

Basic Knowledge about Animal Glue

What is animal glue?/
Raw materials of and production methods
for animal glues /
Animal glue today and tomorrow

Nikawa Labs
(膠文化研究会 / Nikawa Bunka Kenkyu-kai)



Fig.1 Various animal glues

■ **Industrial animal glues** (洋膠/*yo-nikawa/yo-ko*) : **a.** Banshu Pellet Nikawa 播州粒膠 (Terawaki Sangyo Co., etc. 寺脇産業(株) 他) ; **b.** Nanjin Shika Nikawa 軟韌鹿膠 (Tsumaya Nikawa Laboratory, Inc. 妻屋膠研究所(株)) ; **c.** Pearl Nikawa Daio パール膠大王 (Sun-Oriento Chemicals, Inc. サンオリエント化学(株); no longer produced) ; **d.** Ita Nikawa Tengu板膠天狗 (*Ibid*)
■ **Domestic animal glues** (和膠/*wa-nikawa/wa-ko*) : **e.** Sanzenbon Nikawa 三千本膠 (Seikei Shoten 清恵商店; no longer produced) ; **f.** Kyojo Nikawa 京上膠 (*Ibid*) ; **g.** Sanzenbon Nikawa Asuka 三千本膠飛鳥 (Asahi Gelatine Industrial Co., Ltd 旭陽化学工業(株))
■ **Classical animal glues** (古典的膠/*koten-teki nikawa*) : **h.** Shaved Raw Cattle Hide Animal Glue, Third Extraction by Soft Water 牛剃毛生皮軟水三番抽出膠 (General Incorporated Foundations. World Paper Heritage Support Foundation KAMIMORI 財世界紙文化遺産支援財団紙守) ; **i.** Gyuhui Wako Aoi 牛皮和膠葵 (Amanosan Cultural Heritages Research Institute, etc. 社天野山文化遺産研究所 他) ; **j.** Deer Hide Animal Glue, First Extraction 鹿皮膠一番抽出 (*Ibid*)
■ **Prototypes by UDAKA Kentaro (classical animal glues)** : **k.** Shaved raw deer hide animal glue, first extraction by hard water ; **l.** Carp scale animal glue, first extraction by soft water ; **m.** Deer antler animal glue, second extraction by soft water

What is animal glue?

Animal glue (膠/*nikawa*) is traditional material produced from animal hide, bones or other materials. It has been used widely from ancient days in the creation of art, calligraphic work and craftwork as well as in conservation. Its main constituent is gelatin (polypeptide, straight-chain polymer formed from amino acids). Other ingredients include fats, salts and minute amounts of other impurities. In the production of Japanese-style paintings, animal glue is first used as a dispersant (surfactant) when dispersing pigments in water. Then, as drying and lowering of temperature progress, intermolecular hydrogen bonding progresses until animal glue hardens into a gel form (gelation) and holds pigment particles to the support (base). Finally,

after animal glue has dried, it functions as an adhesive to fix pigments to the support. The fluidity, rigidity, and flexibility of animal glue greatly influence workability and the stability of the paint layer after completion of the artwork (decreasing pigment flaking as well as increasing water-resistance).

In Edo period (1603-1867) Japan, production of leather and that of animal glue were undertaken by people of special villages. As a result, few referential documents remain and, even though animal glue has always been an extremely important material, knowledge concerning its production has not been correctly made known to the general public for a long time.

Raw materials of and production methods for animal glues

1. Raw materials

Various raw materials are used to produce animal glues, including animal hide, bones, antlers and fish scales¹⁻¹⁰). In this leaflet the most common type of animal glue, that produced from animal hide, will be introduced. In order to produce high quality animal glue, it is necessary to epilate the hide before extraction^{1-4,11}). There are many contaminants such as dirt and dung attached to animal hair and the surface of the hide. Thus, if animal glue is extracted from

hide with hair remaining, the product will contain a great amount of impurities. To epilate, the hide may be soaked in natural river water or treated with lime, etc. (either to pull out or dissolve hair) or physically shaved^{1-4,6,7,12-14}). Today, to economize and preserve resources, pieces of epilated hide produced in the process of leather production or scraps of tanned leather are commonly used as raw material for animal glue^{10,15}).

