Construction Glues

CASEIN GLUE

Strong, water-resistant casein glue, which produces joints as strong as or stronger
than most of the common species of wood, is made from skim milk and common chemicals. Casein glue joints are water-resistant but not waterproof. They will withstand occasional soaking, but if soaked and dried, they will fail.

Tools and Materials

Mixer: paddle and bowl of wood, iron, or other material that won't be corroded by the alkali in the glue.
Containers
Scale or balance
Skim milk
Hydrated lime, [CA(OH).sub.2], also known as slaked lime. This should be a good quality
lime: high in calcium and low in magnesia.
Silicate of soda, also called "waterglass" or sodium silicate. The preferred

solution
should have a density of about 40 degrees Baume (Density 1.38) with a ratio of silica to soda of approximately 3.25 to 1.
Cupric chloride, [CuCl.sub.2] (cupric sulfate, [CuSO.sub.4], also called "blue vitreol" can be
substituted)
Wire screen or 20-mesh sieve with 0.033" (0.84mm) openings
Cloth for squeezing moisture out of curds

Making Casein Powder

Casein powder is made from skim milk by the following steps:

o Let the milk sour naturally or sour it by slowly adding dilute hydrochloric or sulfuric acid until curds form. The milk will separate into curd and whey.

o Drain the whey off. Wash the curd by adding water and draining it off.

o Press the curd in a cloth to remove most of the moisture.

o Break the curd into small particles and spread it out to dry.

o Grind the dry curd to a powder and pass it through a 20-mesh screen.

Mixing Casein Glue

Proportions for Glue
Formula 11 (not restricted by patent), U.S. Forest Products Laboratory

Parts by Weight

Casein (powder) 100
Water 150 to 250

Hydrated Lime (powder) 20 to 30
Water 100

Silicate of soda (solution) 70

Cupric chloride (powder) 2 to 3
Water 30 to 50

If hydrated lime is not available, quicklime (CaO) can be used in the following ways:

A mixture of 15.1 parts CaO and 104.9 parts water by weight can be substituted for 20 hydrated lime and 100 water.

A mixture of 23.5 CaO and 106.5 water can substitute for 30 hydrated lime and 100 water.

When CaO is added to the water, it must be stirred for 15 minutes to get a uniform slurry.

The bowl and paddle for mixing casein glue should be made of wood, iron, or some other material that will not be corroded by the alkali in the glue and can be cleaned easily. All the ingredients should be weighed rather than measured by volume so that the proportions will be accurate. It is especially important not

**to
use too much water.**

o Put the casein and water in the mixing bowl and mix them well enough to distribute the water throughout the casein. If the casein used has been ground to pass through a 20-mesh screen, let it soak in the water for 15 to 30 minutes before going on to the next step. The soaking period can be reduced if the casein is ground more finely.

o Mix the hydrated lime and water in a separate container.

o Dissolve the cupric chloride in water in a separate container and add it, while stirring, to the moistened casein.

o Immediately pour the hydrated lime-water mixture into the casein mixture. When casein and lime are mixed, large lumps form at first but they break up rapidly and finally disappear. The solution becomes somewhat thinner. Thorough stirring is very important at this point.

o About a minute after the lime is mixed with the casein, the glue begins to thicken. Add the silicate of soda at this time.

o The glue will thicken momentarily, but continue stirring the mixture until the glue is free of lumps. This should take no longer than 20 minutes.

If the glue is a little too thick, a small amount of water can be added. If it is too thin, start the whole process over again, using a smaller proportion of water.

Using Casein Glue

The working life of glue is the length of time it stays fluid enough to be workable. The silicate of soda extends this time. The glue produced by the formula used here will be usable for more than 7 hours at temperatures between 21C and 24C (70F and 75F). Working life will be shorter at higher temperatures.

Casein glue is fluid enough to be spread by a roll spreader or by hand with a brush or scraper. Very heavy spreads are wasteful because excess glue will be squeezed from the bond. Very light spreads can produce weak joints. A suggested minimum is 29.5 kilograms (65 pounds) of wet glue per 92.8 square meters (1,000 square feet) of glue-joint area.

To obtain good contact between wooden members of a joint, apply pressure while the glue is still wet. There is not much drying before 15 or 20 minutes. Under ordinary circumstances, a pressure of 105,450 to 140,600 kilograms per square meter (150 to 200 pounds per square inch) will give good results.

If casein glue joints are exposed for long periods to conditions that favor the growth of molds, they will eventually fail. The joints will be permanent only if the moisture content of the wood is not greater than 18 to 20 percent for long or repeated periods.

Dry casein can be kept for a long time in a cool, dry place.

Sources:

Casein Glues: Their Manufacture, Preparation, and Application. Madison, Wisconsin:

Forest Products Laboratory, Forest Service, U.S. Department of Agriculture.

Dr. Louis Navias, VITA Volunteer, Schenectady, New York

LIQUID FISH GLUE

Cold liquid glue can be made from the heads, skins, and skeletal wastes of cod, haddock, mackerel, hake, and pollack. A great advantage of liquid fish glue is that it remains in liquid form and consequently has an almost permanent working life. An advantage of using it to make wood joints is that it sets slowly and therefore penetrates further than other glues before hardening.

**Since liquid fish glues are not very water-resistant, a casein or other glue should
be used where water-resistance is needed. Thick fish glues produce stronger joints
than thin solutions.**

Tools and Materials

**Fish heads, skins, and skeletal waste
Large pan for washing fish parts
Steam bath or double boiler
Paddle for stirring
Filter, such as cheese cloth**

To make the glue:

o Wash the fish material thoroughly to remove blood, dirt and salt. If salted

fish are used, wash them in running water for 12 hours.

o Once the material is washed and drained, put it into a large container, cover it with water, and cook it slowly at a low temperature, about 60 [degrees] C 140 [degrees] F).
Cooking in an open pot helps to eliminate unpleasant odors in the glue. A steam bath or double boiler should be set up so that live steam surrounds the pot. Stir the contents occasionally. The length of the cooking period varies with the kind of fish material used.

o Let the cooked mixture settle. Skim off and discard the grease. Pour the remaining contents of the pot onto a filter.

o Concentrate the filtered fluid by slow heating to the desired thickness. This is the glue; it can be stored in convenient containers.

o Take the fish material remaining on the filter and cook it again to extract more glue, then repeat the filtering and concentrating.

Sources:

Encyclopedia of Chemical Technology.
Paul I. Smith. Glue and Gelatine, Chemical Publishing Co., Inc., 1943.
Thomas D. Perry. Modern Wood Adhesives. Pitman Publishing Co., 1944.