National Aeronautics and Space Administration

NASA Engineering and Safety Center Technical Bulletin No. 09-05

Self-Contained Oxygen Generator: Effects of Organic Contamination, Briquette Fracturing, Pressure Containment, and Variations in Chemical Composition

A Self-Contained Oxygen Generator (SCOG) produces breathable oxygen (O_2) by using chemically-reactive briquettes that begin producing O_2 when mechanically ignited. Contamination with organic material of, or manufacturing defects in, the briquettes have been shown to lead to conditions that can cause an explosive failure

Applicability

This information is applicable to military and aerospace SCOGs.

Background

SCOG failures were recently investigated by the NASA Engineering and Safety Center (NESC) as a result of an SCOG explosion aboard the United Kingdom's Royal Navy submarine *HMS Tireless*. The root cause identified during this investigation was contamination of the internal briquette. When the briquette is contaminated, it can result in a runaway pressure event, which can lead to an SCOG explosion.

Findings and Conclusions

Liquid organic (oil) contamination can cause excessive heating and an increased burn rate in SCOGs. Contamination also contributes to an accelerated pressure increase, which does not allow the containment system to vent the accelerated pressure increase effectively.

A history of overheating and faster burn rate areas attributed to uneven mixing of the chemicals in the briquette was identified in SCOGs. The chemical mixture in the briquette contains iron filings that act as an accelerant for the SCOG reaction. When the iron is not uniformly distributed in the briquette mixture, the result will be locally enriched "hot spots" with faster burn rates.

An additional area of concern with the design of the SCOG containment system was identified. Systems that have an undersized venting mechanism could fail as a result of pressure runaway. This pressure runaway is caused when the gas is generated in the SCOG faster than it can be vented from the containment system.

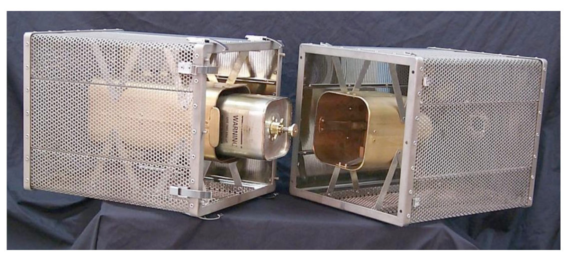
Corrective actions were identified for the safe operation of SCOGs, one of which was to prevent organic material/fuel contamination. Contamination should be prevented by maintaining the briquette seals and storing away from organic materials. The briquette should be tested for uneven mixing of iron additives. Another corrective action was to design the containment system in a manner that allows the pressure to escape during the chemical reaction. There are a variety of possibilities for the containment system for a SCOG. The United States Navy uses an open containment system for their SCOGs and this system has been working successfully.

Reference

Self-Contained Oxygen Generator Safety Assessment: Effects of Organics Contamination, Briquette Fracturing, Pressure Containment and Variations in Chemical Composition. NESC Assessment Number: 07-051-E, October 2008

WSTF-IR-1120-001-08 Self-contained Oxygen Generator Investigation, Analysis and Testing

This work was led by Henry Rotter and John Graf, Johnson Space Flight Center, and by Jon Haas, White Sands Test Facility.



Space Station Backup Oxygen Candle System (4" x 4" square candle)

(Far left) Test cell candle initiation in 8' x 8' test cell with Lexan flexible sheets

(Left) Duplication of explosion on the Royal Navy submarine (Note: destroyed Lexan sheets)

NESC tech bulletin

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