White Sands team applies expertise to real-life problems

White Sands Test Facility has been researching materials and flammability hazards for various space pursuits since the Apollo 201 fire. The backbone of the oxygen fire hazards work since that time has been testing. WSTF has the capability to perform all of the current NASA standard tests for oxygen compatibility.

Joel Stoltzfus, the WSTF Oxygen Hazards Analysis Team leader, states, "We've developed an expertise through the years. Our lab has become a resource NASA-wide for controlling fire hazards in oxygen systems through proper design and operation."

The lab began building its niche in understanding the hazards of oxygen systems in the 1980s when David Pippen, then chief of the Laboratories Office at WSTF, empowered researchers to delve into studying flammability and oxygen-enriched atmospheres. "His vision was to create a world-class, pre-eminent laboratory, and his foresight in this area of safety is what set us on the path," said Stoltzfus. "He was the one who endorsed moving ahead in this direction and developing the hazards analysis approach. Frank Benz and Jack Stradling developed the technical foundation on which the current protocol rests. Now everyone uses the system Pippen fostered here."

Under Pippen's guidance, WSTF transitioned from producing data to be analyzed elsewhere, to analyzing test data and developing materials science in-house. The next step was to apply this data to, and develop an understanding of, real-life problems. Thus the current oxygen hazards analysis approach was born. With time, this approach of applying materials flammability and ignitability data to oxygen systems has been refined into a very useful tool. So useful, in fact, that members of the WSTF Oxygen Hazards Analysis Team are often called upon to teach this approach to others.

The end result was development of a universal oxygen hazard analysis protocol that could be applied to a wide range of industries that use oxygen systems, such as aviation, the medical industry, chemical producers, and the scuba diving industry.

Tech transfer

In the early 1980s, WSTF sought to interact with the oxygen-using community in a more formal way. This was accomplished by joining consensus standards committees such as the American Society for Testing and Materials G-4 Committee on Flammability and Sensitivity of Materials in Oxygen-Enriched Atmospheres. WSTF has been involved in the development of several ASTM standard test methods, editing of publications, and performing industry-sponsored test programs. WSTF personnel were instrumental in developing the award-winning ASTM Technical and Professional Training course "Fire Hazards in Oxygen Systems."

In fact, past and present members of the WSTF Oxygen Hazards Analysis Team are the primary instructors for this course. These instructors are frequently requested to train personnel from various industries on proper procedures for minimizing fire risks in oxygen systems. The course gives a step-by-step process for managing the fire risk through material selection, proper design, and operating procedures. The WSTF Oxygen Hazards Analysis Team also developed an Oxygen Systems Operation and Maintenance course for personnel who work hands-on with oxygen systems. Members of the Oxygen Hazards Analysis Team have taught more than 200 courses and have traveled worldwide in support of this effort.

It's an interesting challenge, according to Stoltzfus, who sees the complexities of trying to ensure safe conditions for environments that sometimes lack control, such as emergency response teams. "It's completely different when dealing with fault tolerance in the private sector, where the environment cannot always be controlled," said Stoltzfus. "Even if they attempt to maintain their oxygen systems by the book, they might unknowingly contaminate their oxygen system and create a fire hazard. For example, an EMT might be in the field having to rescue someone from under a car, using the jaws of life – busy saving lives, and they don't notice the oil from the car dripping into their oxygen regulator. Just that small amount of contaminant is all it takes to create a fire hazard in an oxygen system."

That is why WSTF continues to work with industry to train others and develop oxygen components and systems that are more fault-tolerant. To this end, WSTF is working with the National Institute for Occupational Safety and Health and the Food and Drug Administration to develop a test for medical oxygen regulators to give the regulator a chance of surviving in such a hostile environment.

Most recently, the team rewrote NASA's safety standard for oxygen systems (NSS 1740.15) for publication as ASTM Manual 36, "Guidelines for Oxygen System Design, Materials Selection, Operations, Storage, and Transportation."

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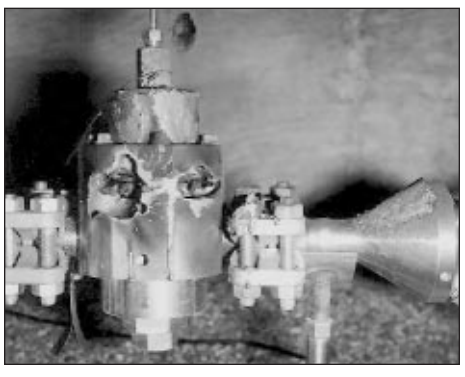
White Sands Test Facility Oxygen Hazards Analysis Team members, left to right, David Hirsch, Harold Beeson, Steve Peralta, Mike Kirsch, Brian Anderson, Joel Stoltzfus, Lori Kubinski, and Mike Shoffstall. Not pictured are Elliot Forsyth, Tim Gallus and Sarah Phelps.



Shown here, an example of a fire investigated by the WSTF Oxygen Hazards Analysis Team. When the fire occurred, oxygen was not flowing through the regulator; however, the dome and body of the stainless-steel regulator were pressurized. It was postulated that the ignition occurred as a result of a leak past the seal between the diaphragm and the regulator body. The fire probably propagated from the diaphragm to the stainless-steel body, where the resulting damage occurred.

Relevance

Fire hazards in oxygen systems is a relevant subject for the general public as well. In 1993, a woman burned to death while in her doctor's office waiting room. It is most likely that the oxygen regulator on top of her small, portable oxygen tank ignited and caused the fatal fire. It is probable that just a small fault in the component led to the disaster, but it is just one example of the potential risks associated with oxygen-enriched environments.

In such a case, WSTF's recommendations to change from flammable aluminum valves to nonflammable brass valves might have saved the woman's life. NIOSH and FDA have since issued safety alerts regarding the use of aluminum valves, which are believed to have a design flaw. No one can put a value on the lives that might be saved by this type of research and, undoubtedly, this small NASA team is making a big impact on all of our lives, as well as our space program.

Current work

The expertise of the WSTF Oxygen Hazards Analysis Team still plays a vital role in the space program today. Currently, it is busy supporting the International Space Station Program. The team has performed an end-to-end oxygen hazards analysis of the entire ISS Environmental Control and Life Support System and fields questions daily from the ISS team concerning potential fire hazards in the ISS. Team members have gone to Russia to inspect their ISS oxygen hardware to ensure their designs meet the established standard.

The team is also interested in making sure those who use the ECLSS on orbit are aware of potential hazards. "We want to get the training to those folks who'll be using the life-support systems," said Stoltzfus. "They'll be relying on hardware like the portable breathing apparatus for more than 15 years. During that time, an astronaut could lose some Chapstick®, which could accidentally come into contact with an exposed oxygen system connection, contaminating the system. Crew members need to know that this would create a fire hazard."

The team will soon be conducting a training session for the Expedition One crew. Stoltzfus says that in the future, they hope to incorporate an abbreviated course into the training that all astronauts and T-38 pilots undergo. ■

For additional information visit the Oxygen Compatibility Web site at http://www.wstf.nasa.gov/oxcompat/