

## **O6320 Casein**

Casein is the most important protein component of milk. It is supplied in the form of white to yellowish, slightly hygroscopic powder. Casein is soluble in water and alkalis and is obtained from cow's milk. This contains about 3% casein in colloidal, milky opalescent solution. About 83% of milk protein is casein, this is not a uniform substance according to recent research, but a mixture of about 60%  $\alpha$ I and  $\alpha$ II-casein (forms insoluble calcium salts), 25%  $\beta$ -casein (Ca-salt insoluble), 10%  $\gamma$ -casein (Ca-salt insoluble), and 5% Ca salt soluble.

In cow, buffalo, sheep, llama, reindeer and goat, almost all milk protein is casein.

In horses, donkeys, dogs and cats, however, albumin predominates. Casein is flocculated by boiling.

In contrast, milk is covered with a skin of calcium caseinate. After addition of acid (H ions) or rennet (pepsin-like digestive enzyme, available from calf stomach), the casein colloidal "dissolved" in the milk rapidly coagulates to form a white, bulbous mass.

If cow's milk is left to stand for a few days, the tiny fat droplets accumulate as cream on top.

Underneath is a white, bulbous mass of coagulated casein.

This casein coagulation is due to the H ions of lactic acid produced by the ubiquitous lactic acid bacteria by splitting the milk sugar. Casein is relatively easily broken down into peptides and amino acids, respectively, by pepsin and trypsin.

### **Production**

Whole milk is centrifuged, reducing its fat content from 3.4% to 0.05-0.2%. Then a pure culture of lactic acid bacteria is added to the skimmed milk heated to 35°C and after a few hours heated to 45°C and above. Meanwhile, the lactic acid bacteria multiply. They break down the lactose into lactic acid and when the pH value of 4.6 is reached, the casein coagulates.

The clear, supernatant liquid (whey) is allowed to drain off, washed out with water, the casein is pressed to a water content of 65 to 68% and, after prior comminution, dried to a water content of about 10%. Casein coagulation can also be carried out with acetic acid, hydrochloric acid or sulfuric acid.

### **Use**

As a binder for paints (see casein recipes), for plywood gluing, for the production of adhesives, putties, finishes and leather topcoats, for sizing and coating paper, for waterproofing fabrics, etc.

Casein waste can be somewhat hardened with formaldehyde and used as slow-acting nitrogen flower fertilizer.

## Casein Recipes

Casein can be digested in several ways.

### Borax - Casein - Glue

Powdered caseins require a sufficiently long swelling process, which is usually carried out at night, and then digestion with suitable alkalis to form water-soluble casein glue.

However, the decomposition agents determine the various usability of casein-based cold glues. The usually solid compound of lime casein has been duly praised among the materials for wall painting, where plastic swamp lime or clear hydrated lime do the pulping. For all purposes of panel painting, on the other hand, borax casein glue has proven to be the best in practice, even though ammonium casein glue could theoretically be preferred, because after the conditions of the pulping process, all alkaline components not required for this purpose escape into the air as gaseous ammonia. However, the author found that ammonia components remain in the casein paste for an exceptionally long time, losing their tough consistency after 3 days, and that ammonium casein paste rots much more rapidly. Strong alkalis such as soda (sodium carbonate), potash (potassium carbonate) or similar must be excluded for the production of casein glues for painting purposes! Borax (sodium tetraborate), on the other hand, is so weakly alkaline that it has proved quite successful in practice, although mainly in panel painting, where weather resistance is generally not important. For self-preparation of casein glue, one uses crystalline borax, which still contains water of crystallization, and avoids the artificially fired product.

### 1. Borax - Casein according to Wehlte

40 g lactic acid casein powder, about 12 hours in 125 cc water, cold swollen.

16 g of borax, crystalline, dissolved in 125 cc of water, as hot as possible. For the preparation you can use a big porcelain bowl with a pestle, but any enameled bowl or a plastic one and a self-carved chunky stirring stick will do. The porcelain bowl, in which the casein powder has already been soaked, is covered right from the start with a folded, thick, soft, strongly moistened cloth, so that no casein grains initially dry on the edge and remain excluded from the swelling process, and that furthermore a skin formation on the finished casein glue is prevented until it is used or filled into a sealed container. Stir the hot borax solution into the gritty casein slurry, stir two or three times after a few minutes and leave covered. After 1 - 2 hours, no more individual casein grains can be seen in the viscous, yellowish, cloudy glassy mass, a sign that the digestion process can be considered complete. Nevertheless, if time permits, the digested mass can be left to stand for up to one day, during which time the finished casein paste becomes even more creamy. If casein paste is to be stored for several days or even weeks, it must be preserved. It has proved useful to prepare only small quantities of casein glue fresh at a time and not to keep it for longer. For use as paint glue, this quantity of glue is further diluted with water to the total volume of 1 liter, so that the concentration of casein in the paint solution becomes 4%. With one liter of casein paint can be painted on non-absorbent smooth surface about 10 square meters.

Borax casein lasts longer if hygienic work is done, i.e. boiled water and vessels are used, then borax casein can last half a year or more without preservatives.

## 2. Ammonium - Casein according to Dörner

Mix 40 g of casein in a little cold water, then add 250 ml of warm water, stir until smooth, then add 10 g of ammonium carbonate dissolved in a little water, stir, ready for use when the carbon dioxide from the carbonate no longer produces gas (bubbles no longer rise) use for tempera, for wall dilute to 1 liter with water.

