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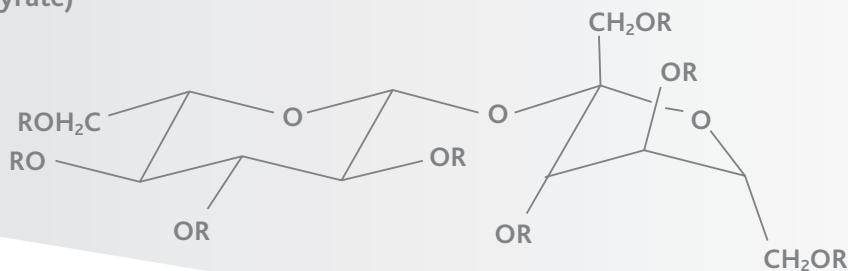


**Eastman Sustane™
and Eastman SAIB**
(sucrose acetate isobutyrate)
for cosmetics and personal care

Contents

Introduction.....	3
Physical properties.....	5
Solubility.....	7
Compatibility.....	8
End-use applications.....	9
Lipstick and other makeup applications.....	9
Nail lacquers.....	9
Other applications.....	9
Regulatory information.....	10
United States.....	10
European Union.....	10
Japan.....	11
CAS numbers.....	11
Packaging and handling.....	11

Eastman Sustane and Eastman SAIB (sucrose acetate isobutyrate)



Where



SAIB offers the following benefits in cosmetics applications:

- Derived from sucrose, a natural sugar
- Excellent solubility and compatibility with solvents, polymers and modifiers
- Low volatility over a wide temperature range
- Increased nonvolatile content while maintaining desired formulation viscosity
- Oil-phase density adjustment and emulsion stabilization for oils in aqueous systems
- Nonyellowing; stable to UV light exposure
- Modification of film former without appreciable loss of film hardness
- Improved adhesion to fingernails and skin
- Increased water resistance of films
- Enhanced gloss

Introduction

Sucrose acetate isobutyrate (SAIB) is a low-odor, thermally stable liquid produced by the controlled esterification of sugar (sucrose) with acetic and isobutyric anhydrides. At 100% concentration, SAIB is extremely viscous. Therefore, low-viscosity blends are available to provide ease of handling.

SAIB is useful in various types of coatings such as lipsticks and nail lacquers. It can provide coatings higher nonvolatile content, resulting in lower solvent requirements and greater coverage (increased film deposition per application). Depending on the other formulation ingredients, film adhesion and gloss may be improved.

SAIB is characterized as a modifying extender for film formers such as nitrocellulose and cellulose esters. At levels up to 15% in some polymers, SAIB has minimal effect on surface hardness. High levels of SAIB provide flexibility and reduce the glass transition temperature of the film former.

Eastman Sustane SAIB, food grade is used as a density adjusting agent in beverages that contain essential flavoring oils. It is mixed with the flavoring oil to increase the density of the oil phase before preparing the oil-in-water emulsion, increasing the stability of the beverage.

Table 1. SAIB products

Product	Blend component ^a	INCI name
Eastman Sustane SAIB, food grade, kosher	None	Sucrose acetate isobutyrate
Eastman Sustane SAIB MCT, food grade, kosher	20% caprylic/capric triglyceride	Sucrose acetate isobutyrate (and) caprylic/capric triglyceride
Eastman SAIB-100	None	Sucrose acetate isobutyrate
Eastman SAIB-90EA	10% ethyl acetate	Sucrose acetate isobutyrate (and) ethyl acetate
Eastman SAIB-90	10% Tecsol™ 3 ^b solvents	Sucrose acetate isobutyrate (and) alcohol (and) methyl alcohol (and) MIBK (and) ethyl acetate (and) heptane

^aThe composition given is typical of average lots.

^bDenatured ethyl alcohol, proprietary formula

Table 2. Applications for SAIB products

Application	Recommended SAIB products	Benefits of SAIB
Lipstick, lip gloss, mascara, foundation, concealer, etc.	Eastman Sustane SAIB MCT Eastman Sustane SAIB	Extended wear, transfer resistance, water resistance
Nail lacquers	Eastman SAIB-90EA Eastman SAIB-90	Chip and scratch resistance, leveling of brush strokes, increased film flexibility, gloss enhancement
Skin creams and lotions	Eastman Sustane SAIB MCT	Increased water resistance
Epilatories	Eastman SAIB-100	Tack, low odor



Physical properties

SAIB has a light color, low odor, low volatility, and good thermal stability. Its color stability in heat and ultraviolet light is also good. Hydrolytic stability is excellent — less than 0.3% hydrolyzed after four days in boiling water. SAIB's tack translates into good adhesion to substrates, including fingernails, skin and hair. If desired, tack can be reduced by other formulation ingredients.

