lower cost high resistance fiber. The consortium is thus focused on the other planned strategies (resin, high performance CF, optimized process and design).

The optimized composite architecture (developed on reference liner) might not be directly applicable to new liner (other polymer material with different shrinkage induce modified liner geometry using same mould)

- Revision of targets: No

RISKS AND MITIGATION

Objective no.3 "**Development activities on tank components and systems**"

Delay in component definition. State of the art and project specifications are defined. Nevertheless, activities (*T3.2 Improved Pressure components*) have been suspended since June 2014 and former responsible partner has been declared as a **defaulting partner** end of 2014.

The consortium managed with FCH JU the **replacement by ANLEG** which has expressed its willing to take over these challenging activities during the last Mid-Term Review (February 2015).

Design activities have been completed meanwhile by ANLEG and are **consistent with the improvement targets** but prototypes manufacturing and testing are subjected to formal entrance of ANLEG in the consortium and grant transfer.

Revision of targets: No

SYNERGIES WITH OTHER PROJECTS AND INITIATIVES

- Overview of support received via national programmes or other agencies
  - No external funding for cost/performance improvement R&D
- Extent to which project builds on previous FCH JU/EU-funded projects
  - FP6 **STORHY** (COPV testing)
  - FCH **HYCOMP** (PNR, failure mode of type III/IV tanks, testing procedures)
- Description of any partnerships, joint activities formed with other FCH JU/EU projects
  - Very few **but link with demo projects with large FCEV/HRS deployment would be desirable** (real load profiles Vs normative tests, existing limitations, SHM, prepare cost competitive maintenance/inspection procedures, provide feedback from system to material specs …)
  - FCH JU **HYPACTOR** (COPV testing, SHM & diagnostics)
- Interactions with any international-level projects or initiatives
  - Multiple connections with National, European and International standard committees

HORIZONTAL ACTIVITIES

- Training activities organised by the project
  - CEA: H2 lectures in French universities and Eng. Schools
  - ANLEG: Workshop on EC 79 homologation on Tank components (organised by ZBT)
  - WUT: lectures at Wroclaw University of Technology on SHM technologies and COPV (modelling, manufacturing, testing, H2 storage)

- Project work in safety, regulations, codes, standards, general public awareness
  - Testing of type IV cylinders, survey of PNR external activities, advanced testing protocoles, in situ monitoring during regulation compliant tests, recommendations towards technical committees (Afnor, ISO)
  - Results might be used for on-board monitoring of COPV (automotive) and stationary applications (HRS)
  - ISO TC197 WG 18: normative committee for on-board storage of hydrogen
  - SuperGen project (UK) : fire behaviour of COPV

DISSEMINATION ACTIVITIES

- A dedicated on-line website: http://project-copernic.com
- 1 patent on multimaterial assemblie / interface treatment
- 4 papers on SHM
- 14 presentations of the Copernic project and results
  (JEC, WGF, ATC Expo, ICCM, CPVS, WHEC, ECCM, ICHPS)
- COPERNIC workshop in 2016. *Scan QR Code for latest information* ➔
- 3 planned meetings in 2016 with end-users

EXPLOITATION PLAN/EXPECTED IMPACT

- What has your project changed in the panorama of FCH technology development and/or commercialisation?

➢ Cheaper tanks : (-20% CF) & Fully integrated OTV-R (On-Tank Valve with integrated Regulator)

➢ Benefits from embedded SHM : filling process enhanced safety & Easier re-testing

- How will the project's results be exploited? When? By whom?

SS&A: - Commercialization of ComposicaD™ software with improved numerical interfaces
- Improved laminate architecture applies to other high pressure cylinders (e.g. CNG)

SYMBIO FCELL: Benefit from Copernic design tanks for its range extender FCEVs

RAIGI: - Implement results in a tank (Automotive Type IV 70MPa) for a certification (EC 79) in 2017

ANLEG: - To make Anleg known also as HP Components manufacturer. Commercialisation of OTV-R for automobile and aeronautical apps. The OTV-R has not existed before on the market.
- Position Anleg to be a Tank-System Supplier. Need to finalise EC 79 shortly to bring to market
- Knowledge on HP solenoid valves, with very low power consumption and no dynamic sealing.

- What are the achievements that will allow progressing one step further to cost reductions and enhanced performance (efficiency, durability)?

Push forward instrumented manufacturing and testing, improved modelling, enhanced materials, novel concepts, analyze COPV status after real operation, prepare maintenance procedures …