



Using Drained Spacecraft Propellant Tanks for Habitation

A document proposes that future spacecraft for planetary and space exploration be designed to enable reuse of drained propellant tanks for occupancy by humans. This proposal would enable utilization of volume and mass that would otherwise be unavailable and, in some cases, discarded. Such utilization could enable reductions in cost, initial launch mass, and number of launches needed to build up a habitable outpost in orbit about, or on the surface of, a planet or moon. According to the proposal, the large propellant tanks of a spacecraft would be configured to enable crews to gain access to their interiors.

The spacecraft would incorporate hatchways, between a tank and the crew volume, that would remain sealed while the tank contained propellant and could be opened after the tank was purged by venting to outer space and then refilled with air. The interior of the tank would be pre-fitted with some habitation fixtures that were compatible with the propellant environment. Electrical feedthroughs, used originally for gauging propellants, could be reused to supply electric power to equipment installed in the newly occupied space. After a small amount of work, the tank would be ready for long-term use as a habitation module.

This work was done by Andrew S. W. Thomas of Johnson Space Center. Further information is contained in a TSP (see page 1). MSC-24236-1

Connecting Node

A paper describes the Octanode, a connecting node that facilitates the integration of multiple docking mechanisms, hatches, windows, and internal and external systems with the use of flat surfaces. The Octanode is a 26-faced Great Rhombicuboctahedron Archimedean solid with six octagon-shaped panels, eight hexagon-shaped

panels, and 12 square panels using three unique, simple, flat shapes to construct a spherical approximation. Each flat shape can be constructed with a variety of material and manufacturing techniques, such as honeycomb composite panels or a pocketed skin-stringer configuration, using conventional means.

The flat shapes can be connected together and sealed to create a pressurizable volume by the use of any conventional means including welding or fastening devices and sealant. The node can then be connected to other elements to allow transfer between those elements, or it could serve as an airlock. The Octanode can be manufactured on the ground and can be integrated with subsystems including hatches and ports. The node can then be transported to its intended location, whether on orbit or on surface. Any of the flat panels could be replaced by curved ones, turning the node into a copula.

Windows may be placed on flat panes with optimal viewing angles that are not blocked by large connecting nodes. The advantage of using flat panels to represent a spherical approximation is that this allows for easier integration of subsystems and design features.

This work was done by Christopher J. Johnson, Jason L. Raboin, and Gary R. Spexarth for Johnson Space Center. Further information is contained in a TSP (see page 1).

This invention is owned by NASA, and a patent application has been filed. Inquiries concerning nonexclusive or exclusive license for its commercial development should be addressed to the Patent Counsel, Johnson Space Center, (281) 483-1003. Refer to MSC-24216-1.

Electrolytes for Low-Temperature Operation of Li-CF_x Cells

A report describes a study of electrolyte compositions selected as candidates for improving the low-temperature performances of primary electrochemical cells that contain

lithium anodes and fluorinated carbonaceous (CF_x) cathodes. This study complements the developments reported in "Additive for Low-Temperature Operation of Li-(CF)_n Cells" (NPO-43579) and Li/CF_x Cells Optimized for Low-Temperature Operation (NPO-43585), which appear elsewhere in this issue of *NASA Tech Briefs*.

Similar to lithium-based electrolytes described in several previous *NASA Tech Briefs* articles, each of these electrolytes consisted of a lithium salt dissolved in a nonaqueous solvent mixture. Each such mixture consisted of two or more of the following ingredients: propylene carbonate (PC); 1,2-dimethoxyethane (DME); trifluoropropylene carbonate; *bis*(2,2,2-trifluoroethyl) ether; diethyl carbonate; dimethyl carbonate; and ethyl methyl carbonate. The report describes the physical and chemical principles underlying the selection of the compositions (which were not optimized) and presents results of preliminary tests made to determine effects of the compositions upon the low-temperature capabilities of Li-CF_x cells, relative to a baseline composition of LiBF₄ at a concentration of 1.0 M in a solvent comprising equal volume parts of PC and DME.

This work was done by Marshall C. Smart, Jay F. Whitacre, and Ratnakumar V. Bugga of Caltech; and G. K. Surya Prakash, Pooja Bhalla, and Kiah Smith of the Loker Hydrocarbon Institute at the University of Southern California for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1).

In accordance with Public Law 96-517, the contractor has elected to retain title to this invention. Inquiries concerning rights for its commercial use should be addressed to:

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Refer to NPO-43587, volume and number of this NASA Tech Briefs issue, and the page number.