Ammonium casein and ammonium casein prepared with staghorn salt spoil quickly, and also soon become thin when preserved.

Advantage: relatively low tension and in the dried casein there is no alkali later.

If staghorn salt is used, use a large container as it foams strongly.

## Lime - Casein - Glue

(Excerpt from Kuhrt Wehlte - MATERIALS AND TECHNIQUES OF PAINTING)

### Recipe for Lime Casein:

5 parts quark by volume (low fat quark)

1 part by volume slaked lime (pit lime)

5 parts by volume of quark and 1 part by volume of slaked lime are first squeezed well in a cloth to remove the excess whey (water + protein). The now somewhat drier, crumbly mass is put into a grating bowl and approximately the 5th part of lime is added. In practice, this quantity is never weighed, but merely estimated, because in this case exact proportions are not important (in contrast to a neutral lime casein!). The lime is used as it is extracted from the pit where it was stored, i.e. in a buttery consistency. With the pestle, curd and lime are now well rubbed together. As a precaution, you can also rub the curd on its own beforehand, in order to avoid the formation of lumps. In the course of about one minute, i.e. enormously fast, the digestion process takes place. The result is a viscous mass that has a low consistency only if there was still too much water in the curd. Some painters who do not have a grating bowl available take instead a small porcelain, plastic or enamel bowl and a self-carved chunky stirring stick, or they also mix curd and lime on a grating plate or an ordinary glass plate by carefully spackling the two together. The latter method has only the disadvantage that the casein glue easily runs off the flat plate at the moment of mixing. One more thing needs to be mentioned: the lime-casein glue begins to gel after a relatively short time, sometimes after about an hour. This makes it unusable, since it cannot be made liquid again either by applying heat or by rubbing it through again with a small amount of water. However, this annoying phenomenon can be avoided by rubbing the colors with it as soon as possible and immediately diluting the remaining binder with water. At a low concentration level, gelatinization does not occur. Ready-mixed lime-casein paints also no longer gel (at least not in most cases). The only thing that can be observed on them is another phenomenon that applies to all casein paints, and sometimes even to casein tempera paints: Various pigments turn out to thicken strongly thixotropically. Thixotropy is a strange colloidal chemical process.

A normal bound paint, which is filled onto tins in an equally normal tube consistency, has already become a sulky mass the following morning. The painter is then easily inclined to dilute such paint with water. The result, however, is a too thin, bodiless color broth, even if only a very small amount of water has been added.

If, on the other hand, a thixotropic paint is simply stirred with a brush handle without adding water, it immediately returns to its original consistency. Sometimes it is even sufficient to tap the side of the container or to tap it several times on the tabletop to remove the thixotropy.

**Recipe for Lime Casein:**

40 g powder casein 125 ccm water (cold), 33 g (slurry lime). The weighed casein powder is immediately soaked in the grating bowl with the specified amount of water and, if possible, left in a warm place, covered (!), for several hours until it has swollen to a soft slurry. The casein has then mostly swallowed up all the water. In practice, this soaking process is usually postponed until the previous evening. One is then sure that the swelling process will be completed the next morning. Now this casein slurry is treated like the fresh curd, i.e. it is digested with the indicated amount of lime (20%). Thus, in any case, one obtains a nice, tough casein glue of always uniform consistency. However, this casein paste made from powdered casein tends to gel even more quickly than curd casein paste and therefore requires rapid further processing. All lime casein glues occupy a special position technologically, because they are even largely weatherproof! (We recommend diluting the casein recipe from the "Wehlte" with 3 - 5 parts of water and adding approx. 1 kg of pigment to approx. 1 liter of dilution.

(Marble flour, quartz flour with appropriate pigment to be used. Make samples, because of chalking or flaking, binder requirement of pigments is very different. In the case of lime casein, use [kalkechtesfreskoliste.htm](#) pigments as a precaution). Lime casein is waterproof. The glue must always be diluted with water within a quarter of an hour after the lime has been added, otherwise it will gel insolubly!

**or: Casein Paint Dry mixed with Lime: (source Brühl "Casein")**

Lime caseins are not water soluble when dried. 5.5 parts champagne chalk 1.5 parts China clay (or kaolin) 0.2 parts dextrin 1.2 parts casein dry mix well. Sprinkle 1 kg of this mixture in 830 ml of water, let it sump, about 5 hours, better overnight. Stir well and add about 200 g of sump lime, which has been previously stirred so that it is homogeneous, i.e. free of lumps. Leave to stand for 1 - 2 hours. The champagne chalk can be partially or completely replaced by other pigments. In this case, the properties of the color may change due to the special properties of the pigments, so that preliminary tests must always be made.

**or : Casein Paint White**

450 g Champagne Chalk 123 g Titanium White 123 g Zinc White 168 g China Clay 23 g Dextrin 112 g Casein = approx. 1 kg dry mixed + approx. 830 ml water sprinkled and left to soak for approx. 5 hours. Mix well and add approx. 200 ml of homogeneously stirred sump lime. Cracking, especially flaking or peeling, indicates over-bonded paint. The casein content must be reduced. Chalking layers indicate under-bonded paint or poorly dispersed pigments - increase casein content or rub pigments better. The pigments must be lime-fast. Wear protective goggles when painting! Use up the paint soon, it will stink within a few days! (depending on the weather). Preservation with our Preventols is possible. Concentrations see price list. Zinc sulfide (46350) is also suitable. 0.35 parts based on the dry mixture are added to the dry components and mixed with them.