Gas Generators and Their Potential to Support Human-Scale HIADs

(Hypersonic Inflatable Aerodynamic Decelerators)

Introduction

As HIAD technology progresses from 3-m diameter experimental scale to as large as 20-m diameter for human Mars entry, the mass penalties of carrying compressed gas has led the HIAD team to research current state-of-the-art gas generator approaches. Summarized below are several technologies identified in this survey, along with some of the pros and cons with respect to supporting large-scale HIAD applications.

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<th>Technology</th>
<th>Pros</th>
<th>Cons</th>
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| Sublimating Powders/Crystals | - Used as far back as Echo-1 (1960)       
- Minimum support infrastructure       
- Fairly light weight       | - High inflation pressure of the HIAD leads to difficult solutions       
- Slow sublimation limits failure mode protection       
- Potential for early deployment due to packing irregularities | |
| Hybrid Gas Generators    | - Storing gas as a liquid increases storage density       
- Used to inflate some aircraft escape slides       | - Risk of introducing liquid into inflatable       
- Still carrying pressurized components       
- Pressure vessel increases mass       | |
| Solid Gas Generators     | - Several gases available       
- Tailorable output temperature       
- No pressure during transit       | - Concern about grain cracking as size increases       
- Still have pressure vessel during deployment       | |
| Metal Hydride/Membrane Storage | - No/low pressure during transit       
- Scaling of the chemistry is well understood       
- Release can be electrical or chemical initiated | - Gas Temperature near system limits       
- Manufacture challenges with the hydrides (industrial scale) | |
| Re-purposing of Fluids   | - Some chemicals endothermic (reduce insulation)       
- Known technology       | - Risk of induced liquid into inflatable       
- Still carrying pressurized components       
- Pressure vessel increases mass       | |

2. Small metal hydride storage unit at SRNL, USA. 

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