The Neglected Element

GASEOUS CORROSION

Data center equipment can be damaged if left unprotected.

Environmental control programs for data centers may be lacking a critical protective element: removal of corrosive gases which can harm sensitive electronics. While environmental threats posed by fire, power, temperature, humidity and airborne particulates have long been recognized and successfully addressed in the computer-room environment, the corrosive potential of the air has been largely ignored.

This neglect can have costly ramifications. Over time, even extremely low levels of contaminant gases in the parts per billion can cause corrosive damage to electronic equipment. The results may be ghost signals and sporadic circuit failure, leading to incorrect and lost data. Additionally, replacing damaged electronic components can substantially increase a data center's maintenance costs.

Computer systems need not be exposed to the threat of corrosive damage. Gas-phase air filtration technology offers critical protection against airborne contaminants. In conjunction with other environmental control technologies, gas-phase air filtration can help provide today's MIS director with a full circle of protection against potential environmental threats.

HOW CORROSION OCCURS

In the context of electronic equipment, corrosion is defined as the deterioration of a base metal resulting from a reaction with its environment. More specifically, corrosive gases and water vapor coming into contact with a base metal result in the buildup of various chemical reaction products. As the chemical reaction continues, pitting and metal loss can occur.

Disk drives can be adversely affected by corrosion. While corrosion-related problems are not common in conventional disc drives because the materials in the ferric oxide recording media are already technically "rust," thin-film disk drives are very sensitive to corrosion in indoor air environments.

Corrosion on a thin film disk can have serious results. At the reaction site there can be a loss of ferromagnetism (stored information). Additionally, as reaction products accumulate, mechanical failure (head crashes. wear) can occur on data tracks previously not corroded.

Edge connectors on circuit boards can also suffer from corrosive attack. Whether the contacts are made solely of copper or are gold-plated over a nickel-plated copper substrate, they are both susceptible to corrosion.

With both copper and composite contacts the end result is the same: a disruption of the contact point. The severity of the environment (i.e., humidity, temperature, types and levels of gases) will determine the speed in which these films are created and the level of disruption of the flow of electrical current.

CORROSIVE GASES

Not all gases cause corrosion. Specifically, we are concerned with three types of gases: acidic gases, such as hydrogen sulfide, sulfur oxides, chlorine, hydrogen fluoride (HF) and nitrogen oxides; caustic gases, such as ammonia; and oxidizing gases, such as ozone. Of the gases that can cause corrosion, the acidic gases are typically the most harmful. For instance, it takes only 10 parts per billion (ppb) of chlorine to inflict the same amount of damage as 25,000 ppb of ammonia.

These corrosive gases have many sources. Both externally and internally generated gases can pose a problem to sensitive electronic equipment.

Externally, corrosive gases are generated primarily from auto emissions, heavy industrial production and heat and power generation. Urban environments are particularly susceptible.

Of course, weather conditions play a major role in concentrating or dispersing external gaseous contaminants. Temperature inversions can trap pollutants, producing a serious air pollution problem.

In addition to general outdoor pollution levels. specific sources of outdoor contamination in the immediate vicinity of a building need to be reviewed. Depending upon the location of a building's supply-air intake, the HVAC system may be drawing in diesel exhaust fumes from loading docks, raising the level of gaseous contaminants in the building.

Within a building, gases can be produced by cleaning agents, cigarette smoke, microfiche operations and data center printers. Cleaning compounds, especially industrial strength types, can be sources of ammonia. Cigarette smoke contains both particulate and gaseous contaminants; in particular. cigarette smoke is a source of nitrogen oxide. (Even if smoking is not allowed in the computer room, off-gassing can occur from clothing.) Microfiche systems are heavy producers of ammonia, while printers can discharge sulfur compounds and chlorides.

Since computer rooms typically have their own air conditioning systems and are supposedly controlled environments, it may be assumed that gaseous contaminants, created externally or internally, will not enter the computer room. However, the computer room's dedicated air conditioning system is being used purely for recirculation not pressurization. Without pressurization, gaseous contaminants can seep into the computer room through cracks in wall and ceiling joints, cable and utility penetrations, and spaces above drop ceilings and below raised floors.

Gases are often present at such low levels that they are not detectable by the human nose. This does not mean that the gases are not present in sufficient amounts to damage electronic equipment. Most of the odor threshold levels are much higher than the levels needed to cause corrosive damage.

ENVIRONMENTAL STANDARD

The Instrument Society of America (ISA) has developed a standard specifying the type and concentration of airborne contaminants that computers can be exposed to.

The ISA standard defines or characterizes environments in terms of their overall corrosion potential. By the use of “reactivity monitoring,” a quantitative measure of this corrosion potential can be established. Reactivity monitoring involves placing strips of copper metal, called Corrosion Classification Coupons, into an environment. The coupons are left for 30 days. then analyzed in a qualified laboratory to determine how much corrosion copper film formation in angstroms has occurred. This data is then used to determine the severity level of the environment. This severity level refers to the potential damage that corrosive gases in the air could cause to electronic contacts.

