HYDROCARBON OIL FOUND IN THE INTERIOR OF A "COLD FUSION" ELECTROLYSIS CELL AFTER FATAL EXPLOSION

ELECTROLYTIC DEVICES

KEYWORDS: *explosion hazard, organic oil, safety precautions*

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Forensic analyses of debris from the fatal explosion of an electrochemical "cold fusion" cell revealed the presence of unanticipated organic residues that could be very important in the future design and performance of these experiments. A hydrocarbon oil, likely a lubricant from machining the metal components of the electrolysis cell, was detected on the interior cell walls. Reactions of oil with electrolytic oxygen have the potential for significant energy generation and could have contributed to the initiation and total energy inventory of the subject explosion.

INTRODUCTION

On January 2, 1992, a "cold fusion" electrochemical cell exploded at SRI International, causing extensive laboratory damage and a fatality.[1,2] Forensic analyses of debris from this incident were performed in our facilities at the request of the Division of Occupational Safety and Health of the State of California. An analytical protocol was implemented to search for any unusual organic compounds that might be present in the explosion residue. The resulting examinations were very sensitive and were conducted for completeness of the overall forensic analyses. Organic species were removed from the debris, concentrated, and analyzed by computer-guided gas chromatography-mass spectrometry (GC-MS).

RESULTS AND DISCUSSION

The analyses of residue from the inner wall of the primary electrolysis cell identified silicones, dibutylphthalate, dioctylphthalate, and a series of compounds that were indicative of the fingerprint of an organic oil. The mass-spectral data were characterized by a continuum of hydrocarbon compounds, with ion-fragment mass-to-charge (m/z) ratios of 57, 71, 85, 99, etc. The presence of these species, along with a distinctive gas chromatographic profile at elevated column temperature, is consistent with the presence of saturated oil residues. Results of GC-MS analyses of a known lubricating oil were very similar to those obtained with the analyte recovered from the explosion debris. This oil gave the same distinctive chromatographic profile and fragment-ion m/z values as the explosion sample and provided qualitative confirmation of analyte identification.

The characteristic GC-MS data strongly suggest the presence of hydrocarbon oil on the interior wall of the electrolysis cell. Lubricating fluid from the routine machining and fabrication of metal parts may be a likely source of this material.

Organic oil in the interior of an electrochemical "cold fusion" cell could be very important for safety considerations. The reaction mechanism of these experiments results in a cell headspace enriched in pressurized O_2, and hydrocarbons are known to be excellent fuels for combustion with oxygen. In addition to a potential contribution to the total energy release of the explosion, lubricating oil might have also served as a possible initiator of this incident. An important protocol of the American Society for Testing and Materials in the utilization of high-pressure gases is that any components used in an oxygen atmosphere must be scrupulously cleaned to avoid explosions and catastrophic overpressures caused by the combustion of residual organic contaminants. It would be prudent, and relatively unobtrusive, to establish effective cleaning methods to remove organic impurities potentially present on apparatus utilized in the interior of "cold fusion" electrochemical cells.

A fuller exposition of this technical note, providing more experimental, analytic, and interpretational detail than allowed here, has been drafted.[3]

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