CNS 632 Technology and Conservation of Works of Art on Paper II

Adhesives, Sizing Agents, Fixatives and Consolidants: Description of Materials

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First, a note about purchasing materials which are repackaged and distributed by conservation material suppliers. It is dangerous to select a material solely on the use of the words "archival" and "acid-free." These terms have not yet been well defined for use by the industry, and at present are used fairly indiscriminately to sell a product.

Whenever possible, buy only materials for which you can get information about purity, viscosity, method of preparation, name of manufacturer, and date of manufacture. If not in the catalogue, the supplier should be happy to give this information to you on request. *You might strongly recommend that in the future the information be included on the product label and in the catalogue.* If you can't get the information, make it clear to the supplier either that you will not buy the material or that you will not buy it again from that supplier.

STARCH PASTES

Description:

Starch and gluten are components of flour which is made from seeds, roots, and tubers of plants. Precipitated starch is prepared in such a way to remove the gluten, a proteinaceous component of flour, leaving pure starch. Compared to flour, precipitated starch is more stable, less likely to color on aging, and is easier to reverse. The starch contains amylose (a straight chain polymer of a-linked glucose units) and amylopectin (a branched chain of repeating glucose units with branches every 25 units). Wheat and rice starch tend to have more amylose than amylopectin. Starch is insoluble in cold water and must be heated to a gelatinous stage before it can be used as an adhesive. Generally the longer the starch is cooked, the greater its adhesive power. Therefore, the inherent strength of a starch paste is based on its cooking time and the degree of dilution. The cooked paste must be diluted before it can be used in conservation as its adhesive properties are great. Expect all starch pastes to be naturally acidic - conditioning cooking water to pH 8 with calcium hydroxide might help to elevate the pH of the paste.

Dextrin is starch which has undergone acid hydrolysis in the presence of an acid, water, and heat to repolymerize to form an adhesive or binder which is both strong and in some cases remoistenable (with the addition of an humectant), hence its use on some postage stamps.

Starches:

AYTEX-P: precipitated wheat starch, manufactured by General Mills, distributed by TALAS, New York, NY.

Zin-shofu: precipitated wheat starch, manufactured in Japan, distributed by Conservation Materials Ltd., Sparks, NV.

Others: Conservation quality starches such as rice, corn, arrowroot, etc. Purchase only starches which have to be cooked into paste form before they can be used as an adhesive.

PROTEIN GLUES

Description:

Protein glues are derived by the hydrolysis (water + heat) of fibrous protein collagen. **Gelatin** is a pure form of an **animal glue**, and is the most

common protein glue used in paper conservation (**parchment glue** is commonly used in book and parchment conservation and is made by hydrolyzing parchment clippings). Gelatin is a natural polymer (MW 20,000 - 200,000) built up from a variety of amino acids in a polypeptide chain structure. To maintain flexibility, modern protein glues contain plasticizers and humectants such as sorbitol or glycerol. Protein glues dissolve in hot water and set by gelation on cooling. When using gelatin, it is recommended not to allow the solution to exceed 132°F. The color of glue solutions e.g. **rabbit skin glue** is usually dark brown. Gelatins are usually pale brown, while parchment glues are normally off-white in color. **Casein** is a protein-based adhesive and binder obtained by acidifying skim milk to pH 4. Casein was used between ca. 1890-1960 as the binder in industrially-applied paper coatings. It is usually a powder which is mixed with cold water to yield the adhesive or binder.

Gelatins:

Photographic grade gelatin: available through most chemical supply houses, Kodax, Peter Cooper Co., Rousselot Co.

CELLULOSE ETHERS

Description:

Cellulose ethers are synthetic materials obtained by chemically modifying pure cellulose with a variety of compounds. They can be non-ionic (e.g. methylcellulose) or ionic (e.g. sodium carboxymethyl cellulose). Cellulose can be chemically produced to yield ethers with vastly different purity grades, viscosity characteristics, solubility characteristics, etc. These differing characteristics make them useful as binders, surfactant, coatings or varnishes, sizing agents, adhesives, consolidants, fixatives, medium for enzymes, etc. Solutions made with pure cellulose ethers (usually designated as pharmaceutical grade) range from cloudy white to clear. If made with pure solvents, solutions have a long shelf life and need no refrigeration.

Cellulose ethers - water soluble only:

METHOCEL A: methylcellulose; viscosity grades 4M, 15C, 4C (see Cellulose Ethers handout); manufactured by Dow Chemical Co.; and available from chemical supply houses; as a sample from Dow Chemical Co., Midland, MI; and some conservation supply houses (usually have to ask <u>exactly</u> which methylcellulose is being sold). Film or powder not soluble in hot water.

Culminal: methylcellulose, (Aqualon, Inc., Hopewell, VA)

METHOCEL E,F,J,K: hydroxypropylmethylcellulose; various viscosity grades; manufactured by Dow Chemical Co., available from chemical houses, and as a sample from Dow.

Cellulose Gum CMC: sodium carboxymethylcellulose; 7HP or 7HSP preferred (ca. 3500 cPs at 2.0% conc. 20°C); manufactured by Aqualon, Hopewell, VA (formerly Hercules Inc. product); available as sample from Aqualon (specify pharmaceutical grade); some chemical supply houses. Other viscosity grades are available besides 7H (high): 7M (medium) and 7L (low).

