Why Not Period Glue?

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UNDERSTANDING TRADITIONAL PROTEIN WOOD GLUES

In the SAPFM Journal, Volume 2, I wrote an article, "Why Not Period Glue?"

My first woodworking project was a failure. I thought I would make a backgammon board with veneer. I carefully cut all the elements out of rosewood and satinwood, making a nice veneer assembly held together with veneer tape.

W. Patrick Edwards—
SAPFM 2014 Cartouche recipient

I selected a piece of MDF and applied white glue to the surface and pressed the veneer in place. The next day, when I removed it from the press I was very upset that the entire surface was wrinkled. Nothing I could do would fix it, and it ended up in the trash.

After some reflection, I realized that the problem was with the glue, so I started over with animal hide glue. The results were wonderful, and I decided immediately that I would only use protein glues after that. That was over 45 years ago, and I have never questioned the wisdom of my decision.

In *American Period Furniture*, Volume 2, I wrote an article, "Why Not Period Glue?" which included a lot of information on animal protein glues. Since that volume is hard to find, I posted my article on my website. However, it is time to address the issue of using traditional glues again since it seems to be making a comeback, and more questions have been raised by new users.

UNDERSTANDING GLUES BEGINS WITH UNDERSTANDING HOW ADHESIVES WORK.

The American Society for Testing and Materials (ASTM) defines an adhesive as *a substance capable of holding materials together by surface attachment.* There are a variety of forces at work that make this possible. The most common is called mechanical bonding, meaning that the surfaces are held together by an adhesive that has penetrated the porous surface while it is liquid, then anchored itself during solidification. With some adhesives, there are also other physical forces of attraction, which are referred to as "specific adhesion." These include intermolecular attraction forces that form bonds between the adhesive polymer and the molecular structure of the wood itself, such as van der Waal's forces and hydrogen bonding. I believe that covalent bonding, which is 11 times stronger than hydrogen bonding, is also a factor, but at this time there is no clear evidence that such bonds constitute an important mechanism in adhesive bonding to wood.

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The reason I suspect that these molecular forces are a factor is that water has a strong molecular attraction to wood, primarily through hydrogen bonding with hydroxyl groups of the cellulose that

YouTube

Watch this video!

W. Patrick Edwards from Old Brown Glue explains how you can conserve your excess "Hot Hide Glue" by drying it and re-humidifying it later when you are ready to use it again. No more wasted glue!

https://www.youtube.com/watch?v=l41AXS5eBx8

PHOTOS ARE FROM PATRICK'S WEBSITE AND ARE USED WITH PERMISSION.

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is in the wood. Since protein glues are carried by hot water, it's obvious to me that they would have excellent penetration into the wood surface and form specific adhesion with the molecules of the wood itself.

Animal glues are derived by the hydrolysis of the protein constituent collagen of animal hides and bones. They are described as "hydrolyzed collagen" and are actually various amino acids that join in polypeptide linkages to form long-chain polymers. Studies have indicated that most glue molecules consist of single chains terminated at one end by an amino group and at the other end by a carboxyl group. Cross linkage between protein molecules is possible through hydrogen, ionic, and covalent bonds.

These glues are manufactured in a wide range of average molecular weights but are graded for commercial use by a

test instrument called a Bloom Gelometer. In general, woodworkers use glues rated at 192-, 222-, or 251-average gram strength. The higher the number, the faster it sets and the more brittle the bond. The lower the number, the slower it sets and the more flexible the bond.

I have always used 192-gram strength glue and find its properties perfectly suited to a wide range of woodworking, from making large front doors for my house to attaching tiny pieces of marquetry to furniture. Of course, a traditional double glue pot is essential, as is the glue brush, hot plate, and thermometer. Hide glue is best at 140 degrees, and it can be heated and cooled as many times as you like without any problems. I cook it all day long and turn it off when I go home. The only consideration in cooking hide glue is that it will attract mold if it is not heated on a regular basis. Therefore, if I am not using the glue for some period of time, I pour it out on a piece of heavy plastic, wait an hour for it to gel and then place the glue sheet on a screen to dry. Once dry, it will last forever. To reuse it, just break it up into pieces and soak in cold water as usual before heating once again in the glue pot.

Historically, woodworkers have used glues made of either bone or hide or a mixture of both.

Protein glues can be easily modified with a wide variety of additives to change the working characteristics of the glue. I have used urea to reduce the gel point of the hide glue to manufacture "Old Brown Glue," which has become a recognized liquid protein glue. It is in the form of a gel in the bottle at room temperature and needs to be heated up to be used. It can be frozen, refrigerated, or kept at room temperature and has a guaranteed shelf life of 18 months, regardless of storage conditions. It has a much longer working time than the hot glue, is just as strong, and is easier to clean up.

