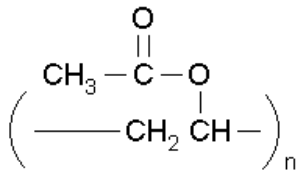
POLYVINYL ACETATE

SYNONYMS

Polyvinyl acetate homopolymer, Acetic acid ethenyl ester.
76 Res, ASB 516, AYAA, AYAF, AYJV, Acetic acid ethenyl ester, homopolymer, Acetic acid vinyl ester, polymers, Asahisol 1527, Bakelite AYAA, Bakelite AYAF, Bakelite AYAT, Bakelite LP 90, Bond CH 1200, Bond CH 18, Bond CH 3, Booksaver, Borden 2123, Cascorez, Cemedine 196, Cevian 380, Cevian A 678, D 50, D 50 (Polymer), D 50 M, DCA 70, Danfirm, Daratak, Duvilax, Duvilax BD 20, Duvilax HN, Duvilax LM 52, EP 1208, EP 1436, EP 1437, EP 1463, Elmer's Glue All, Elvacet 81-900, Emultex F, Encor, Esnil P 18, Ethenyl acetate homopolymer, Everflex B, Formvar 1285, Gelva, Gelva 25, Gelva CSV 16, Gelva GP 702, Gelva S 55H, Gelva TS 22, Gelva TS 23, Gelva TS 30, Gelva TS 85, Gelva V 100, Gelva V 15, Gelva V 25, Gelva V 800, Gohensil E 50Y, Gohsenyl E 50 Y, HSDB 1250, Kurare OM 100, Lemac, Lemac 1000, Meikatex 5000NG60, Merckogel OR, Merckogen 6000, Mokotex D 2602, Polyco 117FR, Polyco 2116, Polyco 2134, Polyco 953, Polyfox P 20, Polyfox PO, Polysol 1000, Polysol 1000AX, Polysol 1200, Polysol PS 10, Polysol S 5, Polysol S 6, Polyvinyl acetate, Polyvinyl acetate resin, Protex (polymer), R 10688, RV225-5B, Raviflex 43, Resyn 25-1014, Resyn 25-1025, Rhodopas, Rhodopas 010, Rhodopas 5000SMR, Rhodopas 5425, Rhodopas A 10, Rhodopas AM 041, Rhodopas B, Rhodopas BB, Rhodopas HV 2, Rhodopas M, S-Nyl-P 42, SP 60, SP 60 (Ester), Sakunol SN 08, Soloid, Soviol, TS2, Toabond 2, Toabond 40H, Toabond 6, UK 131, Ucar 130, Ucar 15, V 501, VA 0112, Vinac, Vinac ASB 10, Vinac B 7, Vinac RP251, Vinacet D, Vinalite D 50N, Vinalite DS 41/11, Vinamul 9300, Vinapol A 16, Vinipaint 555, Vinnapas B, Vinnapas B 100, Vinnapas B 17, Vinnapas UW 50, Vinyl Acetate, Homopolymer, Vinyl acetate homopolymer, Vinyl acetate polymer.

CHEMICAL STRUCTURE



CHEMICAL FORMULA

$(C_4H_6O_2)_n$

IDENTIFIER DETAILS

CAS Number	:	9003-20-7
CoE Number	:	
FEMA	:	
EINECS Number	:	
E Number	:	

CLP CLASSIFICATION

Ingredient CLP Classification: No

Endpoint	Classification	Category
Acute Oral Toxicity	-	-
Acute Dermal Toxicity	-	-
Acute Inhalation Toxicity	-	-
Skin Corrosive/irritant	-	-
Eye Damage/Irritation	-	-
Respiratory Sensitisation	-	-
Skin Sensitisation	-	-
Mutagenicity/Genotoxicity	-	-
Carcinogenicity	-	-
Reproductive Toxicity	-	-
Specific Target Organ Toxicity	-	-
Aspiration Toxicity	-	-

SPECIFICATIONS

Melting Point: 35^{o}C [Chemfinder, 2002]

Boiling point:

PURPOSE

Flavouring substance.

