Composites and RailWay

Lightweighting research in EU surface transport projects: the role of composites

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Composites in surface transport/rail applications

- Lightweight, adaptable
- Cinderella role – mostly for sub-assemblies, trim
- Greater confidence following widespread use in aviation
- Has the time for composites in load bearing applications finally come?
- A few examples in different sectors to encourage greater use of composites....
- Where we are going?
MARITIME APPLICATIONS:

**BB GREEN**
Electric, air-supported high speed waterbus

*Fully carbon composite sandwich hull*

Other projects have looked at superstructures of large ships

AUTOMOTIVE APPLICATIONS

- **SLC**
  - Development of multimaterial optimized structures (30-50% reduction of structure weight, equivalent to up to 25 g/km CO₂)
  - The right material for each part, keeping costs and production rates suitable for mass production
  - Achieved 28% weight reduction with a cost increase of 3-5 €/kg (10 for niche cars)

- **LITEBUS**
  - Lightweight bus structures
  - All composite sandwich material
  - New modular architecture
  - "The bus that bounced"
**ALIVE**

**Mission:**
Achieve a significant reduction in weight of electric cars destined for mass-production with minimal additional costs

**Focus:**
- Biw with integrated battery housing: approx. 45% (i.e. from 355 kg to 200 kg)
- Chassis: approx. 25% (i.e. from 260 kg to 200 kg)
- Hang-on parts: at least 25% (i.e. from 100 kg to 75 kg)
- Interior components: in the range of 30% (i.e. from 100 kg to 70 kg)

**Coordinator:** Volkswagen AG  
**Total costs:** 13,08M€  
**EC contribution:** 7,57M€  
**Start date:** 1/10/2012  
**Duration:** 48 months

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**WIDE-MOB**

**Mission:**
Building blocks concepts for efficient and safe multiuse urban electrical vehicles

**Focus:**
- Development of state-of-the-art building blocks critical systems
- Demonstrate and validate the integration of the developed systems into a next generation low weight and safe Electrical Vehicles for urban mobility

**Coordinator:** Fiat Research Center  
**Total budget:** 3,9M€  
**EC contribution:** 2,6M€  
**Start date:** 1/12/2010  
**Duration:** 36 months

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**Research Topics and results:**
- Development of advanced design and simulation capabilities for multi-material vehicle concepts
- Generate a data-rich novel fast and reliable LCA simulation tool
- Generate advancements in joining technologies aimed at realistic industrial solutions that can reliably and economically join a variety of materials
- Build a set of demonstrators for destructive and non-destructive testing and validation of simulation results
Mission:
Fully carbon composite trailer

Conclusions:
- high raw material cost
- high tooling cost or only simple shapes
- long cycle time
- high energy usage in production
- availability of compatible structural adhesives
- availability of in-mould paints or gel coats.

RAIL APPLICATIONS
A look back…..

Nothing new under the sun?
1975: composite cab for HST power car cab shell and skirting
Survived collisions >200kph
But....
For coaching stock
GRP used for panels, vestibule ends, water storage tanks, no load bearing/structural components
Feasibility studies but nothing 'in real life'
RAIL APPLICATIONS 2010s

- Weight per seat for passengers trains from 400kg to 800kg (some, such as the ICE 2, up to 1100kg)
- Composites used in the front ends of trains and locomotive, lateral panels, interiors...
- Lack of confidence for structural application from an absence of legislation about requirements, conformity procedures and acceptance criteria
- MODTRAIN (FP6) MODLINK mock ups of passenger driver interfaces
- DE-LIGHT (FP6) has proven the feasibility of structural lightweight materials for rail vehicles.
- Refresco (FP7) - Towards a REgulatory FRamework for the usE of Structural new materials in railway CarbOdyshells
- Lowflip (FP7) looking at new manufacturing techniques

Lowflip

- To develop a low cost flexible and integrated composite parts manufacturing process which will require minimum investment in comparison with current state of the art processes.
- To develop, assess and analyse new out-of-autoclave composite raw materials for easy and low cost automated manipulation
- To develop low cost and flexible multifunctional handling, placement and draping solutions for both small complex parts and big structures
- To reduce composite manufacturing process steps by selective, fast and energy efficient heating technologies
- To develop simulation tools to support automation of the process with regards to material drapability, curing optimization and crash behaviour
- To design and produce prototype manufacturing cells that integrate the technologies validated at laboratory scale and to create a new process concept for the composites manufacturing sector
- https://www.thinglink.com/scene/725650995635290113
Next steps - Roll2Rail – Lighthouse project in Horizon 2020
Builds on Refresco

- Development of two technical specifications (High Speed Train and Urban) for the car bodies;
- Studying the integration of coach subparts in composite material car bodyshells;
- Establishing a selection process to find new combinations of composite materials that are adequate for each sub-assembly of the whole carbody;
- Researching joining technologies for next generation composite materials applied to railway environment;
- Researching manufacturing processes and automation solutions.

In Shift2Rail JT1 (H2020), a Carbodyshell Demonstrator will be launched, to demonstrate:
- weight reduction with energy consumption benefits
- improved comfort and function
- alternative vehicle concepts
- increased capacity

Stage 3 of the Refresco Roll2Rail Shift2Rail process
Keep your eyes open....

- "Mobility for Growth" has topics open for all modes collectively
- Preparation for the 2018/19/20 Work Programmes starting soon
- Look out for topics in calls for 'NMP' (Key Enabling Technologies) Programmes on materials & nanomaterials, manufacturing processes

The future.....

- Build confidence in 'real life' applications of composites as load bearing structural components
- Improve modelling processes and simulation for the use of composites
- Determine more efficient large scale manufacturing processes
Thank you for your attention!

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