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ADHESIVES AND CONSOLIDANTS IN GEOLOGICAL AND PALEONTOLOGICAL CONSERVATION: A WALL CHART

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INTRODUCTION

Geological materials, perhaps more than any other class of natural history materials, are subject to the application of various polymeric materials from field to museum to exhibition. Some common uses of polymers include field and preparation stabilization, adhesion of broken pieces, consolidation of crushed or fragile specimens, gap-filling, molding and casting.

The use of adhesives and consolidants is the most wide-spread application of polymers in geological conservation, yet the most poorly documented and most problematic. Current research may remedy some problems in geological conservation, but much remains to be done.

The nature of geological materials and their uses in research, exhibition and education has resulted in the use of a wide range of polymers. It is important to note that there is no single polymer that is universally useful for all types of specimens and all varieties of use. This chart is a quick guide to some of the most common classes of polymers.

In general, it is best to select polymers that are easy to use, are stable over time, suit the specific task at hand, and can be practically reversed at need. Other desirable characteristics include unobtrusiveness (ideally the polymer is water-clear and does not discolor over time), cost effectiveness, ease of use, and compatibility with the materials being treated..

GUIDE TO THE WALL CHART

The wall chart summarizes some of the key information about adhesives and consolidants commonly encountered in geological conservation, either in modern use or in older specimens needing attention. A list of references for further investigation is given on the back page of this Leaflet, as is a glossary of terms. The major categories included in the chart are:

- Chemical family: the general class of polymer or compound to which the materials belong.
- Chemical composition: further information as needed on the chemical structure of the materials.
- Trade name(s) and manufacturer(s): information on the common brand or trade names in the US, Canada and the UK.
- Tg (glass transition temperature): temperature at which thermoplastic substances pass from a solid or glassy stage to a plastic, flexible one. Not given for thermoset or irreversible substances.
- Reversibility and solvents: information on the practical (not ideal) reversibility of the material, and on which solvents can be used with the material.
- Historic uses and comments: quick summary of uses, characteristics, advantages and disadvantages.

HEALTH AND SAFETY

Most of the materials listed in the wall chart depend on the use of solvents to carry the polymer or to reverse a joint. The health and safety aspects of solvent use are extremely important. Most of these require the use of a fume hood in a laboratory setting. A fitted respirator with appropriate filter cartridges is highly recommended for field use of solvents.

It is important to understand the health precautions to use with all materials. For each proprietary substance, including both polymers and solvents, it is necessary to have on hand a copy of the manufacturer's official Materials Safety Data Sheet (MSDS). This should not be confused with an advertising or general information flyer from the manufacturer. The MSDS must be provided free from the manufacturer on demand; it summarizes the health risks and safety precautions which the user has a right to know.

UNIDENTIFIED ADHESIVES AND CONSOLIDANTS

Many substances are not problematic until long after they are used; problems such as shrinkage, yellowing, or other degradation may take years to develop. Unfortunately, polymer use in the past (and to some extent in the present) is poorly documented. There are some substances listed on the wall chart which are not in common use today, but which are often encountered by people working on specimens treated years ago.

It is beyond the scope of this Leaflet to describe a protocol for identifying aged and problematic consolidants and adhesives. The best approach, in the absence of documentation, is to test with minute amounts of common solvents to see which ones are effective in softening the polymer, and to consult a conservator if the material seems to be immovable and insoluble.

DEFINITIONS

Adhesive: any substance capable of bonding other substances together by surface attachment.

Catalyst: a substance that markedly speeds up the cure of an adhesive.

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Coating: a surface skin application of a polymer.
Consolidant: an adhesive, often in a volatile carrier solvent, applied to soak into a specimen and force subsurface adhesion.
Copolymer: a preparation made from two polymers.
Cross-linkage: the formation of bonds between otherwise unattached polymer chains; often a source of shrinking or degradation of the polymer; renders affected materials insoluble.
Dispersion: a suspension of polymer particles in a solvent, usually water, in which the particles are suspended but will not dissolve.
Emulsion: very similar to a dispersion, often distinguished by a larger particle size.
Homopolymer: a preparation made from a single polymer.
Hydrolysis: the reaction of materials with water, causing hydration and swelling of materials; often irreversible.
Monomer: a simple molecular unit that can react to form a polymeric chain or compound.
Oxidation: a chemical change based on a reaction with oxygen, often degradative.
Plasticizer: a material incorporated in an adhesive to increase its flexibility, workability, or distensibility. The addition of a plasticizer may cause a reduction in melt viscosity, lower the transition temperature, or reduce the elasticity of the solidified adhesive.
Polymer: a large molecule formed by the linking together of many repeated units of the same small molecules (monomers) by normal covalent bonds; may be linear or nonlinear (branched).
Resin: a solid, semi-solid or pseudo-solid organic material that has an indefinite and often high molecular weight, exhibits a tendency to flow when subjected to stress, usually has a softening or melting range, and usually fractures conchoidally.
Reversibility: in conservation science, the ideal ability to remove a substance completely from a treated object, so that no traces or contamination are left. In geological preparation, the practical ability to un-do a joint through the use of solvents. The latter definition is used in the wall chart, but the former should be considered in the selection of polymers.
Solubility: the ability of a substance to dissolve in a given solvent.
Solvent: a substance capable of dissolving another substance (solute) to form a solution.
Terpolymer: a preparation made from three or more polymers.
Tg (glass transition temperature): temperature at which a thermoplastic polymer changes from a brittle, glassy state to a plastic state. The higher the Tg, the more brittle the polymer is at room temperature; the lower the Tg, the more likely the polymer is to flow or fail as an adhesive at room temperature.
Thermoplastic: polymers that can be heated to a plastic state, molded, and then cooled to harden in that shape; theoretically, this can be repeated and new shapes made.
Thermoset: polymers that, once set, cannot be heated and returned to a plastic state. The desired shape is obtained by applying or forming the initial polymer(s), then fixing the substance in place through heat, chemical reaction, or use of a catalyst.
Volatilization: the tendency of some materials, such as solvents or plasticizers, to pass to a vapor phase and leave the parent surface or compound.

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