STATUS IN FOOD AND DRUG LAWS

CoE limits:

Beverages (mg/kg)	Food (mg/kg)	Exceptions (mg/kg)
-	-	-

Acceptable Daily Intake:

ADI (mg/kg)	ADI Set by	Date Set	Comments
-	-	-	

FDA Status:

Section Number	Comments
172.615	Food additives permitted for direct addition to food for human consumption - Chewing gum base.
a)175.300 & b) 175.320 176.170	a) Resinous and polymeric coatings, b) Resinous and polymeric coatings for polyolefin films. Components of paper and paperboard in contact with aqueous and fatty foods.

177.1200 181.30	Cellophane Substances used in the manufacture of paper and paperboard products used in food packaging.

HUMAN EXPOSURE

Reported Uses: As adhesives and binders for water based or emulsion paints [HSDB, 2002]. Also used in polyethylene-polyvinylacetate copolymers used to manufacture mouth guards [Kleog & Collys, 2003] and has been trialled in the production of time release pharmaceuticals [Bordaweka *et al.,* 2006].

TOXICITY DATA

In Vivo Toxicity Status

Administration of a single dispersion of PVA 15g/kg (rats) and 20 g/kg (mice) did not result in death [Sheftel, 1990]. However the single oral administration of 25 g/kg/bw to rats and mice was reported to produce lymphoid infiltration of the liver, epithelial dystrophy of the kidney and a slight increase in the number of polynucleated cells in the spleen [HSDB, 2002].

A study in which 25g/kg of PVA was administered orally to rats and mice (as a single dose) revealed lymphoid infiltration of the liver, depigmented epithelial cells of the renal tubes and a small increase in the number of polynucleated cells in the spleen [Final report on the safety assessment of polyvinyl acetate, 1992].

PVA (250mg/kg) was administered orally to rats and mice for a period of 12 months. Subsequent changes were then observed in animal body weight, blood composition and liver-to-bodyweight ratios. Alterations in cholinesterase and catalase were also noted (exact details of these changes were not given) [Final report on the safety assessment of polyvinyl acetate, 1992].

No observed toxic effects were noted in animals administered cheese (surface coated with PVA) in doses of 20 g/kg rats and 40 g/kg (mice) for 1 year [Sheftel, 1990].

Species	Test Type	Route	Reported Dose
Mouse	LD_{50}	Oral	>25,000mg/kg
Rat	LD_{50}	Oral	>25,000mg/kg [ToxNet, 2010]

Carcinogenicity and Mutagenicity

An unspecified amount of PVA was implanted (unknown route) into 100 Wistar rats and 100 mice (unspecified strain), no sarcoma's were observed 16-20 months after implantation [IARC Monographs, 1979].

A study in which 96 rats were exposed 6 h/day 5 days/ wk to vinyl acetate at a concentration of 8750 mg/m^3 for 1 year (observed until death) revealed that exposure did not influence the incidence of neoplasms [Final report on the safety assessment of polyvinyl acetate, 1992].

The peripheral blood lymphocytes of 27 workers involved in PVA production in comparison with the blood lymphocytes of 20 workers in non-chemical production was shown to have a higher number of chromosome breaks/100 cells. A three year study to monitor any changes in aberrant metaphase chromosomes /100 between these two groups of workers did not detect any changes [Shirinian and Arutyunyan, 1980].

Dermal Toxicity

0.1 ml of 1.25 % solution PVA (in ethanol) was administered onto the shaved posterior of 25 albino rats to assess the irritation potential of PVA. Twelve negative (vehicle treated) controls, and 24 positive (carrageenin) controls were also included into the study. Two rats from the negative, and 4 from the positive control and 4 from the test groups were sacrificed on days 3, 7, 14, 28 and 42. Injection sites were then removed for microscopic evaluation results and results were as tabulated below [Final report on the safety assessment of polyvinyl acetate, 1992].

Day of sacrifice [post injection]	Visual effects
3	Moderate inflammatory infiltrate, lymphocytes and plasma cells present. Ulceration with edema and tissue destruction.
7	Animals retained PVA surrounded by severe inflammatory response. Ulceration, abscess formation and necrosis [present in virtually all tissue samples]. Many lymphocytes and plasma cells also present.
14	Inflammatory response reduced in severity, but many lymphocytes and plasma cells still present. Many areas of granulation with many points of necrosis with ulceration.
21	Moderate inflammatory response with many inflammatory cells and granulation tissue.
28	Minimal inflammatory response, cicatrisation and early mutation of collagen fibrils.
42	Inflammatory response minimal, epithelium intact, with normal cicatrisation of the dermis.

