The Myth of 'Acid Free'

James Miller, MCPF, GCF

"Acid free" is a common term in the picture framing industry, but it is often misunderstood and misused. The term is most often applied to board products, but some framers believe that any framing materials described as acid free are the best available for protective framing. Framers often extend this misunderstanding to framing materials like fabrics, paints, and inks used to create decorative features as well as tapes and adhesives used in frame construction. Some of them may be inherently acid-free by nature, or they may contain impurities or reactive chemical elements other than acid.

It would be logical to assume that "acid-free" boards are free of acid, but that is not exactly true. To understand the meaning of "acid free" as it applies to mat and mounting boards, it is important to know about the pH scale and some associated terms. Here is a good description given by the EPA (www.epa.gov/ acidrain/ measure/ph.html):

> *The pH scale measures how acidic or basic a substance is. It ranges from 0 to 14. A pH of 7 is neutral. A pH of less than 7 is acidic, and a pH greater than 7 is basic. Each whole pH value below 7 is ten times more acidic than the next higher value. For example, a pH of 4 is ten times more acidic than a pH of 5 and 100 times (10 times 10) more acidic than a pH of 6. The same holds true for pH values above 7, each of which is ten times more alkaline (another way to say basic) than the next lower whole value. For example, a pH of 10 is ten times more alkaline than a pH of 9. Pure water is neutral, with a pH of 7.0.*

In other words, a slight difference in pH value represents a significant difference in acidity or alkalinity.

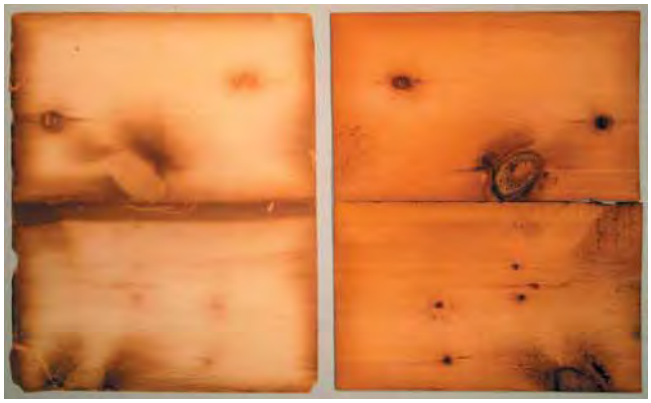
This triple mat made of acid-free 4-ply matboard was cut in 1994. It has been exposed to normal interior lighting conditions, which have not caused any discernable damage to the art image. In 15 years the buffer has become exhausted and no longer provides adequate protection from acid burn. The mat's colors have begun to shift, the bevels are now badly discolored, and acidic outgassing probably will begin discoloring the art paper soon.

Perhaps most significant for framing purposes, the pH levels in framing materials may change over time, depending on the migration and interactions of chemical elements within the closed environment of the frame. Acid is not the only issue to consider. Peroxide and other elements in the board's fibers can also chemically react over time.

Acid-free Matboards

So-called "acid-free" matboards are made from moderately processed wood pulp containing lignin, an acidic,

