

Department of Energy Physical-Based Hydrogen Storage Workshop: Identifying Potential Pathways for Lower Cost 700 Bar Storage Vessels

Wednesday, August 24th, 2016

USCAR

1000 Town Center Drive, Suite 300
Southfield, Michigan

WORKSHOP OBJECTIVES

- Identify and prioritize specific and tangible research and development strategies that have high potential to lower the costs of Composite Overwrapped Pressure Vessels (COPVs) for 700 bar hydrogen storage to enable wide-spread commercialization of fuel cell electric vehicles.
 - Identify and prioritize potential strategies to reduce the cost and complexity of the refueling infrastructure through onboard storage system design as well as strategies relating to codes and standards to ease the COPV requirements and reduce cost.
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AGENDA

<i>Time</i>	<i>Topic</i>
8:15–8:30 am	Introduction and Workshop Goals – <i>Ned Stetson, DOE</i>
8:30–9:00 am	Current 700 Bar System Cost Projection – <i>Brian James, Strategic Analysis</i>
9:00–9:30 am	Carbon Fiber (CF) Precursors & Conversion – <i>Dave Warren, ORNL</i>
9:30–10:00 am	700 Bar COPV Manufacturing – <i>Brian Rice, University of Dayton Research Institute / Institute for Advanced Composite Manufacturing Innovation</i>
10:00–10:15 am	Break
10:15–10:45 am	Automobile OEM's View on 700 Bar Hydrogen Storage System Needs to Enable Fuel Cell Electric Vehicle Rollout – <i>Michael Luckham, GM</i>
10:45–11:15 am	Breakout Instructions / General Discussion – <i>Ned Stetson, DOE</i>
11:15–12:00 pm	Lunch [Note – please bring \$10 cash for the provided lunch and coffee]
12:00–2:00 pm	Breakout #1 <ul style="list-style-type: none">• <u>Breakout A</u>: Carbon Fiber Precursors & Conversion <i>[Moderators: Dave Warren, Grace Ordaz; Scribe: John Gangloff]</i><ul style="list-style-type: none">○ For low-cost, high-strength CF – what new precursor chemistries and process engineering are needed?○ Pros and cons of CF precursor chemistry types: Acrylic, Cellulosic, Pitch-based, other (i.e. Vinylidene chloride, Phenolic, etc.)○ Is melt spun PAN the best way to generate alternative CF precursor that can yield high-strength CF? Are there alternative pathways?○ Cellulosic / bio-based precursors are not high enough quality for high-strength CF – how can this be improved?○ What existing low-cost / low-strength CF precursor materials and processes can be modified to make low-cost / high-strength CF?

- **Breakout B:** COPV Certifications and Related Codes & Standards
[Moderators: Ian Sutherland, Will James; Scribe: Deanna Schenck]
 - Is there a pathway to relax current 700 Bar COPV codes and standards such that COPVs do not have to be as overdesigned? Is more test data needed?
 - Using performance based standards and physics based models to justify relaxing codes and standards has been mentioned. Are there examples?
 - Big hurdle for alternative fibers (i.e. glass) is high safety factor. Is there potential / pathway to reduce this?
 - Should more be done to standardize port sizes, interfaces, and COPV sizes?
 - Should alternative BOP materials (i.e., polymers, alloys, aluminum) and component integration be pursued given likelihood that each OEM will develop their own unique designs?

2:00–2:15 pm

Break

2:15–4:15 pm

Breakout #2

- **Breakout C:** Pressure Vessel Design & Manufacturing
[Moderators: Brian Rice, Jesse Adams; Scribe: Deanna Schenck]
 - Should new manufacturing technologies for better cycle times (i.e. braiding, multi head filament winding, prepregs, etc.) be pursued?
 - Does it make sense to pursue tradeoff analysis for resins comparing production time and recyclability vs. material cost? Is there potential here to significantly impact cost?
 - Should resins with nano-additives for improved fiber translation efficiency be further pursued?
 - Is there interest in new liners – thinner, hybrid materials, layers, heat transfer, compatible at lower temperature, etc.?
- **Breakout D:** Outside the Box Ideas to Reduce Cost
[Moderators: Mike Veenstra, Ned Stetson; Scribe: John Gangloff]
 - Should any of these ideas be pursued?
 - Structural Health Monitoring to reduce design risk
 - Conformable tanks for heat transfer benefits and increased hydrogen storage packaging design flexibility
 - Modular tanks where a single module can be built upon for multiple applications to reduce cost
 - Hybrid CFs – blend low-strength/high-strength CFs or high-strength CF with alternative fibers, such as basalt, glass, aramid
 - Are there other novel ideas to reduce cost and improve performance?

4:15–5:00 pm

Reports Out / Wrap-up / Action Items