An unusual property of SAIB is its abrupt decrease in viscosity with increased temperature or with the addition of solvents (Figures 1, 2 and 3). Typically, 100% SAIB is heated to about 70°C to facilitate transfer, e.g., pouring or pumping.

Figure 1. Viscosity of Eastman SAIB as influenced by temperature

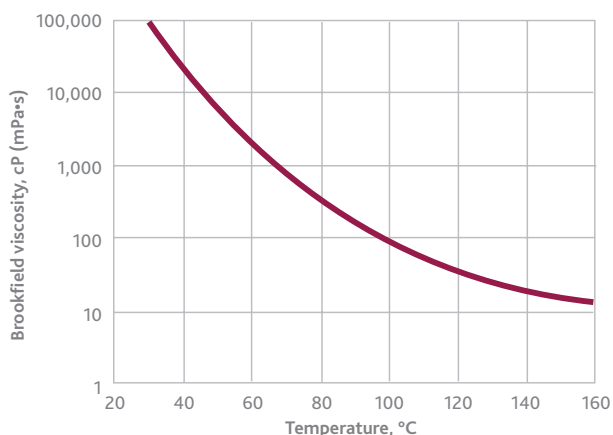


Figure 3. Solution viscosity of Eastman SAIB in ethyl acetate and in ethanol (Brookfield viscosity at 25°C)

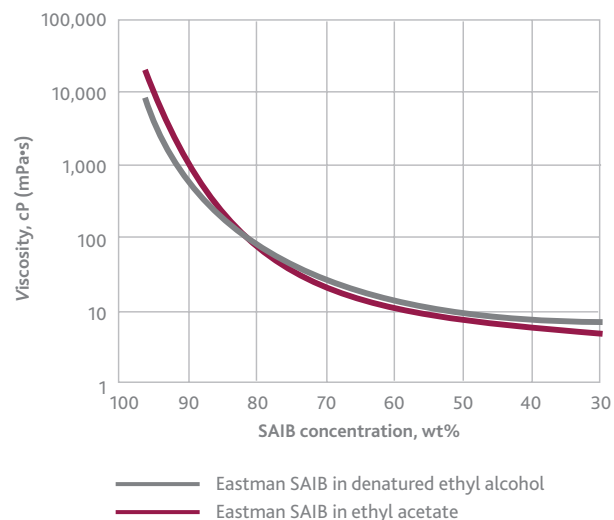


Figure 2. Viscosity of Eastman Sustane SAIB grades when influenced by temperature

