CELLULOSE ESTERS

Coatings Chemicals

Eastman Cellulose Acetate Butyrate CAB-531-1

CAB-531-1 is a cellulose ester with a higher butyryl level than CAB-381 type esters. Tough films with good resistance to marring and weathering are possible through combinations of cellulose acetate butyrate resins with thermoplastic acrylic resins. CAB-531-1 exhibits good compatibility with a broad range of thermoplastic acrylic resins and with some thermosetting acrylic resins. CAB-531-1 resembles the CAB-381 esters in hydroxyl content and solubility characteristics, being soluble in a wide range of solvents. With its higher butyryl content, CAB-531-1 is a more flexible resin requiring lower plasticizer modification than CAB-381 esters.

Because of its melting range (135° to 150°C), CAB-531-1 can be useful as a component in powder coatings. The dry, free-flowing characteristic of CAB-531-1 is carried through into powder formulations, reducing the tendency of powders made from lower T_g resins to cake or agglomerate. The relatively narrow melting range of this ester permits rapid fusion and good flowout of electrostatically applied powder formulations. In addition, the dispersion of pigments in CAB-531-1 can be efficiently accomplished by two-roll milling to produce clean, easy-to-handle chips.

High clarity films can be produced with CAB-531-1 in low-cost alcohol-aromatic hydrocarbon solvent blends. The films have good ultraviolet light stability and maintain their low color for long periods of time. Unmodified films have tensile strength of about 5,000 psi (352 kgf/cm^2) and good flexibility.

For convenience and ease of handling, CAB-531-1 is shipped as a dry, free-flowing powder. Typical properties are shown in Table 1.

Table 1

Typical Properties[a] of CAB-531-1

Butyryl content, avg. wt %	50
Acetyl content, avg. wt %	2.8
Hydroxyl content, avg. wt %	1.7
Viscosity, sec[b]	1.5
Viscosity, poises[b]	5.6
Color, ppm[c]	50
Haze, ppm[c]	15
Free acidity, as acetic acid, wt %	0.02
Ash, % max.	0.05
Refractive index	1.475
Heat test (160°C for 8 h)	Tan melt
Melting range, °C (°F)	135–150 (275–302)
T_g, °C	115
Specific gravity	1.17
Weight/volume (cast film)	
lb/gal (U.S.)	9.75
kg/L	1.17
Bulk density, as poured	
lb/ft^3	30
kg/m^3	480
Bulk density, tapped	
lb/ft^3	36
kg/m^3	576
Dielectric strength	
kV/mil	2.0–2.5
kV/cm	787–984
Molecular weight, $\overline{M}_n$[d]	40,000

[a] *Properties reported here are typical of average lots. Eastman makes no representation that the material in any particular shipment will conform to the listed properties.*

[b] *Viscosity determined by ASTM Method D-1343 in the solution described as Formula A, ASTM Method D-817. Viscosities in poises converted to ASTM seconds equivalent to values obtained under ASTM Method D-817.*

[c] *Determination of color and haze made on CAB solutions using Pt-Co standard (color) and a monodisperse latex suspension (haze). Analysis performed with a* Gardner *Model XL-835 colorimeter.*

[d] *Polystyrene equivalent number average molecular weight determined by using gel permeation chromatography.*

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Solubility

CAB-531-1 is soluble in a wide range of individual solvents and solvent combinations as noted in Table 2. Particularly attractive, from an economic point of view, is the high degree of solubility of CAB-531-1 in alcohol-aromatic hydrocarbon mixtures.