Why acid-free matting shouldn't be used for preservation framing



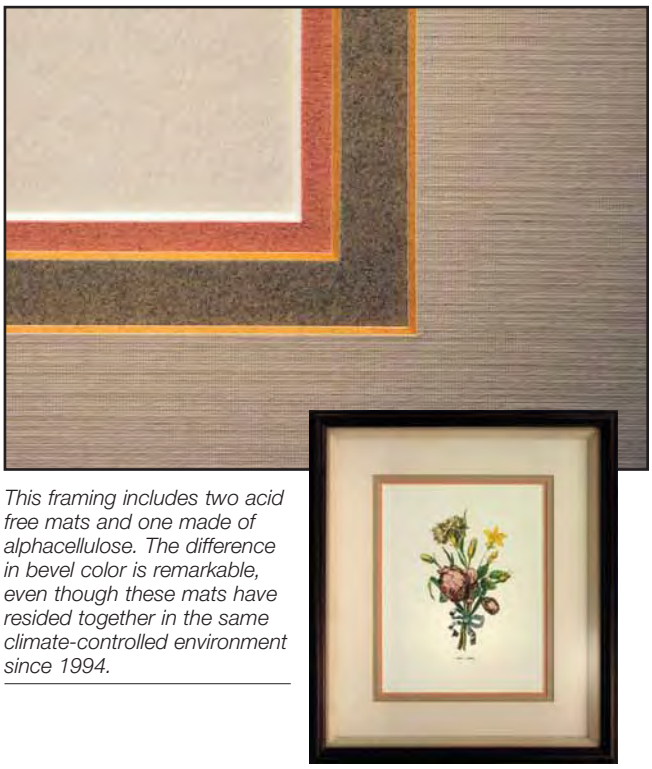
The back of this photograph on heavy paper, about 100 years old, represents a classic example of acid burn. The image of each knot and edge of the wood has been transferred to the back of the art paper. The discoloration is permanent and might have migrated completely through a thinner sheet.

This print was framed in 1994 using alpha-cellulose mats. The bevels and mat colors remain intact. This demonstrates the stark contrast between acid free matting and alphacellulose matting of similar age, displayed in a similar environment.

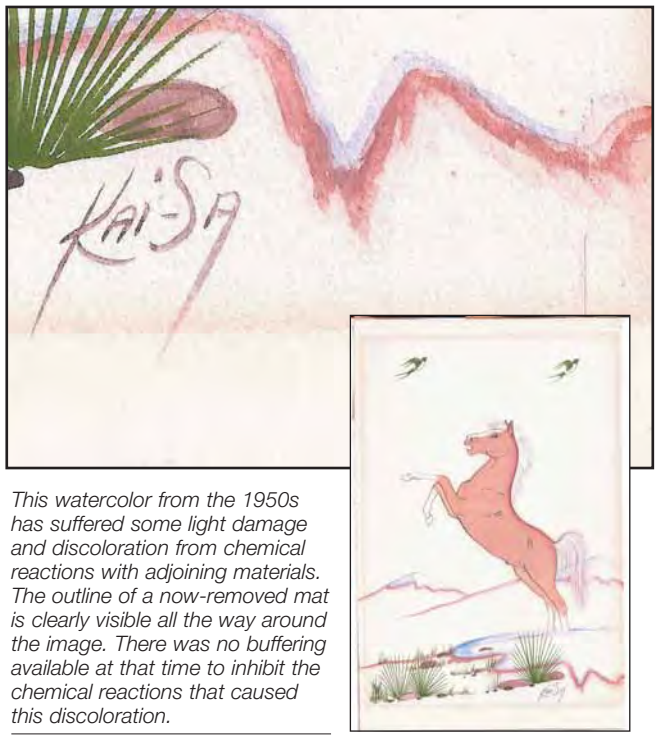
organic substance that helps bond wood fibers together. Lignin oxidizes over time, producing acid and other chemically reactive by-products that may be harmful inside a frame. The oxidation of lignin causes what may be described as "acid burn," referring to discoloration and embrittlement that gets worse over time. Eventually the reactive and harmful chemical elements may migrate into adjoining materials or chemically react within a closed frame, spreading the deterioration. Exposure to environmental extremes, such as high temperature, high humidity, or intense light would accelerate the oxidation of the lignin and the resulting deterioration. Extreme conditions can also contribute to other chemical reactions within the closed-up frame package. That is why frames should be stored, transported, and displayed in environments controlled as much as possible.

