Health & Safety

Flammability of Rehousing Materials

As part of preventive conservation, conservators and collections managers strive to purchase and use the best archival materials to house their collection in storage and while on display. They carefully think about how these materials can best support the objects and contribute to their preservation, and they focus on testing whether these materials off-gas anything that might harm collection items. However, other risks these materials pose to collections have largely been ignored, most significantly, the hazard of a fire.

Many museums use plastics such as Coroplast, Ethafoam, Volara, and polyethylene sheeting for housing collection items and keep additional supplies of these materials in their storage areas. This abundance of plastic materials creates a large fuel load, and under the right conditions, it can present a serious hazard to the collection. Even a small fire will cause widespread smoke damage to all items stored in a room. The Smithsonian Institution (SI) considers these materials a fire risk, so we restrict their use in our exhibit spaces.

Why are these items so dangerous?

In general, plastics/foams:

- Have a higher heat of combustion / heat release rate (the amount of heat released per unit mass of a substance when completely burned / the amount of heat generated by a fire)
- Have a higher smoke output than their organic alternatives
- Tend to melt and spread

What this means is that a fast-growing fire can spread easily and will cause heat and smoke damage to an entire collection in a matter of minutes. Note that a fire can occur without these items present, but their presence in the room will make the situation worse.

Recently, SI partnered with the National Institute of Standards and Technology (NIST) to perform a full-scale fire test in which we simulated a fire in a collections storage room. A sampling of mock collection item types, storage methods, and packaging materials were placed in a room, and a fire was set in a small trash can to recreate a realistic scenario. Bulk packaging materials were stored adjacent to the fire source to emphasize the effect that storing large amounts of solid plastics and foams in a collection's storage area can have on a fire. After several minutes, the fire was extinguished with a sprinkler system installed in the test chamber. See figure 1.

The test was attended by several SI conservators and collections staff members. After the test was complete, items were recovered, examined, and treated by staff on-site. There were a few key takeaways from the test:

- Smoke and heat damage done to the objects was much harder to repair than the water damage done by the fire sprinklers. In some cases, the damage was impossible to repair. More information on smoke and soot in relation to conservation can be found in the lead article published in *AIC News* on September 2010.
- Enclosed metal cabinets greatly limited smoke and heat damage to the items inside. We purposefully compromised the cabinet to simulate a door being left ajar. Even then, damage was very limited as compared to the rest of the room.
- If objects were wrapped in plastic sheeting, the sheeting can melt and adhere to the items, making them difficult/impossible to repair. In our exercise, melting occurred on open shelves in the test chamber, but not in the adjacent enclosed metal cabinet.
- Tyvek sheeting disintegrated early in the fire, leaving the objects exposed. Nomex (similar to Kevlar) sheeting (and the objects inside it) fared much better.

Figure 1. Photos taken before (top), during (middle), and after (bottom) fire test at NIST. The middle image shows the fire in a small trash can.

At the SI, our policy for protecting our staff, collections, and facilities from fire does not prohibit the use of plastics and foams for collection care, but it disallows several items and activities in the collections spaces to reduce the fire risk. Here are some precautions you can take to safely and properly store your collections while limiting the risk of fire.

- Ensure you have a fire sprinkler system in your spaces. Any water damage suffered in a fire will pale in comparison to the permanent damage the fire itself will cause.
- Ensure you have smoke detection in your spaces. Early detection of a fire is essential for ensuring quicker fire department response times. Systems should be monitored 24/7 to ensure signals are noticed and sent to the local fire department.
- If possible, obtain enclosed metal cabinets or enclosed storage compactors. This will limit the spread of a fire and limit the damage to the collection should a fire occur.
- Store extra housing materials outside the storage area. If you don't have a space for this, ensure that these materials are at least stored in an enclosed metal cabinet of their own.
- Limit access to and operations within your collection's spaces. Processing and conservation activities increase ignition risk and should take place elsewhere.
- Limit combustibles in your collection's spaces. Electrical equipment and cluttered desks are two items that can easily become an ignition source. Mechanical and HVAC equipment should not be located in the space if at all possible. Personal space heaters are also a common fire risk.
- Get to know your local fire department. Invite them for a tour and explain to them what your organization does and what they might be dealing with should a fire occur. The Washington, DC, fire chief, for instance, has instructed his crews to treat a fire at SI facilities like a crime scene (instead of charging in, hoses blazing).

Smoke vs Heat Detection

Smoke detection is specifically recommended as part of a fire alarm system, as even very small amounts of smoke can be detected with certain detection systems.

Heat detection is provided via a fire sprinkler system. When a sprinkler head opens, it is because it was hot enough at the ceiling for that to occur. Therefore, while heat detectors are available for fire alarm systems, adding additional heat detectors will not provide any benefit if a sprinkler system is present.

In conclusion, it is important to recognize both the advantages and the risks of using foams and other plastics in housing your collection. We are not advocating against their use; these materials contribute hugely to the long-term preservation of collections. However, knowing how to minimize the risks associated with them further protects your collection from the catastrophic hazards of fire and smoke damage.

—Josh Stewart, P.E., Fire Protection Engineer, Smithsonian Institution, josh.stewart.fpe@gmail.com

Need help?

Have a question about health and safety in your conservation work? Send it to us at health-safety@culturalheritage.org.