Table 2

Solubility of CAB-531-1

Solvent	Solution Viscosity at 25°C (15% Conc), mPa•s (cP)
KETONES	
Acetone*	180
Methyl Ethyl Ketone (MEK)	229
Methyl n-Propyl Ketone (MPK)*	289
Methyl Isobutyl Ketone (MIBK)*	404
Methyl Isoamyl Ketone (MIAK)*	491
Methyl n-Amyl Ketone (MAK)*	511
Cyclohexanone	2,340
Eastman C-11 Ketone*	2,670
Diisobutyl Ketone (DIBK)*	4,260
ESTERS	
Ethyl Acetate*	444
n-Propyl Acetate*	528
Isopropyl Acetate*	538
Isobutyl Acetate*	638
n-butyl Acetate*	665
Ethylene Glycol Diacetate*	1,420
Dibasic Esters	1,250
Isobutyl Isobutyrate (IBIB)*	3,810
ETHER ESTER	
Eastman EEP Solvent*	1,490
ALCOHOLS	
Diacetone Alcohol	3,690
Tecsol C Anhydrous Ethyl Alcohol*	Insoluble
Tecsol C (95%) Ethyl Alcohol*	Insoluble
GLYCOL ETHERS	
Eastman PM Solvent*	1,310
Eastman DM Solvent*	5,580
Eastman DE Solvent*	4,480
GLYCOL ETHERS *(Continued)*	
Dipropylene Glycol Monomethyl Ether	3,960
Eastman EP Solvent*	1,480
Eastman EB Solvent*	1,840
Eastman EEH Solvent*	Insoluble
Propylene Glycol Monopropyl Ether	Insoluble
GLYCOL ETHER ESTERS	
Ethylene Glycol Monoethyl Ether Acetate	1,460
Eastman PM Acetate*	1,510
Eastman EB Acetate*	1,840
Eastman DE Acetate*	4,020
Eastman DB Acetate*	5,640
MISCELLANEOUS	
Tetrahydrofuran (THF)	312
Dimethyl Formamide (DMF)	1,220
M-Pyrol Solvent	5,060
Mixed Hexyl Acetate Esters	1,700
1,1,1-Trichloroethane	26,900
Heptane	Insoluble
Xylene	Insoluble
BLENDS	
Toluene/*Tecsol* C Alcohol (95%)* (80/20)	169
Tecsol C Alcohol (95%)*/ Ethyl Acetate* (70/30)	524
Toluene/Xylene/*Tecsol* 3 Alcohol (95%)* (60/20/20)	170

**Product available from Eastman.*

Resin Compatibility

CAB-531-1 offers formulators a wide latitude in the selection of resins and modifying compounds. The compatibility of various resins and modifiers with this ester are shown in Table 3. Compatibility may be appreciably altered by the other components of a formulation. To determine the performance of a particular resin or plasticizer, it should be evaluated in a specific formulation.

Table 3

Compatibility of Resins and Other Modifiers With CAB-531-1

	Compatibility[a]				
Resin	**1:4[b]**	**1:1[b]**	**4:1[b]**	**Type of Resin**	**Manufacturer**
Abalyn	C	C	C	Rosin Ester	Hercules
Acryloid A-21-LV[c]	C	I	I	Acrylic	Rohm and Haas
Acryloid AT-51[c]	I	I	I	Thermoset Acrylic	Rohm and Haas
Acryloid B-66[c]	C	C	C	Acrylic	Rohm and Haas
Acryloid B-72[c]	C	C	C	Acrylic	Rohm and Haas
Acryloid B-82[c]	C	C	C	Acrylic	Rohm and Haas
Arochem 404	C	C	C	Modified Maleic	Reichhold
CAB-381-0.5	C	C	C	Cellulose Acetate Butyrate	Eastman
Cellolyn 95	C	C	S	Alkyd	Hercules
CK 2103	C	C	C	Phenolic	Union Carbide
Cymel 300	C	C	C	Hexamethoxymethyl Melamine	Cytec
Elvacite 2008	C	C	S	Acrylic	Du Pont
Elvacite 2009	C	S	S	Acrylic	Du Pont
Elvacite 2010	S	I	I	Acrylic	Du Pont
Elvacite 2013	C	C	C	Acrylic	Du Pont
Elvacite 2042	C	C	C	Acrylic	Du Pont
Elvacite 2044	S	I	I	Acrylic	Du Pont
Elvacite 2045	C	I	I	Acrylic	Du Pont
Elvax 240	I	I	I	Ethylene-Vinyl Acetate	Du Pont
Ethyl Cellulose N-14	C	C	C	Cellulose Ether	Hercules
Genamid 250	I	I	I	Resinous Amine Adduct	Henkel
Hercolyn	I	C	C	Rosin Ester	Hercules
Methylon 75121	I	I	I	Phenolic	General Electric
Nirez 2040 Low Melt	C	C	C	α-Pinene	Arizona Chemical
Resimene 879	C	I	I	Melamine	Monsanto
Resimene 882	I	I	I	Urea-Formaldehyde	Monsanto
RS ½-Sec NC	C	C	C	Cellulose Nitrate	Hercules
SAIB (Sucrose Acetate Isobutyrate)	C	C	C	Sucrose Derivative	Eastman
Staybelite No. 10	C	C	I	Glycerol Ester of Hydrogenated Rosin	Hercules
Sucrose Benzoate	C	C	I	Sucrose Ester	Velsicol
Uformite 21-805	C	C	C	Urea Resin	Reichhold
Uformite 27-802	C	I	I	Melamine	Reichhold
Uformite 27-809	C	C	C	Melamine	Reichhold
VMCH	I	I	I	Vinyl Chloride/Vinyl Acetate	Union Carbide

[a] *Ratings: C = Compatible; S = Slightly Incompatible; I = Incompatible.*
[b] *Ratio by weight of resin, wax, or oil to CAB-531-1 (dry film basis).*
[c] *Available internationally under the trademark* Paraloid.