To counteract the lignin's harm, an alkaline buffer is added to the paper pulp during its manufacture. The buffer commonly used in framing boards is calcium carbonate, which is basically chalk and is also a main ingredient in stomach antacids. Because calcium carbonate is alkaline, it counteracts acid in the stomachs. It works similarly in framing boards, where the acid comes from lignin. The buffer added to framing boards is proven to be a good defense against acid deterioration for perhaps a decade or more, but it eventually becomes exhausted. When the "acid-free" buffered framing board is new, it measures on the alkaline side of the pH scale, usually with a value of 8 or higher. Over time, as the board's content of lignin oxidizes, it uses up the buffer, and the pH value eventually falls below the neutral value of 7 and continues more toward the acidic side of the pH scale. As the buffer wears out, the acid from lignin—in the paper all along—can cause the board to discolor and become brittle.

"Acid free" is probably not the best term to describe these boards, because the acid-bearing component, lignin, remains in the board all the time. A more accurate term might be "temporarily acid-neutralized"



This framing includes two acid free mats and one made of alphacellulose. The difference in bevel color is remarkable, even though these mats have resided together in the same climate-controlled environment since 1994.



This watercolor from the 1950s has suffered some light damage and discoloration from chemical reactions with adjoining materials. The outline of a now-removed mat is clearly visible all the way around the image. There was no buffering available at that time to inhibit the chemical reactions that caused this discoloration.

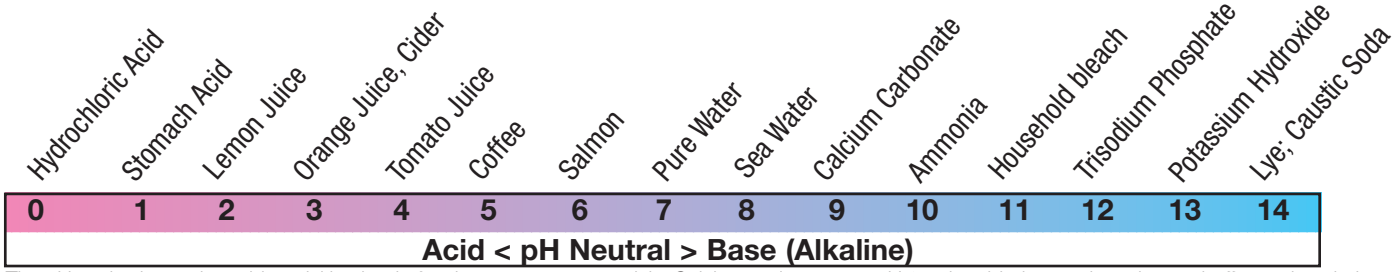
or "acid-delayed." While these less-costly boards may be suitable for framing decorative items that have no long-term value, they are not considered suitable for protective framing.

Alpha-cellulose

For protective framing, the best preservation-grade boards are manufactured using only alpha cellulose, the purest paper pulp. Papermaking processes for alpha cellulose are different from those used in the manufacture of "acid-free" boards. Alpha cellulose boards are really free of acid because lignin and other impurities are extracted, leaving only the purified pulp. Alpha cellulose fibers used to make these preservation-grade framing boards may come from either wood or cotton.

Cotton linters inherently contain no lignin and fewer impurities than wood pulp, so less processing is required in making boards with cotton alpha cellulose. Compared to boards made from wood alpha cellulose, cotton boards generally have longer fibers and a softer feel. Wood alpha cellulose, on the other hand, requires more extensive processing to extract lignin and other impurities, resulting in shorter fibers. Boards made of wood alpha cellulose may be slightly heavier, with greater density. Some framers prefer to work with the softer, lighter-weight cotton boards, and some framers prefer to work with the denser, more solid boards made from wood alpha cellulose. Personal preferences aside, both of these types of preservation-grade alpha cellulose boards are equally suitable for protective framing applications.