The PVA response was similar to that of the carrageenan positive control until day 14 however, after this time period the PVA response was reduced in comparison with the positive control (as the carrageenan treated animals showed granuloma formation, which was not seen in the PVA treated animals).

PVA as used in the cosmetics industry was shown to contain < 50% PVA less than 2 ppm arsenic and <20 ppm of heavy metal. Clinical testing of PVA emulsions containing 50 % PVA revealed no irritation or sensitisation and has been deemed 'safe' for usage in cosmetics [Final safety assessment of polyvinyl acetate, 1996].

PVA was reported to cause a moderate inflammatory reaction on subcutaneous injection into rats. The reaction was reported to peak at day 7 and be minimal at day 42. The histological appearance of the hamster cheek pouch was not reported to be significantly altered from topical application to pouches [HSDB, 2002].

54 female volunteers took part in an occlusive skin irritation study. 0.05 ml of aqueous PVA solution (50% conc.) was placed on a plaster and applied to the forearm (24h). On removal of the plaster the skin response was scored on a six-point scale. All 54 volunteers had no reaction [Final safety assessment of polyvinyl acetate, 1996].

In an Insult patch test 0.3 ml PVA (aqueous solution 50% conc.) was applied to the back of 133 females and 26 males volunteers (aged 16-65). The patch was left on for 24 h and removed for 24 h until there had been 9 applications of PVA (48h left between application of the patch at weekends). Of the volunteers that completed the study none reported any irritation or allergic sensitisation [Final safety assessment of polyvinyl acetate, 1996].

In vitro and *in vivo* characterisation of a beta blocker transdermal drug delivery system comprising of Eudragit RL-100 and polyvinyl acetate (2:8, 4:6, 6:4 & 8:2) was conducted. All systems also contained metoprolol tartrate (10% w/w) dibutylphalate (5% w/w) and (±) menthol in dichloromethane:isopropyl alcohol (80:20 v/v). Cumulative drug release (in 48hrs) was: 79.16, 81.17, 85.98 and 95.04% and drug permeation 59.72, 66.52, 77.36 and 90.38%. The drug delivery system containing the 8:2 ratios produced no skin irritation and a significant reduction in blood pressure in methyl prednisolone induced hypertensive rats [Aqil *et al.,* 2004].

Reproductive and Developmental Toxicity

A study in which the long-term effects of chronic poisoning with an un-plasticized [PVA dispersion] and a plasticized PVA dispersion (with up to 15 % dibutylphthalate), was studied in male rats revealed that rats given 120 mg/kg (PVA) in aqueous solution in their food (for eleven months) and subsequently paired with 11 females revealed no changes in the length of the pregnancies. Offspring were noted to have no external defects or changes in body weight. Further tests did however reveal that male offspring of plasticised treated animals, had disturbances in orientation responses, with female offspring unaffected [Final safety assessment of polyvinyl acetate, 1996].

Polyvinyl acetate administered i.v to pregnant rabbits (no dose stated and unspecified strain) indicated that polyvinyl acetate was not transferred to the foetus [Final safety assessment of polyvinyl acetate, 1996].

Inhalation Toxicity

Chemical factors have been reported to cause pathological changes in the broncho-pulmonary system of workers exposed to the manufacture of vinyl acetate and its derivatives. Ventilatory disturbances tending to be encountered in the workers rather than chronic bronchitis [Amatuni *et al.,* 1980].

Other Relevant Studies

A study which investigated the histocompatablity of PVA as an ingredient in chewing gum revealed that PVA (1.25 % in ethanol) on injection of two tenths millilitre (quoted from paper could mean 0.2 X10 $^{-3}$ L) of a 1.25 % solution placed into the cheek pouch of Syrian hamsters and repeated twice a week for 6 weeks showed no significant changes on histological examination [Carpenter *et al*., 1976].