There are other proteins used to make glues, and each type has its historic application. Rabbit skin glues are diluted quite thin with water (16:1) and work under the gold leaf and gesso quite well. Fish glues are a different animal. They are normally liquid at room temperature and are generally used to adhere a variety of materials that are not wood to a substrate. Materials used in marquetry, such as ivory, bone, horn, shell, and metals all expand and contract as a function of humidity and temperature in opposite directions to wood. Therefore, fish glues are used to hold them in place, since these glues allow a certain movement of elements during environmental fluctuations.

Historically, woodworkers have used glues made of either bone or hide or a mixture of both. Bone glues have slightly different characteristics than hide glues and are essentially more rigid after curing. The most common mixture of these glues is 1/3 bone and 2/3 hide. Hide glues are usually made from the skins and tendons of cows, and in the past there were specific uses for each part of the animal. The last American manufacturer of hide glues is Milligan & Higgins, in New York. More information on the properties of hide glues can be found by contacting Jay Utzig at **www.Milligan1868.com**, as he is their chief chemist and is always willing to share his insights with interested parties.

Obviously, there are many sites on the web that discuss working with protein glues. Nothing replaces the actual experience of cooking and using these glues in practice. They are easy to mix and cook. In a dry state, they have an unlimited shelf life. Cooking involves a hot plate, a double boiler, a meat thermometer, glue, water, and a glue brush. The double boiler can be cast iron, aluminum, copper, stainless steel, or any other material, as it makes no difference. The cooking temperature is 140 degrees F, and it can be cooked as long as you want. Cooking the glue every day makes it stronger over time. Overcooking

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damages the protein, and if the glue temperature is above 180 degrees it is best to start over.

From time to time the glue pot, thermometer, and brush are boiled in water to clean them. If the glue is left unheated for several days, it may attract mold, in which case it is necessary to boil the pot and start over.

Water must be added from time to time to keep the viscosity thin. Hot water is added to hot glue and cold water to cold glue. Mixing the dry glue with water must be done with cold water; the usual ratio is 50/50 to start. The glue must be hydrated before heating.

In conclusion: cold water is added to dry glue and left to set for half an hour. Then the hydrated glue is heated in a double boiler to 140 degrees. Each day the glue is cooked and becomes darker and stronger. Water (the same temperature as the glue) is added as necessary to keep the viscosity thin.

Protein glues can be reversed by adding either water or heat or a combination of both. Dry heat alone is not enough to liquify dry glue, but prolonged exposure to cold water will eventually liquify any dry protein. By first adding water and then heat, all protein glues convert from solid to liquid.

Understanding this simple fact leads directly to the explanation of how these glues cure and set. They act in two phases: first they lose heat and form a tack which can be quite strong. Then they lose moisture into the wood and the environment, which completes the full cure. The fast tack of protein glues means that work can be done quickly, and clamps can be removed in short time. Also, this makes hot glues perfect for rubbed joints and hammer veneering. ***—WPE***

BASIC ADVANTAGES OF PROTEIN GLUES OVER SYNTHETIC GLUES:

- *Protein glues can be reversed, and the viscosity can be manipulated by adjusting the ratio of water or heat as variables.*
- *Protein glues penetrate deeply into wood fibers since they are carried by water.*
- *Protein glues are very slippery when hot and provide lubrication for tight wood joints.*
- *Protein glues have a longer working time, which makes them perfect for lamination.*
- *Protein glues are transparent to oils and finishes and do not stain the wood.*
- *Protein glues easily clean up with water.*
- *Some protein glues have a fast tack, which makes them perfect for rubbed joints and hammer veneering, including marquetry fabrication.*
- *Protein glues have a very high sheer resistance to creep.*
- *Protein glues can be used to size wood and sand easily.*
- *Protein glues bond with both mechanical adhesion and molecular attraction.*
- *Protein glues bond to themselves.*
- *Protein glues are the only glues that are appropriate for traditional furniture construction.*
- *Protein glues are not damaged by freezing.*

DISADVANTAGES OF SYNTHETIC GLUES:

- *Synthetic glues are not reversible.*
- *Synthetic glues are not easy to remove from wood surfaces without damage to the wood.*
- *Synthetic glues creep under stress.*
- *Synthetic glues do not bond to themselves.*
- *Synthetic glues are damaged by freezing.*
- *Synthetic glues stain the wood and are difficult to clean up.*
- *Synthetic glues are difficult to sand properly.*
- *Synthetic glues do not penetrate deeply into wood fibers.*
- *It is difficult to adjust the viscosity of synthetic glues.*

Visit Patrick's website at http://wpatrickedwards.com/