This article is archived from a past issue of The Supelco Reporter. Information in the article was appropriate at the time of publication, but product specifications, catalog numbers, and availability may have changed over time.

If you have questions about applying methodology described in this article to a current application, please contact our technical service chemists.
Carbon Adsorbents in Space Exploration Applications

B. Betz, Gas Chromatography, Supelco, Bellefonte, PA, USA

The National Aeronautics and Space Administration (NASA) has been studying planets in our solar system for several decades. The missions attempt to obtain a breadth of knowledge by gathering data on the electromagnetic spectrum, magnetic fields, particle analyses, and atmosphere constituents of these planets. Some information may lead to determining the birth of the solar system and origins of life on Earth. To assist in these studies, Supelco designed unique carbon adsorbents for analyzing atmospheric constituents under the arduous constraints of space exploration.

The Galileo Probe, which arrived at Jupiter in 1995, employed a column packed with a Carbosieve™ carbon molecular sieve adsorbent, as part of a mass spectrometer experiment. This adsorbent was developed to separate and quantify the gases in Jupiter’s atmosphere — methane, water, argon, neon, hydrogen sulfide, krypton, xenon, ammonia, and isotopes of helium and hydrogen. The adsorption/desorption properties of the adsorbent allowed concentration of these gases of interest, and their subsequent desorption to a mass spectrometer sensor for analysis.

NASA’s latest project is the Cassini Mission to Saturn. The journey to the ringed planet will last approximately seven years, and exploration will continue for four years. A total of 27 experiments will be performed, with the involvement of a number of international space agencies, academic institutions, and industrial partners. Supelco participated in composing the atmosphere sampling experiments.

The Cassini spacecraft consists of two parts — the Saturn orbiter will collect data, communicate with Earth, and power the spacecraft; the Huygens probe will separate from the orbiter and travel to Titan, Saturn’s largest moon.

A gas chromatograph/mass spectrometer (GC/MS) in the Huygens probe will analyze the organic components of Titan’s atmosphere. Light hydrocarbons will be concentrated using a new, porous graphitized carbon developed at Supelco specifically for this application. This carbon will trap the C2 to C8 hydrocarbon fraction — an important indicator of the presence of life.

Supelco scientists graphitized a carbon molecular sieve to optimize the analysis of light hydrocarbons and efficiently release the trapped analytes under conditions specific to a totally new GC/MS flow design. The carbon molecular sieve base withstands the vibrations of the launch and entry into Titan’s atmosphere.

Also onboard the Huygens probe is another carbon molecular sieve, Carboxen™-1004. As the atmosphere of Titan is believed to be similar to that of ancient Earth, Supelco provided an adsorbent that will trap permanent gases. Scientists working at the University of Paris, packed a microcolumn with Carboxen-1004, for in situ GC/MS analysis.

A carbon molecular sieve is the carbon skeletal framework remaining after the pyrolysis of a polymeric precursor. They are used primarily for the collection of very small molecular-sized compounds. The size and shape of the molecule, and of the pores in the adsorbent particle, determine how well the analyte is adsorbed and desorbed. Supelco offers numerous types of carbon molecular sieves, all of which have upper temperature limits of at least 400°C.

Supelco’s carbon laboratory is one of the finest in the world. In addition to developing new carbon molecular sieves and making recent developments with porous graphitized carbon, we also produce a variety of graphitized carbon blacks (GCBs).

We can prepare carbons in sub-micron particle sizes (for capillary GC applications) to 1.0mm sizes (for sample preparation applications where pressure drop considerations are required). Some carbons are available in larger sizes. The temperature capability of our furnace reaches 3000°C, and its capacity extends from bench- to pilot-scale. We pride ourselves on being able to tailor carbon adsorbents to specific applications. The graphitized carbon molecular sieve designed specifically for NASA is just one example.

Supelco™ carbon adsorbents are available in bulk, and packed in columns, sampling tubes, or gas purifiers. Custom requests are welcome, even if your demands are earthbound.

**Ordering Information:**

<table>
<thead>
<tr>
<th>Description</th>
<th>Cat. No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLOT Capillary GC Columns</td>
<td></td>
</tr>
<tr>
<td>Carboxen 1010 Columns</td>
<td></td>
</tr>
<tr>
<td>Carbon molecular sieve; for permanent gases. 30m x 0.32mm ID</td>
<td>24246</td>
</tr>
<tr>
<td>30m x 0.53mm ID</td>
<td>25467</td>
</tr>
</tbody>
</table>

Carbosieve, Carboxen, and Supelco are trademarks of Sigma-Aldrich Co.

Fused silica columns manufactured under HP US Pat. No. 4,293,415.