Glues and a Little Chemistry

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Generally, when petrochemical liquids become solid they are called plastics. In this presentation the terms glues, adhesives, plastics and polymers will be interchangeable because almost every common wood working glue is a plastic.

Plastics begin as a very small unit called a monomer. Think of one unit as a mono-mer, one mer. These single units linked together make many mers or poly mer, polymer. Generally a solvent is used to separate the monomers preventing them from combining. Water is the solvent for white glue. As the water evaporates or is absorbed into the wood, the monomers are forced closer and closer together until they combine to create a huge wood fiber plastic.

General Types of Glues

PVA Glue - Common Wood Glue - Vinyl Glue

PVA is the abbreviation for Poly Vinyl Acetate. The key word is vinyl. This plastic is flexible, strong and permanent. This preferred wood glue expands and contracts with the wood. White glue, yellow glue, Titebond II & III, and carpenter's glue are all PVA glues.

Generally PVA glues are about 50% water. I recommend applying the glue and allowing time for the glue to seep and absorb into the pores of the wood. Some water will evaporate during this glue absorbing process which will make the glue more concentrated. If any wood appears uncovered with glue then apply more glue. Also don't be too quick to remove excess glue squeezed out, because some might be needed to seep back into the wood.

Hot Glue - Another Vinyl Glue

Hot glue was developed during WWII to create an easy-to-apply waterproof non-reactive glue system with holding power. During WWII materials were shipped overseas and a strong waterproofing glue was needed on the ships.

Hot glue is a simple substance. When hot, it is soft, runny and sticky and then when cooled, it is hard. A chemical cousin, thermoplastic, is used to make milk jugs and all comparable containers. The process melts the material to be injected into a mold to create the desired shape when cooled.

Hot glue is a useful vinyl plastic for wood workers. Hot glue is commonly used in the furniture industry to fasten items and fill in any imperfections. Hot glue is available in

many colors. Find a crack, fill it with colored hot glue, and you have a quick and easy fix. Cool hot glue is similar to vinyl records or old (1950's, 1960's) lawn chairs.

Hot glue was designed for speed of use and not strength. When attaching a work piece to a glue block, I advise increasing the holding power of hot glue by maximizing the glue contact area. To join two pieces of wood first heat the wood, add a small amount of glue, and reheat the glue with a heat gun to make it runny. Then heat the other wood, join the two pieces together and apply clamping force. More glue should be added to the exterior seams for added glue strength. A heat gun softens and liquifies the hot glue for easily removal with a metal spatula (putty knife).

A simple way to make a glue block is to drill a hole bigger than the 1 inch nut. Place the nut in the drilled hole, heat the nut and cover the outside with hot glue. I put a bolt in the nut to prevent glue from running inside the nut.

Hot melt mini colored glue sticks can be used to cover small imperfections. I use a heat gun and putty knife to heat the glue. The procedure is simple. Cut off a small portion of the glue, put it over the imperfection and heat. Smash the glue with the putty knife to fill the area, cover with a cool putty knife allow to cool the glue. Hot glue will not adhere to latex paints unless primer is added.

CA - Cyanoacrylate Glue - Super Glue - Acrylic Glue

CA glue was discovered during WWII but was not used until many years later. When hardened, this glue becomes an acrylic plastic which is much harder and more durable than the previous mentioned glues.
The problem with using an activator is the glue becomes solid before all the polymerization has occurred. Incomplete polymerization weakens the strength of the acrylic plastic.

CA glue can be used with white glue. Water is one of the activators for CA glue. Adding spots of CA glue to one piece of wood and a thin coat of white glue to another will reduce clamping time. Compressing the wood together will activate the CA glue and later the white glue will cure to create a strong bond. CA glue can be used to create inlays. Make a trench, add CA glue, add material and cover with CA glue. Allow time to harden.

Another Acrylic Glue - UV Resin

UV Resin is a light-activated acrylic which was developed in the 1960s as a way to coat furniture and other items without using a solvent or allowing time for drying. Imagine an assembly line where the item is sprayed a color, lit with a UV light, then packaged. Simple and quick are the watch words for UV resin.