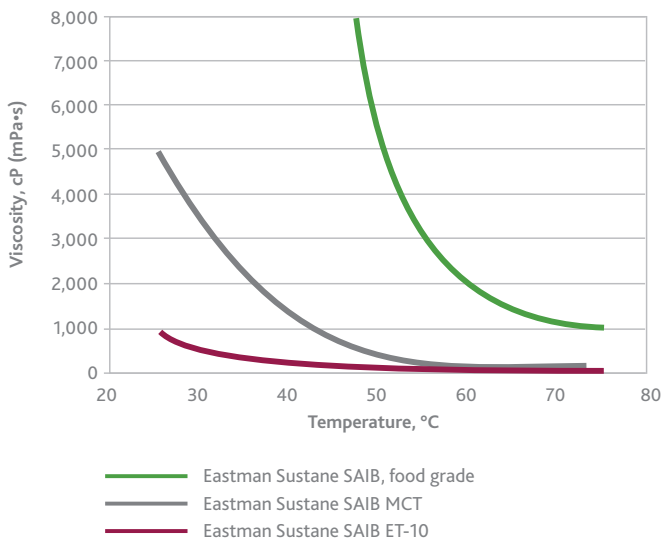


Table 3. Typical properties^a

	Eastman SAIB-100 ^b
Molecular weight	832–856
Specific gravity @ 25°/25°C	1.146
Weight per volume kg/L	1.14
lb/Imperial gal	11.46
lb/U.S. gal	9.55
Flash point, Cleveland open cup, °C (°F)	260 (500)
Solubility in water @ 25°C, wt%	0.1
Appearance	Viscous liquid, free from insoluble matter or haze
Color (Pt-Co scale), max.	200
Color (Gardner scale)	1
Heat test color after 24 hr @ 177°C, Gardner scale, max.	10
Onset of decomposition @ 760 mm, °C (°F) ^c	215 (419)
Haze, (Pt-Co standard) ppm	1
Refractive index, n 20°C/D	1.454
Acid number, mg KOH/g, max.	0.20
Saponification equivalent, g/eq	104–107
Coefficient of thermal expansion (30°–60°C), (cm ³ /cm ³ /°C)	8.6 x 10 ⁻⁴
Surface tension @ 19°C, dynes/cm ²	28
Hydrolytic stability, refluxed in water for 96 hr @ 100°C, wt% hydrolyzed	0.3
Brookfield viscosity ^d @ 30°C, cP (mPa·s)	100,000
Vapor pressure, 20°C, mmHg	<0.00001

Low-viscosity blends	Eastman SAIB-90EA	Eastman SAIB-90 ^b	Eastman Sustane SAIB MCT
SAIB, wt%	90	90	80
Solvent	Ethyl acetate	Denatured ethyl alcohol	Caprylic/capric triglyceride
Acid number, mg KOH/g, max.	0.20	0.20	0.30
Weight per volume kg/L	1.11	1.10	1.10
lb/Imperial gal	11.1	11.0	11.0
lb/U.S. gal	9.3	9.2	9.2
Viscosity @ 25°C, cP (mPa·s)	935	770	5,000
Flash point, Tag closed cup, °C	22	17	> 200
Color (Pt-Co scale), max.	200	200	200
Color (Gardner scale)	1	1	1

^aProperties reported here are typical of average lots. Eastman makes no representation that the material in any particular shipment will conform exactly to the listed properties.

^bFood-grade products are also available (Table 1).

^cDetermined by differential scanning calorimetry in oxygen

^dSee Figure 1.

Solubility

The low solution viscosities listed in Table 4 indicate the excellent solubility of Eastman SAIB in many common solvents. The solubility of SAIB in some widely used propellants suggests a possible use in pressurized aerosol products.

Table 4. Solution viscosity of Eastman SAIB (50 wt% concentration, Brookfield viscosity at 25°C)

Solvent ^a	Viscosity, cP (mPa·s)
Esters	
Amyl acetate	10
<i>n</i>-Butyl acetate	9
Ethyl acetate	8
Ethyl lactate	21
Isobutyl acetate	9
Isopropyl acetate	8
Alcohols	
<i>n</i>-Butyl alcohol	15
Ethyl alcohol	12
Isobutyl alcohol	20
Isopropyl alcohol	14
Methyl alcohol	8
<i>n</i>-Propyl alcohol	14
Glycol ethers and glycol ether esters	
Butoxyethanol (Eastman EB solvent)	21
Ethoxydiglycol (Eastman DE solvent)	22
Methoxyisopropanol (Eastman PM solvent)	11
Methoxyisopropyl acetate (Eastman PM acetate)	8
Hydrocarbons	
Hexane	6
Isododecane	Immiscible
Toluene	9
Ketones	
Acetone	6
Methyl ethyl ketone	6
Methyl isoamyl ketone	10
Methyl isobutyl ketone	8

^aSolvents shown in bold are available from Eastman Chemical Company.



Compatibility

In addition to being soluble in most solvents, SAIB is compatible with a large number of resins, plasticizers, oils and humectants (Table 5). SAIB and each resin, plasticizer or oil were dissolved in a volatile solvent and cast as a film. The solvent was allowed to evaporate at room temperature.

The film was then examined under bright light for evidence of incompatibility. SAIB compatibility with each humectant was determined by mixing SAIB with the humectant and examining the liquid mixture.



