Solid State Battery Tests

Presented to:  Systems Meeting
By:  FAA Fire Safety
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Background

• Solid-State cells
  – Use solid electrolyte instead of liquid electrolyte.
  – There are many types of solid electrolyte available but most (maybe all) have issues.
  – Are said to be “safer” because of the absence of flammable liquid electrolyte.
Introduction

• The FAA conducted a few tests with solid-state lithium ion cells.
• Electrolyte composition not specifically disclosed to FAA has similar flammable ingredients as conventional electrolyte but in a solid form.
Setup

- Test were performed in the 21 liter pressure sphere.
- Flammable gas composition and temperature were measured.
- Solid state cells were 2.6Ah pouch & were compared to regular 2.5Ah LCO pouch cells.

Test Chamber  Solid State Cell  Regular LCO cell
## Results

<table>
<thead>
<tr>
<th></th>
<th>Test 1 solid-state</th>
<th>Test 2 solid-state</th>
<th>Test 3 Typical Li-Ion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Cell Temperature (degC)</td>
<td>N/A</td>
<td>814.4</td>
<td>690.6</td>
</tr>
<tr>
<td>Gas Volume (liters at 1atm)</td>
<td>3.75</td>
<td>3.73</td>
<td>4.318</td>
</tr>
<tr>
<td>Total Hydrocarbon (%)</td>
<td>16.77</td>
<td>17.02</td>
<td>21.13</td>
</tr>
<tr>
<td>Hydrogen (%)</td>
<td>18.5</td>
<td>17.27</td>
<td>22.97</td>
</tr>
<tr>
<td>Carbon Monoxide (%)</td>
<td>23</td>
<td>23.84</td>
<td>16.75</td>
</tr>
<tr>
<td>Carbon Dioxide (%)</td>
<td>30.55</td>
<td>29.7</td>
<td>27.97</td>
</tr>
</tbody>
</table>
Summary

• Maximum temperatures were hotter with the solid-state cells.
  – This could be due to a number of factors such as higher energy density or less phase change energy loss etc.

• Total gas output was about 10% less than typical li-ion.
  – Hydrocarbon: about 30% less gas.
  – Hydrogen: about 30% less gas.
  – Carbon Monoxide: about 20% more gas.

• Overall: gas output was safer but temperatures were less safe.
Questions?

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