UV is easy to use, NO mixing and NO clean-up. Use the black bottle with the drip cap to apply the resin. The resin is thick and warming with a heat gun will cause the liquid to flow easier. After the desired amount has been added, shine the UV light over the

resin for a minute or so. If the resin is tacky, then shine more light. Allow the resin to stabilize for a few minutes and it is done. If more is needed to be added then repeat the process.

When inlaying a solid, it is best to add super glue to the bottom of the wood inlay area (trench). This insures that your inlay will not fall out of the trench.

Add super glue to the trench, place the items to be inlayed into the trench and add the resin. Warm with a heat gun to cause the resin to flows into all areas. Move about the inlay to release any unforeseen air bubbles. When satisfied everything is as desired, add the UV light. The resin will NOT harden until UV light is added. Any expiration date on UV resin is totally bogus!!

Side Note: On a turquoise inlay I needed to use my angle grinder with 36 grit disk to remove the excess resin I accidentally added to the wood.

The resin I recommend is used mainly by people in the Nail Saloon industry. This product is not tacky and when set is totally transparent. And, it is cheap. Another reason UV resin is used in the Nail Saloon industry is because it is not a solvent - no fumes or need for a ventilation system.

Epoxy
Epoxy is the strongest and most durable plastic. Pool and bowling balls are made with epoxy along with the coating over bowling pins. Epoxies are over 100 years old and became commercialized in the 1950s with its use in areas ranging from aerospace to dentistry.

An alternative to Mililput (epoxy putty) is J-B welds which is available in different colors. Cut off a slice, squeeze-mix and roll until you have a uniform color, smash into the wood depression, scrape smooth and allow to harden. The squeezing mixes the epoxy resin components and should be done until a smooth color is achieved.

Polyurethane Glue - Construction Glue
Polyurethane glues are water proof and much stronger than vinyl glues. Liquid Nails, Original Gorilla Glue, Elmers Glue-All Max and other construction adhesive are urethane glues. These glues use a volatile solvent. When working with any volatile solvent, concerns about ventilation and potential fire hazards should be considered. These glues require extra clamping force because the glue expands slightly when set, thus pushing apart the joint. These glues do not dry as clear as PVA glues.

Safety
Safety should always be considered. As with any plastic making chemical it should not ever come in contact with the skin. Also, never look directly into any UV light source without special UV blocking glasses. Finally, don't touch anything while it is hot.

Materials Used and Where purchased

Amazon:	LE UV Flashlight 51 LED (bulbs)	$12.00
	Teexpert UV Resin Ultra Clear 300g	$25.00
Harbor Freight	HFT Super Glue 0.7 oz (20g)	$ 4.00
Tractor Supply	one inch nut and bolt	$?.??
Hometown Crafts	Mini glue sticks at about	$ 2.00
J-B Weld	Gibson	$ 7.00

Glue Video

If you enjoy learning about glue and joints, I recommend Patrick Sullivan's Youtube channel about Glue Myths. Also, he shows how to make carbide chisels for wood carving.

Odd Tidbits about Glue

** When glueing boards with white glue, the clamps are very tight. But when the glue is set these clamps will become less tight. The clamps did not change because the wood did. As the white glue dried and set, it began to shrink as the plastic was being formed. This shrinking pulled the wood together releasing some of the clamping force.

** For almost every wood, the glued wood joint is stronger and harder than the surrounding wood. With this in mind, sanding needs to be carefully observed when sanding over a wood joined area, the sand paper will remove more wood than the glued joint which will create a bump.

** ANSI is abbreviation for the American National Standards Institute and HPVA is the Hardwood Plywood and Veneer Association. ANSI/HPVA defines water resistant and waterproof glues. To be labeled as water resistant glue, the glued wood surface must hold up when being immersed in boiling water for four hours, dried at 150 degrees, boiled again for another four hours, cooled in water, and then pass a strength test. A water proof classification is more rigorous.

** The word glue is derived from the French word Glu meaning birdlime. Birdlime was a sticky substance, usually made from sticky fruits. This sticky substance is applied on twigs to trap small birds.

During World War II the British tried to use Birdlime to make Sticky Bombs. These bombs were intended to be thrown on German vehicles, stick, and explode. The test data was not promising and the Birdlime bombs were never mass produced.

As Paul Harvey used to say, "And now you know the rest of the story".