Wipes, Coatings, and Patches for Detecting Hydrazines

With suitable reformulation, other hazardous substances could also be detected.

John F. Kennedy Space Center, Florida

Three color-indicating devices have been conceived as simple, rapid, inexpensive means of detecting hazardous liquid and gaseous substances in settings in which safety is of paramount concern and it would be too time-consuming or otherwise impractical to perform detection by use of such instruments as mass spectrometers. More specifically, these devices are designed for detecting hypergolic fuels (in particular, hydrazines) and hypergolic oxidizers in spacecraft settings, where occasional leakage of these substances in liquid or vapor form occurs and it is imperative to take early corrective action to minimize adverse health effects. With suitable redesign, including reformulation of their color indicator chemicals, these devices could be adapted to detection of other hazardous substances in terrestrial settings (e.g., industrial and military ones).

One of the devices is a pad of a commercially available absorbent material doped with a color indicator. The absorbent material is made from 70 percent polyester and 30 percent nylon and can absorb about eight times its own weight of liquid. The color indicator is a mixture of conventional pH color indicator chemicals. Hydrazine and monomethyl hydrazine, which are basic, cause the color indicator to turn green. In the original intended application, the pad is wiped on a space suit that is suspected of having been exposed to leaking monomethyl hydrazine during a space walk, before the wearer returns to the interior of the spacecraft. If the wiped surface is contaminated with hydrazine, the pad turns green. In addition, the pad absorbs hydrazine from the wiped surface, thereby reducing or eliminating the hazard. Used pads, including ones that show contamination by hydrazine, can be stored in a sealed plastic bag for subsequent disposal.

The second device, which has been proposed but not yet developed, would comprise a color indicator material in the form of either a coating on a space suit (or other protective garment) or a coating on a sheet that could be easily attached to and detached from the protective garment. The coating material would be a hydrogel doped with a suitable pH indicator. The hydrogel would also serve to maintain a level of moisture needed to support the chemical reaction mentioned in the next sentence. In addition to changing color to indicate the presence of any hypergolic fuel (which is basic) or hypergolic oxidizer (which is acidic) that might splash on the space suit, the pH indicator would also react with the hypergolic fuel or oxidizer and thereby bind it.

The third device is a color dosimeter for detecting hydrazine liquid or vapor coming from microscopic leaks. This device is designed to satisfy several requirements specific to its original intended use in the auxiliary power unit of the space shuttle. These requirements include stability under vacuum, stability at moderate temperature, fast and irreversible change in color upon exposure to hydrazine, and visibility of the color change through polyimide tape. The device is a patch comprising a porous glass-fiber or cellulose patch loaded with potassium tetrachloroaurate (III) [KAuCl₄], which changes color from yellow to purplish gray upon exposure to hydrazine (see figure).

This work was done by Rebecca Young of Kennedy Space Center and William Buttnar of Dynacs, Inc. For further information, contact the Kennedy Innovative Partnerships Office at (321) 867-1463. KSC-12400/342/552