Preservation Problem Solving: Looking at Proteins, Minerals, Polymers, and Plastics

by Hugh Phibbs

Cellulosic materials such as papers and boards constitute the most important class of preservation materials. Their ability to serve as buffers, supports, scavengers, and filters makes them uniquely valuable in preservation problem solving. To compare, animal-based materials are found as components in works of art and may be used by conservators, but they are rarely used in preservation. Photo emulsions, vellums and parchments, bone, ivory, silk, and wool are all examples of animal derived-materials; their roles in the creation of works of art and artifacts should be too familiar to require elaboration. Conservators use hide glue for bonding wooden furniture parts and sizing made from parchment for consolidating some paint films, but the chemical and physical vulnerability of such materials makes them unlikely candidates for use in preservation framing.

Like cellulose, protein (the constituent material of many animal products) can be attacked by acids and peroxides. It is more sensitive to alkalinity than cellulose is and should be housed in as neutral a setting as possible. Some animal products, such as bones and teeth, are made of minerals and have distinct chemical sensitivities.

Mineral-based products, especially silicates and metals, are more commonly found in framing. Quartz, from which glass is made, comprises silicon dioxide with sodium or potassium added. Its fragility, rigidity, temperature retention, vapor barrier potential, and low static retention are familiar to framers. One of its attributes that is most important to preservation is its vapor barrier capacity, which makes it vital to the creation of highly sealed packages that must maintain their conditions for extended periods.

Chemically, glass poses little risk to other materials. When sodium, used to create glass, leaches out onto its surface, it can combine with chlorine to form salt, but salt is not especially harmful to paper. Physically, glass is a more challenging material to use in preservation. When it breaks, its fractured edges are tremendously sharp and can cut paper with the slightest movement. Plastic films and laminates greatly enhance the usefulness of glass in preservation. Ultraviolet absorbers incorporated into films make glass an effective filter. Laminating films that adhere lites of glass together can diminish the hazards of breakage.

Carbonates of calcium and magnesium are used to buffer paper against attack from acids and aluminum silicate. Molecular sieves are included in some papers and boards to trap organic pollutants. Metallic silver and copper in cloths and plastic films can act as sacrificial scavengers, filtering out oxidizing gases before they can degrade the materials protected by these cloths and films. In fact, of all minerals, metals is the group most useful in preservation.

Most minerals on the earth's surface are metallic oxides. Pure metals are rare in nature, but the fact that they are truly crystalline (each of their atoms is bonded to its neighbors) allows them to functions as vapor barriers. Metals, especially aluminum, have tremendous strength with relatively modest weight and can be quite useful to create frames that provide significant support to heavy objects.

Most metals, with exceptions such as gold, chromium, and tin, are vulnerable to oxidation and must be coated or laminated with other materials so that they can be successfully employed for long-term use. One of the simplest forms of coating is anodizing, an electro-oxidative process that creates a surface of stable, fully oxidized metal. Gilding is another coating process and if the layer of leaf is not rubbed through, it can produce an effective vapor-barrier on the surface of the gilded material. Most other coatings used to seal the surface of metals employ polymers.

The first synthetic polymers were acid-modified forms of cellulose: cellulose nitrate and acetate. These early materials embodied one of the hazards we find in synthetic material, in that part of the acid used to modify the cellulose remained with the polymer and allowed for the regeneration of the original acid in time. This is also true of acid-modified vinyls such as polyvinyl acetate and polyvinyl buterate. When these materials are used in preservation or when artifacts made from them are to be preserved, we must be mindful of their acidic tendencies.

Yet acid is not the only possible emission that must be considered when polymers are employed. Polyvinyl chloride can emit chlorine and polymers containing plasticizers or anti-oxidants may contribute those materials to things that they touch. A majority of the plasticizers used in the plastics industry are used to soften vinyl polymers.

One can see the result of this if one attaches a plastic-tipped spring clamp to a freshly sanded piece of wood; the plastic on the clamp is likely to leave stains on the wood. Rubber is a strong source of sulfur and should never be near any metallic silver or lead, or compounds that include those metals. Certain polyureathanes, epoxies, and polyamides are relatively stable and can be used in most preservation settings. Silicones that do not contain acetic acid are stable and can be used as sealants, but they make unsuitable adhesives, since their complete removal is next to impossible.

Polyethylene, polypropylene, and polyester are some of the safest synthetic materials for use in preservation. Their purest forms should have little or nothing that can come out of the plastic and contaminate adjacent materials. This makes them ideal for enclosures that house documents, art on paper, or photographs. The polyolefins (polyethylene and polypropylene) are vulnerable to light and benefit from ultraviolet absorbers if they will be exposed to light.

Polymethyl methacrylate is another safe polymer that is most familiar to framers as the acrylic sheet used as glazing. It is not as profound a vapor barrier as glass is, but this fact only has relevance when a highly sealed package is being glazed. Acrylic's resistance to breakage and its thermal insulating potential are extremely useful to preservation framing. The addition of UV absorbers to acrylic sheet allows it to function as a filter for harmful wavelengths of light.

Polycarbonate sheet is even more shatter-resistant than acrylic is and can be specified for situations in which the ultimate protection is needed for the front surface of the frame. Fluted, double-wall polycarbonate sheet is rigid, puncture-resistant, and clear, but its expense limits its use in framing. Fluted polypropylene board and corrugated polyethylene boards are ideal backing materials for preservation framing.

All plastics are semi-crystalline and most are not effective vapor barriers. Polyvinyl chloride, which does have good vapor-barrier potential, has the problem of chlorine emission, as we have seen. Powdered polyesters and epoxies can be electrostatically applied to metals and then melted to form strong coatings that protect the metal and will not emit any solvents.

Polyester and polyamide (Nylon) are vital puncture-resistant components in heat-bondable films used in making highly sealed framing packages and in sealing frame rabbets. Plastic foams can form rigid cores for paper or plastic-faced boards and their resistance to warping will depend on their thickness and the facing material. Paper facing will respond to changes in humidity and promote warping of the board when its surfaces are exposed to differing conditions. Polyethylene can be found as the core in boards which have coated aluminum skins and which are extremely puncture resistant and quite rigid, given their modest thickness. Polymers can be used to support framed items, to filter light when a UV absorber is present, and to filter pollution if a sacrificial scavenger has been added.

With these facts in mind, we can look at how different preservation materials can be expected to function in normal and extreme conditions. How each has functioned successfully in the past can be a guide to how they may be adapted to new roles in the future. ■