Table 1 shows the outline of the typical processes

involved in the technique of leather production today and in the pre-modern period (pre-1868). Of the classical techniques of producing leather employed in the pre-modern period, that of vegetable-tanning is comparatively widely used even now. However, it seems that the processes of epilation and deliming are the same as those used in the production of chrome-tanned leather since the modern period (about 1868 to 1945) to the present. Today cattle hide is usually preserved in salt by hide distributors immediately after cattle have been slaughtered and decorticated. Then it is delivered to tanners, desalinated with water (antibacterial agents and degreasing agent are added as necessary), fleshed to remove subcutaneous fat and pieces of flesh, epilated, and in some cases tanned and/or dried. After these processes, parts of hide that would not be used for leather products are delivered to animal glue producers to be used as raw material for animal glue. In this way, there is a close connection between animal glue and the leather, meat, livestock, and hunting industries.

Common raw materials for animal glue today are: ③ for industrial animal glue, ① and ② for domestic animal glue^{10,15}) (cf. Table 1). On the other hand, raw materials such as ④, ⑤ and ⑥ are thought to have been commonly used as raw materials for classical animal glue in the pre-modern period^{1-7,12-14}) while materials such as ⑦ were more commonly used in the West^{12,17}).

2. Production methods

In present-day Japan, animal glues are classified into industrial animal glue (洋膠/*yo-nikawa/yo-ko*) and domestic animal glue (和膠/*wa-nikawa/wa-ko*). Production methods for industrial animal glue using modern techniques like decompressing-concentration were introduced to Japan in the early Taisho period (1912-1926), and chrome-tanned leather chips (Table 1 ③) began to be used as a raw material from the early Showa period (1926-1989)^{10,15}). On the other hand, from about this time, products made primarily by heating-concentration from untanned, epilated hide began to be called “*wa-nikawa*” or “*wa-ko*”. Included among these are Sanzenbon Nikawa(三千本膠)¹⁰). For epilating and treating the raw material before extraction, modern methods introduced from the West using lime and sulfur-containing compounds^{10,12,13}) became common (Table 1 ①, ②). After extraction, de-foaming agents, preservatives, and bleach were added as necessary. This type of animal glue differs greatly from classical animal glue in both raw materials and production methods. As with Japanese-style painting (日本画/*nihonga*) domestic animal glue and its terminology are actually new, having been created since the modern period. Thus, domestic animal glue should be clearly distinguished from classical animal glue of the pre-modern period.

The representative raw material of classical animal glue is hide that has been shaved or epilated by washing it in

Table1 Typical methods for leather production today and in the pre-modern period in Japan^{10,12-14,16}

<p>Most common method for leather production today use</p> <p>Chrome tanning (introduced since the end of the Meiji period [1868-1912])</p> <ol style="list-style-type: none"> 1. Wash rawhide in water with antibacterial agent and degreasing agent added. 2. Epilate by lime, sodium sulfide, and sodium hydrosulfide. 3. Delime by ammonium chloride and degreasing agent, etc. ① 4. Pickle in sulfuric acid, formic acid, and sodium chloride. ② 5. Tan using basic chromic sulfate and sodium carbonate. ③
<p>Classical methods for leather production in the pre-modern period used</p> <p>Japanese white tanning (existed from before the Heian period [794-1185] but declined since the modern period)</p> <ol style="list-style-type: none"> 1. Epilate rawhide by washing it in a river for a long time. ④ 2. Tan by extensive rubbing with a small amount of rapeseed oil and sodium chloride. ⑤ <p>Brain fluid tanning (existed from before the Heian period but declined since the modern period)</p> <ol style="list-style-type: none"> 1. Shave (epilate) rawhide. ⑥ 2. Remove grain. 3. Soak in brain fluid that has been kept for a long time and thus has fermented; then tan by rubbing. <p>Vegetable tanning (classical method in the West; introduced into Japan after the beginning of the Meiji period)</p> <ol style="list-style-type: none"> 1. Epilate rawhide by extended soaking in lime. 2. Delime by washing with water. ⑦ 3. Tan by extended soaking in vegetable-based tannin solution.

*These are representative methods. A combination of methods may be used in some cases.

