POLLUTANTS AND COLLECTIONS

INTRODUCTION

The storage environment is important to the long-term preservation of collections. Chemicals that deteriorate collections or accelerate deterioration can have a collection-wide effect. Contamination can occur from contact or proximity. For example, objects stored directly on wood shelves can become contaminated with acetic acid by contact pollution from the wood or by airborne pollution from acidic vapors offgassed by the wood.

Collection pollutants often differ from pollutants in a health and safety context. For some collections, sodium chloride, oxygen, and water are pollutants. Common collection pollutants, their sources, and affected materials are summarized in Table 1.

Pollutant	Collections Affected	Common Indoor Sources
Ammonia	Metals, cellulose nitrate, ebonite	Concrete; certain sealants, adhesives, and paints; some cleaning products; humans
Acetic acid	Metals, paper, calcareous materials, soda-rich glass	Cellulose acetate; certain sealants, adhesives, and paints; linoleum, some cleaning products; humans
Nitrogen oxide compounds	Metals, paper, leather, some artists' colorants	Cellulose nitrate; gas heaters
Sulfur dioxide	Metals, paper, leather, some artists' colorants	Degradation of sulfur-containing materials: proteinaceous fibers, sulfide minerals, vulcanized rubber
Ozone	Some artists' colorants, rubber	Photocopiers; laser printers; ultraviolet light sources; some air filtration systems
Hydrogen sulfide	Metals, photographs	Sulfide minerals; visitors; fuel and coal combustion
Particulates	All, especially magnetic media, metals, natural varnishes	Concrete; laser printers; construction; humans; cooking and food; burning candles; coal combustion; aerosol humidifiers

Table 1. Summary of common collection pollutants adapted from Tétreault 2003.

The risk of pollutant damage increases in microenvironments because pollutants cannot escape, elevating their concentrations. This is why ventilated storage is recommended for collections made of malignant plastics such as cellulose nitrate. There can also be health and safety implications, as in the case of sulfide minerals offgassing toxic vapors.

MONITORING

There is currently no pollutant equivalent to a temperature/relative humidity datalogger that can be read in house within the budgets of many collecting institutions. For example, a relative humidity monitor actually *is* a pollutant monitoring device, but it only monitors for a single pollutant: water vapor. Because there are so many different pollutants and there are so many different components of air, it is, at this stage, impossible to have one monitoring device that can do what it does for relative humidity for all of the pollutants collections about which collections stewards might be concerned. Institutions must "pick their battles" – are you most concerned about a specific collection; are you worried about the potential that a new material has for offgassing; do you have the resources to pursue implementing a monitoring system that is expensive and extensive?

There is a wide range of pollutant monitoring techniques that vary in their accessibility, specificity, and ability to produce quantitative results. Some examples are presented in Table 2.

Type of Technique	Purpose	Example	Notes
Material-Specific	Screen for pollutants that are damaging to a specific collection material.	Placing metal coupons among collections to indicate if the environment is corrosive.	Does not identify or quantify pollutants.
Pollutant-Specific	Measure concentrations of specific pollutants or families of pollutants.	Placing ozone badges among collections to measure ozone exposure.	Careful attention must be paid to interferences and detection limits.
Holistic	Identify and quantify multiple pollutants.	Running air samples through gas chromatograph to separate and measure components.	Not all pollutants detected. For example, detecting hydrogen sulfide using GC requires specialized set-up.

Table 2. Assortment of pollutant monitoring techniques.

Techniques of varying costs and detection limits are outlined in the 2006 book by Cecily Grzywacz, *Monitoring for Gaseous Pollutants in Museum Environments.*

While it is clearly preferred that pollutants be intercepted before damage occurs, monitoring sensitive collections can be informative. Table 3 highlights some hypersensitive materials.

Material	Pollutants of Greatest Concern
Cellulose acetate	Acetic acid (self-produced), water vapor
Cellulose nitrate	Nitrogen oxides (self-produced), water vapor
Lead	Acetic acid
Natural rubber	Ozone, oxygen
Fine silver	Hydrogen sulfide
Polyurethane magnetic tape	Water vapor, particles

Table 3. Examples of hypersensitive materials and corresponding pollutants. Adapted from Tétreault 2003.

Particulates can be monitored directly because they are visible. Simple dust collectors made of label stock and paper can provide a baseline for dust accumulation that informs housekeeping policies and allows later comparison following mitigation activities.

MITIGATION

Mitigation depends on the pollutant and the form it takes. Unneeded storage materials suspected of offgassing can be removed from collections spaces. Mitigating contact pollution can be as straightforward as lining shelves or inserting interleaving. If the source is a collection object or the pollutant is airborne, mitigation can be more complicated.

Techniques include refining policies, rehousing collections, using sorbs, and modifying heating, ventilation, and air conditioning (HVAC) systems. Maintaining clean collection spaces and eliminating cleaning products that contain ammonia or acids will reduce risk of pollutant damage. Boxing collections adds a layer of protection from airborne pollutants.

Sorbs are media that capture pollutants. Some are embedded in other materials, as in the case of MicroChamber papers that contain zeolites. Zeolites trap pollutants on the molecular scale. Sorbs also come in pellets. One example is silica gel, which adsorbs water vapor. Some sorbs, including silica gel, will release (desorb) the adsorbed pollutants in certain conditions, so this should be taken into account when selecting sorbs.

Some collection materials also adsorb and desorb pollutants. This increases the importance of keeping temperature and relative humidity stable to minimize spikes in pollutant levels.

Changes in ventilation and filtration affect the pollutant profile building-wide. Improved ventilation can reduce gaseous pollutant concentrations but also increase particulates. Improving filtration can reduce particulates but limit ventilation. A dust survey as mentioned above would help evaluate the efficacy of HVAC modifications.

If you have further questions or concerns about potential monitoring and mitigation options for pollutants in your institution, use the American Institute for Conservation of Historic and Artistic Works Find a Conservator database to identify someone who has expertise with the type of collections about which you have questions.

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