PVA has been approved by the FDA as an additive in chewing gum base. It has subsequently been tested as an edible food coating. Hagenmaier and Grohmann, (1999) revealed that PVA coatings (dissolved in 95 % ethanol or isopropanol, containing~30 % PVA solid) had a high gloss (on chocolate and fruit), which was still permeable to oxygen (higher oxygen permeability) and water vapour. Because PVA coated fruit appeared to retain more internal oxygen then resin coatings, it is therefore assumed that PVA coatings would reduce the likelihood of the fruit interior becoming anaerobic and ‘going off. It was therefore concluded that PVA has the potential for use as an ingredient in food coatings and that regulatory approval would possibly be needed to expand on its use as a chewing gum base to other foods [Hagenmaier & Grohmann, 1999].

Extracts of hairspray containing PVE (ester)/PVA were dissolved in isotonic saline and injected subcutaneously (no dose specified) into the scapular area of adult mice, rats and Guinea pigs, control animals were injected with saline. Animals were then sacrificed 4, 10, or 30 days after injection, with injection sites biopsied and samples of liver, spleen and kidneys retained for electron microscopic (EM) evaluation. Strong subcutaneous foreign body reactions with the appearance of granulomas were observed in animals injected with hair spray extracts and with separate PVA or PVC, for 4 and 10 days post-injection. Foreign body reactions consisted of many monocytes, large macrophages, multinucleated giant cells with periodic acid-schift (PAS) positive inclusions, and many foam cells. The Kupffer cells of the liver and the macrophages of the spleen all contained PAS-positive cytoplasmic inclusions [Final report on the safety assessment of polyvinyl acetate, 1992].

Human blood when passed through a column of beads containing PVA as well as other materials (in order to assess if it had any retention properties), was shown not to absorb serotonin from platelet free plasma and did not cause lysis of erythrocytes, however, it was also shown that platelet retention

by PVA increased as sedimentation increased [Amended Final safety assessment of polyvinyl acetate, 1996].

Behavioural data

No data identified

***In Vitro* Toxicity Status**

Carcinogenicity and Mutagenicity

PVA was reported to give a negative Ames test with *S. typhimurium* +/- metabolic activation ([no strains or concentration given). PVA was also observed to give an unresolved result in rodent carcinogenicity tests, [Ishidate *et al*., 1988]. A negative result in clastogenicity studies using CHL cells (fibroblast cell line derived from lung) up to a concentration of 200,000μg/ml (treatment time of 48h), [Ishidate *et al*., 1988] was also reported. A negative Ames test results was also observed with *S. typhimurium* (strains TA92, TA94, TA98, TA100, TA135, TA137, solvent acetone), at a maximum dose of 5 mg/plate [Ishidate *et al*., 1984].

In vitro chromosome aberration studies using a Chinese hamster fibroblast cell line revealed an incidence of polyploidal cells (at 48h) to be 2%. The researchers reported this as a negative result. The incidence of structural aberrations at 48 hr was also shown to be zero, therefore indicating that PVA was negative for both gene mutation and chromosomal aberrations in this study [Ishidate *et al*., 1984].

Chromosome aberrations were reported in workers at a polyvinyl acetate production plant however, the researchers reported that ‘an evaluation of this study was not possible’ [BUA abstract, 1994].

Additional information concerning the *in vitro* mutagenicity of this material may be found in “An Interim report on data originating from Imperial Tobacco Limited’s Genotoxicity testing programme September 2003” or “An updated report on data originating from Imperial Tobacco Limited’s external Genotoxicity testing programme – Round 2 August 2007”.

A toxicological evaluation by Coggins et al., (2013) of ethylene vinyl acetate, polyvinyl acetate and starch tested varying levels of the different side-seam adhesives and the transfer of adhesives from packaging materials using experimental cigarettes. Levels were determined by the number of lines of adhesive applied to the cigarette paper; high application levels (three lines of adhesive) were compared with low application levels (one line of adhesive).
There were differences in some mainstream cigarette smoke constituents as a function of the level of adhesive added to experimental cigarettes and between the tested adhesives. None of these differences translated into statistically significant differences in the *in vitro* or *in vivo* assays. Newer "high-speed-manufacture" vinyl acetate-based adhesives can therefore replace the older "low-speed-manufacture" adhesives in cigarettes.

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