Table 5. Compatibility^a of Eastman SAIB with various cosmetic ingredients

Solvent ^b			
Resin (type or INCI name)	SAIB:resin		
	1:4	1:2	2:1
Acrylic	C	C	C
Cellulose acetate	SI ^c	SI	I
Cellulose acetate butyrate	C	C	C
Cellulose acetate propionate	C	C	C
Ethyl cellulose	C	C	C
Nitrocellulose	C	C	C
Polyvinyl acetate	C	C	C
Shellac	C	SI	I
Plasticizer (INCI name)	SAIB:plasticizer		
	1:2	2:1	
Acetyl tributyl citrate	C	C	
Butyl stearate	C	C	
Camphor	C	C	
Dibutyl phthalate	C	C	
Diethyl phthalate	C	C	
Diisobutyl adipate	C	C	
Diethylhexyl adipate	C	C	
Diethylhexyl sebacate	C	C	
Triacetin	C	C	
Trimethyl pentanyl diisobutyrate^d	C	C	
Oil (INCI name)	SAIB:oil		
	1:3		
Castor (<i>Ricinus communis</i>)	C		
Corn (<i>Zea mays</i>) oil	C		
Cottonseed (<i>Gossypium</i>) oil	C		
Linseed (<i>Linum usitatissimum</i>) oil	C		
Mineral oil	I		
Peanut (<i>Arachis hypogaea</i>) oil	C		
Soybean (<i>Glycine soja</i>) oil	C		
Humectant (INCI name)	SAIB:humectant		
	1:3	1:1	
Glycerin	I	ND	
Propylene glycol	I	I	
Dipropylene glycol	C	C	

^aC = Compatible, SI = Slightly incompatible, I = Incompatible, ND = Not determined

^bSolvents shown in bold are available from Eastman Chemical Company.

^cCompatible at 15 wt% Eastman SAIB.

^dEastman TXIB™ formulation additive.

Silicones are desired ingredients in many personal care applications. Their performance benefits can be complemented with SAIB (Table 6). Mixtures are considered compatible if they are clear and homogeneous.

Table 6. Compatibility^a of Eastman Sustane SAIB with silicones^b

SAIB product 10 wt%	Dimethicone 90 wt%	Cyclopentasiloxane 90 wt%	Phenyl trimethicone 90 wt%
Eastman Sustane™ SAIB	I	I	C
Eastman Sustane SAIB MCT	I	C	C
SAIB product 90 wt%	Dimethicone 10 wt%	Cyclopentasiloxane 10 wt%	Phenyl trimethicone 10 wt%
Eastman Sustane SAIB	I	C	C
Eastman Sustane SAIB MCT	I	C	C

^aC = Compatible, I = Incompatible

^bDow Corning Corporation and GE Silicones are suppliers of dimethicone, cyclopentasiloxane and phenyl trimethicone.

End-use applications

Lipstick and other makeup applications

The more polar vegetable waxes, oils and esters commonly used in lipstick formulations are compatible with Eastman Sustane SAIB. In traditional lipsticks, SAIB can improve wear properties by reducing creeping, bleeding and feathering. In transfer-resistant lipsticks, it can act as a plasticizer to soften the primary film former and improve its adhesion and flexibility. The concentration of SAIB used in lipsticks is typically 5–10 wt%.

Nail lacquers

Eastman SAIB's compatibility with a broad range of resins, plasticizers and solvents makes it especially useful in nail lacquers. SAIB can provide the following benefits in this application:

- Reduced volatility
- Pigment dispersion
- Leveling of brush strokes
- Color stability
- Greater coverage per stroke
- Improved film-former flexibility and adhesion
- Chip and scratch resistance
- Gloss enhancement

The low solution viscosity of Eastman SAIB allows excellent flow onto nail surfaces. With proper formulation, a combination of good flexibility and film hardness is possible. The inclusion of 10% to 20% SAIB (based on total solids) in fluid coatings has resulted in improvements in gloss and adhesion.

Other applications

Eastman has filed U.S. Patent Application 2005/0232876 that describes skin care compositions formulated with Eastman Sustane SAIB MCT. The formulations containing SAIB exhibit smoothness and water resistance when applied to the skin.

Eastman SAIB is used in epilatories, taking advantage of its tackiness. Its low odor is often preferred to the odor of other tackifiers typically used in this application.

Regulatory information

United States

Cosmetics and most personal care products are regulated in the United States by the Food and Drug Administration. Unlike foods and drugs, however, regulation of cosmetic ingredients by the FDA is more limited and focuses on specific ingredients and colorants. The industry instead is largely self-regulated through the Cosmetic Ingredient Review (CIR), which was established in 1976 by the industry trade association (then the Cosmetic, Toiletry, and Fragrance Association; now, the Personal Care Products Council) with the support of the FDA and the Consumer Federation of America. Although funded by the council, CIR and the review process are independent from the council and the cosmetics industry. In addition, commonly used cosmetic ingredients are cataloged in the International Cosmetic Ingredient Dictionary and Handbook.