Ethulose 400: ethylhydroxethylcellulose, 400 cPs; manufacturer: Mo och Domsjo (also sold under name Modocoll E); supplied by Conservation Materials Ltd., Sparks, NV.

Others, not necessarily recommended: **Methofas:** methylcellulose (Imperial Chemical Industries, United Kingdom); **Cellofas-B 3500:** sodium carboxymethylcellulose; manufactured by I.C.I.; distributed by TALAS.

Cellulose ethers - water and alcohol soluble:

Klucel: hydroxypropyl cellulose; a variety of viscosity grades available; manufactured by Aqualon, Hopewell, VA. **NOTE:** This cellulose ether cannot be recommended for permanent use in direct contact with a valued artifact. Temporary use (i.e. facing adhesive) might be possible as long as its complete removal can be guaranteed.

POLY (ETHYLENE/VINYL ACETATE)

Description:

Solutions and films made of **poly (ethylene/vinyl acetate)** are usually used as heat seal adhesives which require relatively low temperatures to activate, ca. 130° - 160°F. In solution form, they are quick setting, and require little or no curing or fusing. They are used in circumstances when aqueous materials cannot be used, or when speed of application is required. Heat seal tissues using BEVA can be easily made, stored for long periods, and appear to have good to excellent aging characteristics. The heat seal tissues are generally reversible in petroleum spirits (BEVA 371 solution), xylene (BEVA 371 film) or heat.

Poly (ethylene/vinyl acetate) resin co-polymers:

BEVA 371 solution and film: manufactured and distributed by Conservator's Products Co., Chatham, NJ; dist. by Conservation Materials Ltd, Sparks, NV.

Poly (ethylene/vinyl acetate) dispersions:

BEVA D-8: a dispersion of EVA co-polymers.

Jade 403, 454 (Jade Adhesives, Chicago, IL, distributed by TALAS, New York, NY). Not receommended for permanent use on a valued artifact.

ACRYLICS

Description:

These constitute a diverse range of **acrylic resins** with wet, heat seal, or contact adhesive properties. Their uses in paper conservation: fixatives, consolidants, and occasionally, local coatings or overall varnishes. Commercially, **acrylic resin dispersions** form the binder in latex paints. Although water soluble initially, upon drying the films from these dispersions are reversible in alcohols (fresh); acetone (aged). Heat seal tissues have been made from both the resins and the dispersions, the latter being more common. The dispersion-based heat seal adhesives require sealing temperatures around 180° - 220°F making them less ideal compared to BEVA 371 which seals at lower temperatures. There also seems to be a potential problem with common acrylic resin dispersions in that they are usually alkaline and not as stable as the resin alone.

Acrylic resins:

Acryloid B72 (Paraloid B72): ethyl methacrylate and methylacrylate co-polymer manufactured by Rohm & Haas, distributed by Conservation Materials Ltd., Sparks, NV.

Others: **Acryloid B67:** iso-butyl methacrylate (Rohm & Haas, Cons. Mats. Ltd.). **Acryloid F10:** n-butyl methacrylate (Rohm & Haas). **Soluvar:** iso- and n-butyl methacrylate (Permanent Pigments).

Acrylic resin dispersions:

Rhoplex AC 33: ethyl methacrylate and methylacrylate co-polymer dispersion manufactured by Rohm & Haas, distributed by Conservation Materials Ltd., Sparks, NV. This Rhoplex has the lowest temperature requirement as a heat seal adhesive and is therefore preferred over the other Rhoplexs.

Rhoplex N580: ethyl methacrylate and methylacrylate co-polymer dispersion manufactured by Rohm & Haas, distributed by Conservation Materials Ltd., Sparks, NV. This product can be used as a contact adhesive and is very useful for adhering together secondary materials.

Others: **Rhoplex AC 73, 234** (Rohm & Haas). Note: Library of Congress "Heat Set Tissue" is made of a mixture of Rhoplex ACs. (Note: The term "Heat Set" is used incorrectly here as the adhesive is used as a dry film and reactivated with heat or solvent vapors.) **Texicryl:** probably a ethyl methacrylate and methylacrylate co-polymer dispersion (Scott Bader, United Kingdom). **Lamatec** heat seal products are prepared with Texicryl as the adhesive (distributed by Conservation Materials Ltd.). **Plextol B500:** same as Rhoplex AC (Rohm & Haas, available in Europe).

POLY (VINYL ACETATE)

Description:

Generally, the films of the **poly (vinyl acetate) resins** are more stable and reversible than the films of the **poly (vinyl acetate) dispersions.** Reversing the aged, dispersion-based films is very difficult, and usually only some swelling can be achieved with water, acetone or mixtures of water and acetone, dimethyl formamide might also be effective. Though their use in paper conservation is rather limited, the following information is given in case they might have some use in conjunction with secondary materials (mats, bookbinding, box making, etc.)

PVA resins:

Union Carbide AYAC, AYAB, AYAA, AYAF, AYAT: Listed in ascending order by size of molecule manufactured and available from Union Carbide.

PVA dispersions*:

C M Bond M series distributed by Conservation Materials Ltd., Sparks, NV.

M-1: high molecular weight PVA homopolymer dispersion, 300-600 cPs
M-2: medium low molecular weight PVA dispersion, 1500-2000 cPs
M-3: high molecular weight PVA homopolymer dispersion, 2300-2700 cPs
M-4: high molecular weight PVA copolymer dispersion, 300-700 cPs

* These are generally not recommended for permanent use in direct contact with a valued artifact.

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