Equipment Damage Consultants, LLC

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Smoke Damage - *Is Acid Gas for Real?*

Irreparable damage to electronic equipment and mechanical systems far away from the actual fire area is often attributed to the phenomenon of "acid gas" attack. Is acid gas real? *Yes*. Is it always produced after a fire involving plastics? *No*. Is it a high probability that acid gas will deposit directly on surfaces after a fire? *Probably not*. Read on to learn more!

Fire and smoke (smoke = soot + gases) produce several different impacts that require evaluation during a damage assessment. For example, a fire produces thermal damage both from direct combustion of the materials involved with the event (i.e., the fire), as well as thermal damage to materials from the heat of the event (e.g., melting). The fire-fighting activities themselves can produce significant damage during a fire event, ranging from electrolytic corrosion of electrical and electronic systems (see Newsletter V2 N1: http://www.eqdamcon.com/aboutcontactus.html) through simply physical damage. Damage from other extinguishing agents (e.g., corrosion from dry chemical or thermal stress from carbon dioxide) can also occur. The final and most difficult category of fire and smoke damage to evaluate is widely known as non-thermal damage.

The main concern with non-thermal damage is acidic gases and the production of hygroscopic (literally "water absorbing") salts on metal surfaces. Acidic gases are primarily associated with the combustion of plastics; most commonly PVC, which contain halogens (the category of chemical elements which contains chlorine, bromine, fluorine, and iodine).

The combustion of PVC produces a very large amount of the highly reactive hydrogen chloride acid gas. The combustion of PVC may produce up to 58% of its weight as acidic gas. When in the presence of moisture, this gas reacts with metallic surfaces to produce hydrochloric acid. The now liquid acid continues to react with the metal surface to produce a highly corrosive metal-chloride hygroscopic salt. The salt further reacts with moisture in the air, typically at lower than common relative humidities, to consume the surface metal and reproduce hydrochloric acid in an unending cycle that corrodes deep into the metal, resulting in an inverted funnel shaped damage pattern. One example often used to illustrate this mechanism is a rust patch that is sometime found on a vintage automobile (when they were made of metal) that has been exposed to sea or road salts. The visible degree of rust on the surface, often starting at a nick in the paint, is very small in comparison to the amount of rust behind the surface.

However, the production and fate of acid gases after thermal decomposition of PVC and other halogen containing materials is highly dependent upon the fire dynamics, ventilation rate, additional products that are involved in the fire and numerous other factors. In most instances involving high temperature, rapid combustion events with other organic materials involved (e.g., cardboard, wood and other plastics), the highly reactive acid gas will tend to become adsorbed onto the surface of soot particles. This often eliminates the free (unbound) acidic gas from the air prior to reaction with metallic surfaces located within the building, particularly if it is a large volume facility.

We have seen this occur in numerous facilities, particularly manufacturing plants which are often of large volume and have a limited availability of fire retardant plastics available for decomposition; i.e. the small or even moderate amount of acidic gases that are produced become bound within the soot, and thus do not directly attack metallic surfaces in the gas phase. Although removal of the chloride/bromide containing soot is still required to prevent the reliability concerns associated with hygroscopic dust, once the soot is removed, the structural surfaces, electronic and mechanical equipment would be considered to be at a pre-loss or better reliability state in relation to corrosion rates and airborne contaminate failure mechanisms.

In summary, acidic gas damages to electronic and mechanical equipment is not as probable as it is often publicized to be.

For a more complete technical article on this subject, please visit the following website link: http://www.eqdamcon.com/resources.html

Please address any comments or questions on these articles via email to Mark Krzyzanowski at mark@eqdamcon.com. Please also feel free to suggest newsletter article topics related to technology equipment and property claims.

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