SAIB is listed in the International Cosmetic Ingredient Dictionary and Handbook and has been assigned an International Nomenclature for Cosmetic Ingredients (INCI) name of sucrose acetate isobutyrate. MCT is the subject of a GRAS affirmation petition as a food additive, which the FDA accepted for filing with no limitations on use except those required by good manufacturing practice and has been assigned an INCI name of caprylic/capric triglyceride.

Ethyl acetate (component of SAIB-90 and SAIB-90EA) was reviewed by CIR; the review was published in the "Journal of the American College of Toxicology" Volume 8, Issue 4, 1989. It was determined that ethyl acetate is safe at concentrations in use at the time (>50% in some products). Following are the statuses of some components of SAIB-90. MIBK was reviewed by CIR and is safe as used in nail polish removers and as an alcohol denaturant (IJT 23(S1):29-57, 2004). SD alcohol 3-A was reviewed by CIR and is safe as used up to 5%. Methyl alcohol was reviewed by CIR and is safe for use as a denaturant (IJT 20(S1):57-85, 2001).

The viscosity adjusting solvents ethyl acetate, alcohol and denatured alcohol may be considered incidental additives under 21 CFR 701.3(l) if they are present in the cosmetic at insignificant levels and have no technical or functional effect in the cosmetic. In general, incidental additives are exempt from the requirement that they be declared in the cosmetic ingredient list.

European Union

Sucrose acetate isobutyrate (SAIB), ethyl acetate, ethanol, denatured ethanol and MCT may be used in cosmetics in the European Union member nations. A basic requirement for use in European Union member states is that all components of a cosmetic must be listed in the European Inventory of Existing Commercial Chemical Substances (EINECS): SAIB is listed on EINECS as 204-771-6; ethyl acetate is listed as 205-500-4; ethanol is listed as 200-578-6; methanol is listed as 200-659-6; MIBK is listed as 203-550-1; and MCT is listed as No. 277-452-2. Substances that may not be used, are exempt or have restrictions are included in the listings in the Annex documents to the EU Directive 76/768/EEC and amendments on the approximation of the laws of the member states relating to cosmetic products. This directive sets out a list of substances that cannot be included in the composition of cosmetic products (Annex II) and a list of substances that cosmetic products may not contain outside the restrictions and conditions laid down (Annex III). The directive does not directly address SAIB or the blend components listed above specifically; they are not included in either of the directive's positive or negative lists. The use of SAIB or its low-viscosity mixtures may be subject to a requirement for the cosmetic producer to complete a Product Information Package.

Japan

Under the Japanese Comprehensive Licensing Standards of Cosmetics (CLS 1999), sucrose acetate isobutyrate (listed as sucrose acetate isobutyrate, serial number 2518, ingredient code 502082, standard code 42) may be used in all cosmetic categories except eyeliner preparations (CLS Category 8) with no restrictions other than good manufacturing practices (GMP).

Ethyl acetate may only be used in nail makeup preparations (CLS Category 7) with no other restrictions other than GMP. Both ethanol (serial number 741, ingredient code 001075) and denatured alcohol not designated by the government (serial number 541, ingredient code 507073) may be used in all CLS cosmetic categories with no restrictions other than GMP.

Effective April 1, 2001, a Japanese translated INCI name allows a substance to be used for any application. The translation for sucrose acetate isobutyrate and caprylic/capric triglyceride are available on request.

CAS numbers

SAIB has different CAS numbers depending on the country or region.

CAS number	Country or region
027216-37-1	United States, Latin America
000126-13-6	Europe, Asia
137204-24-1	Canada

Packaging and handling

Eastman Sustane SAIB and SAIB ET-10 food grade are packaged in 208-L (55-gal, U.S.; 45.8-gal, U.K.) closed-head or open-head steel drums. SAIB, food grade, is also available in 19-L (5-gal) open-head steel drums. These drums have been treated with "food-approved"¹ linings. The net weight of each drum is 215.5 kg (475 lb). Eastman SAIB-100, SAIB-90EA, and SAIB-90 are packaged in 208-L (55-gal, U.S.; 45.8-gal, U.K.) drums.

For ease of handling, the viscosity of 100% SAIB products can be reduced by heating drum contents to 60°–70°C (140°–158°F) for a limited amount of time with a drum warmer or steam bath.

¹According to information received from the drum supplier, the drum liner complies with the U.S. food additive regulations with respect to food contact coatings.



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