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

CHEMICAL FAMILY	CHEMICAL COMPOSITION	TRADE NAMES AND MANUFACTURERS	T _g (°C)	REVERSIBILITY AND SOLVENTS	HISTORIC USES AND COMMENTS (A: ADHESIVE; C: CONSOLIDANT)
ACRYLIC POLYMERS (RESINS)	Methylmethacrylate (MMA), ethylmethacrylate (EMA), iso-butylmethacrylate (iBMA)	Acryloid (Paraloid) (Rohm & Haas)			
		B72 (EMA/MMA) ¹	40	R medium; S: Ac, EtOH.	A/C commonly used in conservation.
		B67 (iBMA)	50	R medium; S: W, Al, K, Gly.	A/C used in paleontology, fine art.
		Lucite (Perspex) (MMA)	-40	R medium; S: CCl ₄	A/C.
		Elvacite (DuPont)	-40		
		Synocril (Cray Valley Products)	-40		
		Bedacryl (ICI)	-40	S: 40% solution in X.	Used in acid preparation as coating.
		Pliantex	-40		
ACRYLIC DISPERSIONS OR EMULSIONS	MMA, EMA, ethylmethacrylate (EA)	Rhoplex (Primal) (Rohm & Haas)			
		AC 33: emulsion	16-20	R medium to good in Ac.	A/C used for bone and some wet fossil material.
		B60A: emulsion	16-20	S: H ₂ O (not after set).	
		WS 24: dispersion	39		A/C used for bone.
		Lascaux: emulsion (Lascaux)			
ANIMAL GLUES	Complex protein preparations (bone, fish, rabbit, etc.)	Secotine Fish glue	Varies; us. low	R: varies with type, age. S: Al.	Surface A/C. Label application. Tend to yellow. Very unstable. May invite pest attack.
CELLULOSE ACETATE	Cellulose acetate/butyrate	Lepages Cement		R: limited S: Al.	A. Limited use in geology.
CELLULOSE NITRATE (CN)	Cellulose polynitrate ester; plasticizers may be dibutyl phthalate, camphor, or triphenyl phosphate	Duco cement, UHU, Durofix, Ambroid, Randolph's	-55	R limited. S: Ac, EtAc, B.	A. Not generally recommended: tends to yellow and deteriorate. Migration or volatilization of plasticizers results in severe shrinkage, potentially damaging objects. Reactive with some metals. May yellow.
		HMG (H. Marcel Guest)	-55	R: good S: aliphatic/aromatic.	Maintains solubility over time if used as directed.
		CN and alkyd resins	Glyptal (Canadian General Electric Co)	-55	R: fair to good. S: Ac, CGE Thinner
CYANOACRYLATES [POLY(ALKYL 2-CYANOACRYLATE)]	95-100% ethyl cyanoacrylate 60-100% ethyl cyanoacrylate (viscosity varies with %age of ethyl cyanoacrylate and poly(methyl methacrylate))	Hot Stuff (Satellite City) PaleoBond (Uncommon Cong.) Zap (Pacer Technology); "superglues"	Varies	R poor. S: Nitromethane (Super Solvent); acetone/nitrite (PB-400); diethylformamide; dimethyl sulfoxide.	A/C. Use for geological materials began in 1980s. Quick drying time; good ease of use. Bonds can be undone with solvents with difficulty; can be removed mechanically if still tacky. Problems with hardeners. Brittle failure possible. Limited use. Severe degradation under alkaline conditions. May weaken under UV. Accelerators highly unstable.
EPOXY RESINS	Epoxide resin plus hardener	Araldite (Ciba Geigy) also Abelbond, Devcon, Epo-Tek, Hxtal, Devcon		R: non-reversible. S: Epoxy disintegrators (methylene chloride and methanol mixture).	A. Used mainly in mineralogy when optical properties are important and reversibility may not be a consideration. Disintegrators unstable.

¹ Other supplied names: HMG B72 adhesive, Conservation Adhesive (after Koob)

POLY(ETHYLENE GLYCOL)	Many molecular weights. Higher numbers tend toward more waxy/solid characteristics.	Carbowax, PEG		R very limited. S: H ₂ O. Some molecular weights may be removable mechanically.	C for bone and wood. Used in preparation of damp material.
POLYURETHANE RESIN SYSTEMS		Ureol systems (Ciba Geigy)		R: non-reversible.	Little used as C; supporting material in paleontology coatings and A. Tends to hydrolyze, brown, and become insoluble.
POLY(VINYL ACETAL)		Alvar 1570 (UK, 17/20 (US)		R medium to good. S: Ac, diacetone alcohol, IMS	A/C widely used in paleontology.
POLY(VINYL ACETATE) [PVAC] RESIN	vinyl acetate homopolymer	Mowilith (Hoechst) Vinac range B-15 B-25 Vinylite (Union Carbide) AYAA AYAF AYAC Gelva	16-27 21 24 16	R medium to good. S: Ac, EtOH, T, X.	A/C. Easy to manipulate physical properties by varying solvent systems. Can be reversed as both adhesive and consolidant. Good long-term aging: not prone to cross-linking. May be incompatible with methacrylates in solution. Relatively unaffected by light.
POLY(VINYL ACETATE)-COPOLYMER EMULSION	vinyl acetate/dibutyl maleate	Vinamul Mowilith DM427 (Hoechst) Jade (Lineco Inc. Ltd). Elvace, Elmer's, CM Bond	5-29	R poor once set. S: H ₂ O (swells); EtOH, Ac (poor)	A/C widely used for fossils. Poor solubility makes subsequent treatment of objects difficult. PVAL often used as emulsifier. Not usually recommended for any use in this field.
POLY(VINYL ALCOHOL) [PVAL]		range of suppliers		R good if not cross-linked. S H ₂ O.	Separator, label A, surface C. Poor stability. Becomes insoluble over time.
POLY(VINYL BUTYRAL)	terpolymer of poly(vinyl butyral), poly(vinyl alcohol), and poly(vinyl acetate)	Butvar (Monsanto) B98 B76 B72 Mowital (Hoechst) B30H, B60H Rhovinal B	-65 48-55 -65	R medium to good. S: Al. S: Ac, K. R medium to good. S: Al.	A/C widely used in paleontology. Different grades have different usefulness in this field. B-76 and B-98 appear to be the most popular. Good consolidant. Does not seem to shrink or discolor over time.
POLY(VINYLDENE CHLORIDE) [PVDC]		Saran			C: bone consolidation.
SHELLAC	complex substance from insect secretions and associated plant materials.	Shellac, French polish	-40	R good unless cross-linked. S: Al unless cross-linked, Ac (fair). Very hard to remove mechanically.	Use as a geological specimen coating and consolidant began in 1860s. Darkens. Not recommended for any use in this field. Hydrolyzes. Cross-links rapidly at elevated temperatures and at room temperature.
SOLUBLE NYLON	N-methoxymethyl Nylon	Catalon (ICI) Elvamide 8063 (DuPont)		R: Non-reversible. S: Al.	Widely used on stone in the 1970s; some use in paleontology. Now definitely not recommended.

SOLVENT KEY: Ac: acetone; Al: alcohols in general; B: butyl acetate; CCl₄: carbon tetrachloride; EtAc: ethyl acetate; EtOH: ethanol; Gly: glycol; H₂O: water; IMS: denatured ethanol (industrial methylated spirit); K: ketones in general; MEK: methyl ethyl ketone; T: toluene; W: white spirit; X: xylene