Like lower-quality "acid-free" matboards, most



The pH scale shows the acid or alakine level of various common materials. Calcium carbonate, at pH 8.5, is added to matboards as a buffer against their inherent acidity, making them "acid-free" for about 10 to 20 years. After that, the buffer is used up and the acid in the boards is no longer neutralized.

alpha cellulose boards also contain a buffer to neutralize acids that could migrate from other sources, such as a frame's raw wood rabbet, the fillet in a mat window, or ambient air, or perhaps from the art itself. Some alpha cellulose boards are also available without the buffer. When organic items are being framed, such as sheepskin, leather, or seashells, pH neutral, unbuffered alpha cellulose boards are usually recommended because some organic items react unfavorably to high-alkaline environments.

Some preservation-grade alpha cellulose matboards also contain an additive of zeolite, which serves as a passive molecular trap. This additive further enhances the board's ability to neutralize impurities that may migrate or offgas within the closed-frame package.

When a framer wants the best framing board, "acid free" isn't good enough. Instead, you should specify "lignin-free" boards made of alpha cellulose. That is especially true for preservation framing. But even for framing posters and other items that have only decorative value, alpha cellulose boards offer the advantage of longevity. They are less prone to chemical reactions within the frame, less vulnerable to damage from light exposure, and retain their original appearance much longer than acid-free boards.

"Alpha cellulose" is a term that describes chemistry of fibers used in papermaking. According to *Bookbinding and the Conservation of Books, A Dictionary of Descriptive Terminology*, by Matt T. Roberts and Don Etherington, alpha cellulose is "the part of a cellulosic material that is insoluble in a 17.5% solution of sodium hydroxide at 20° C under specified conditions. Because the permanence of paper depends on the absence of non-cellulosic impurities, the determination of true cellulose (alpha cellulose) gives an indication of the stability of the paper, and therefore its permanence."

Cellulose is the basic raw material used in making paper. It usually exists with substantial amounts of other substances, including lignin, which are removed as much as possible. An exception to this is seed hair fibers, or cotton linters, which are almost pure cellulose. The cellulose content of some materials used in making papers is:

Material	% Cellulose
Cotton	98
Hemp	65
Jute	58
Deciduous woods	41-42
Coniferous woods	41-44

Small Cost Difference

In retail framing, upgrading to alpha cellulose boards may involve only a small extra price and earn more profit in the bargain. The cost of labor for mat cutting remains the same and generally exceeds the cost of the board, whether acid free or alpha cellulose. Upgrading to an alpha cellulose board costing, say, 60 percent more may amount to a retail price difference of only 20 percent more for the matting, with a similar increase in profit. For example, the retail price for an acid-free window mat may be $20. That is, $5 cost for the board, $10 for the labor to cut it, and a $5 profit. If the framer upgrades to an $8 alpha cellulose board and adds $1 extra profit, the retail price would rise to $24, a retail increase of 20 percent for the matting. At the same time, profit also increases by 20 percent, from $5 to $6.

Manufacturers promote their better-quality alpha cellulose products to retail framers and offer their greatest selection of colors and textures in alpha cellulose. Until a few years ago, framers tended to stock mostly acid-free matboards and a smaller selection of alpha cellulose boards. As the trend toward better framing and preservation have progressed in recent years, a typical framer's inventory today may have shifted to mostly alpha cellulose boards with a smaller selection of acid-free boards. Many framers now sell only alpha cellulose boards and no longer stock acid-free boards.

The real beneficiaries of this change are customers, who can now have confidence that the art or other objects they are having framed will not be damaged over the years by the very materials being used to preserve those objects. If something is worth framing, it is certainly worthwhile using materials that will stay in their original condition as long as the art will. ■

James Miller, MCPF, GCF, founded his framing business, ArtFrame, Inc., in suburban Columbus, OH, in 1988, where he specializes in the preservation framing of art, heirlooms, and three-dimensional objects. Miller, who holds a Bachelor's degree in Business Administration, has served as chairman of the PPFA Certification Board, where he helped develop the MCPF exam, and has been chairman of the FACTS Education Committee. He is also the author of *The Complete Guide to Shadowboxes and Framing Objects*, published by PFM Seminars Books.