Four levels of corrosion severity have been established by ISA-S7 1.04 (see Table 1). The optimum severity level is G1-Mild. At this level, corrosion is not a factor in determining equipment reliability. As the corrosive potential of an environment increases, the severity level will be classified as G2, G3 and GX (the most severe).

The effects of humidity and temperature are also quantified in this standard. High or variable relative humidity and elevated temperatures may cause the acceleration of corrosion by gaseous contaminants. Relative humidity of less than 50 percent is specified by the standard.

COMPUTER MANUFACTURERS

Leading computer manufacturers, such as IBM and DEC, who were instrumental in developing the ISA Standard, recognize the potential problem of corrosive gases damaging their systems. Individual computer manufacturers may also establish environmental requirements in association with their warranties. Failure to provide an environmentally safe area for computer systems may result in the manufacturer limiting warranty responsibilities.

To preclude any acrimonious debates over warranty coverage, and, more importantly, to ensure there is no loss of computer system integrity in the first place, data centers should be protected by effective air filtration systems.

AIR FILTRATION TECHNOLOGY

To better understand and appreciate the capabilities of air filtering systems, we must examine what contamination needs to be cleaned. There are three types of airborne contaminants: liquids, solids and gases. The two most common technologies available to deal with low-level airborne contamination are (1) particle removal filtration. such as mechanical filters and electronic air cleaners. and (2) gas-phase (dry-scrubbing) filtration.

Particulate filters vary in their ability to remove particulate matter, depending upon the filter's material composition (typically cellulose, fabric. and glass-fiber materials).

Most computer room air conditioning systems come with low- to mid-efficiency filters already built into the system. But with the primary objective of particulate filtration being protection of heating and cooling coils from dirt, the efficiency of the filters is typically 20 to 65 percent.

Electronic air cleaners, another form of particulate filtration, use the principle of electrostatic precipitation. Particles are charged and then captured on collecting plates. They are relatively efficient against particles of sub-micron size, but require regular cleaning. Additionally, the electronic air cleaners produce ozone which may prove hazardous to human health, as well as causing corrosive damage to electronic circuitry if they are not installed and maintained properly.

In contrast to particulate filtration, gas-phase air filtration uses the processes of adsorption, and/or chemical reaction to remove gaseous contaminants from an airstream. Oftentimes, these systems are used in tandem with particle removal filters for optimal filtration.

Adsorption is the most common form of gas-phase filtration. The material most often used is carbon (activated and/or impregnated charcoal). Carbon is a very effective gas-filtration media due to its high porosity, large surface area presented to the airstream and high removal capacity.

Gas-phase filtration systems typically have gas removal efficiencies of 99.95 percent. To reach this level of efficiency, a system may employ multiple media beds - taking advantage of the strengths of the media to target specific gases.

SUMMARY

In today's electronically oriented business environment, a company’s dependence upon its data processing systems has reached a critical level. Gathering, processing and analyzing data is the lifeblood of a company. Damage to these DP systems can have crippling effects: erroneous information, interrupted operations, and loss of a company’s competitive edge. These are costly, yet avoidable, occurrences.

Protecting the data processing center from any potential environmental threat is a vital step in ensuring a company's continued viability. To an extent. environmental controls in computer rooms are meeting this challenge. Most computer systems are protected against the potential environmental threats posed by fire. power, humidity, temperature and particulate contamination.

Unfortunately, the potential damage to electronic equipment caused by the corrosive effects of gaseous contaminants has not been fully recognized and addressed.

Gas-phase air filtration technology, developed over the past 25 years to protect crucial process control systems operating in harsh, industrial environments, is available for the protection of today's commercial data processing center. Gaseous contaminants, both externally and internally generated, can be effectively removed down to the low parts per billion level to preclude any potential damage to electronic equipment.

This is an exciting time for MIS directors as technology provides greater capabilities for processing ever-increasing quantities of data. But to ensure that data processing systems operate as they were intended, they need to be located within the full circle of environmental protection. Gas-phase air filtration plays a critical role in completing that circle of protection.

TABLE 1 - Classification of Reactive Environments

Severity Level	Environmental Description	Copper Reactivity Level*	Environmental Reliability
G1	Mild	<300	Corrosion not a factor
G2	Moderate	<1000	Corrosion may be a factor
G3	Harsh	<2000	High probability of corrosive attack. Evaluate environmental controls or specially designed and packaged equipment.
GX	Severe	>2000	Only specially designed and packaged equipment would be expected to survive without environmental controls.

* In angstroms per 30 days
Reference: ISA Standard ISA-S71.04-1985