Plasticizer Compatibility

CAB-531-1 has excellent compatibility with a broad range of plasticizers. Several useful plasticizers, which are compatible with CAB-531-1 at 1:4 and 1:1 ratios by weight of plasticizer to ester, are shown in Table 4.

Table 4

Plasticizers Compatible With CAB-531-1 at 1:4 and 1:1 Ratios by Weight

Plasticizer	Supplier
Eastman DOP [Bis(2-Ethylhexyl) Phthalate]	Eastman
Eastman DOTP	Eastman
Eastman TXIB	Eastman
SAIB (Sucrose Acetate Isobutyrate)	Eastman
Butyl Benzyl Phthalate	Monsanto
Benzoflex S-312	Velsicol
Tricresyl Phosphate	Velsicol

Solution Preparation

In the preparation of cellulose ester solutions, vapors of the organic solvents used represent a potential fire, explosion, or health hazard. Care should be taken to provide adequate ventilation in the mixing area to keep solvent vapor concentrations below the explosive limits. Mixing equipment should be designed to ensure that the temperature of the solvent vapor does not approach the flash point during the mixing cycle. All equipment should be grounded. Appropriate industrial hygiene precautions should be followed as recommended by the manufacturer of the solvent(s).

Mixing cellulose esters in a nonpolar hydrocarbon, such as toluene or xylene, may result in the build-up of static electricity which can cause a flash fire or an explosion. When adding cellulose ester to any flammable liquid, an inert gas atmosphere should be maintained within the vessel. (Refer to NFPA 69, Standard on Explosion Prevention Systems and NFPA 77, Static Electricity). This risk may be reduced by use of conductive solvents in combination with the hydrocarbon or an antistatic additive.

Appropriate industrial hygiene controls for the solvents should be instituted, and appropriate personal protective clothing or devices should be provided.

This material, like most organic materials in powder form, is capable of creating a dust explosion. Refer to NFPA Pamphlet No. 654, *Prevention of Fire and Dust Explosions in the Chemical, Dye, Pharmaceutical, and Plastics Industries*.

Safety Precautions

Information on "Handling Precautions for Cellulose Esters in Formulating Coatings" is contained in Eastman Publication E-241. Material Safety Data Sheets providing safety precautions that should be observed in handling and storing Eastman products are also available on request. You should obtain and review these publications before handling any of these products. If any materials are mentioned that are not Eastman products, appropriate industrial hygiene and other safety precautions recommended by their manufacturers should be observed.

FDA Status

In accordance with food additive regulations published by the United States Food and Drug Administration (FDA), *Eastman* cellulose acetate butyrate is lawful for use in certain food-contact applications subject to any limitations in the regulations listed below:

21 CFR 175.105	Adhesives
21 CFR 175.230	Hot-Melt Strippable Food Coatings
21 CFR 175.300	Resinous and Polymeric Coatings
21 CFR 175.380	Xylene-Formaldehyde Resins Condensed With 4,4′-Isopropylidenediphenol-Epichlorohydrin Epoxy Resins
21 CFR 175.390	Zinc-Silicone Dioxide Matrix Coatings
21 CFR 176.170	Components of Paper and Paperboard in Contact With Aqueous and Fatty Foods
21 CFR 176.180	Components of Paper and Paperboard in Contact With Dry Foods
21 CFR 177.1200	Cellophane
21 CFR 177.1210	Closures With Sealing Gaskets for Food Containers
21 CFR 177.1400	Water-Insoluble Hydroxyethyl Cellulose Film

It is the responsibility of users to determine that *Eastman* cellulose acetate butyrate is safe, lawful, and technically suitable for their intended application. Because of possible changes in the law and in regulations, as well as possible changes in our products, we cannot guarantee that the status of this product will remain unchanged. We, therefore, recommend that customers continuing to use this product verify its status no less frequently than every two years from the date of this publication.

Material Safety Data Sheets providing safety precautions that should be observed in handling and storing Eastman products are available on request. You should obtain and review the available material safety information before handling any of these products. If any materials are mentioned that are not Eastman products, appropriate industrial hygiene and other safety precautions recommended by their manufacturers should be observed.

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