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Reference Bulletin On:

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AROCLOR RESINS AND PLASTICIZERS FOR HALF-SECOND CELLULOSE ACETATE BUTYRATE (C.A.B.)

May 18, 1954

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HALF-SECOND CELLULOSE ACETATE BUTYRATE

Excerpts from article by W. M. Gearhart and F. M. Ball
Official Digest, Vol. 343, August, 1953

I.

TABLE 1."Properties of Cellulose Acetate Butyrate Type EAB-381

	Half-Second	20-Second
Specific gravity	1.20	1.21
Wt. per gal., lbs.	10.01	10.08
Acetyl content, %	13.00	13.00
Butyryl content, %	37.00	37.00
Refractive index @ 25°C.	1.48	1.48
Resistance to ultraviolet radia.	Excellent	Excellent
Melting range, °C.	140-170	197-204
Intrinsic Visc. @ 25°C. in acetone	0.6-0.8	1.85 "

II.

Solubility of Half-Second Butyrate

"Half-Second Butyrate is soluble in a blend of ethyl alcohol and toluene. However, the main solvents are esters and ketones. Both esters and ketones tolerate high dilution with alcohols and aromatic hydrocarbons. Half-Second Butyrate is somewhat like cellulose nitrate in this respect, but dilution with aromatic hydrocarbons can be carried to very high proportions without precipitation. At a 10% end point, the dilution ratio with acetone is 8.8 using toluene as the diluent. However, the aliphatic hydrocarbons are not effective diluents.

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TABLE 2

Solvent Combinations for Half-Second Butyrate

Ingredient	Composition, Wt. % 1	2	3	4
Acetone	50	20	20	1
Ethyl Alcohol	15	20	55	20
Toluene	15	50	20	79
Methyl Cellosolve	20	--	--	--
Methyl Isobutyl Ketone	--	10	5	--
	100	100	100	100

The selection of a solvent blend must be made with care because the solvent balance influences adhesion and film properties. Four widely different solvent blends which are possible are shown in Table 2.

"When Half-Second Butyrate is dissolved in solvent combination 1, the dried film exhibits very good adhesion to glass, metal, and wood; adhesion of films from combinations 2 and 3 is not as good. However, films made from combination 2 give higher tensile strength, elongation, and tear resistance than those prepared from combination 1 or 3. Combination 4 is for low cost coating compositions. Further studies are being made."

III.

Plasticization of Half-Second Butyrate

"Generally those plasticizers which are used with vinyl copolymers may be used with Half-Second Butyrate. Of the plasticizers studied, castor oil is the most effective in decreasing film hardness and tricresyl phosphate is the least effective. Paraplex G-62, di-2-ethylbutyl phthalate, dibutyl sebacate, and tetrahydrofurfuryl oleate are intermediate in effect."

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IV.

Modification of Half-Second Butyrate by Resins

"Half-Second Butyrate is compatible with acrylics, non-drying alkyds, silicone alkyds, chlorinated hydrocarbons (Aroclors), phenolics, cellulose nitrate, rosin derivatives, Santolite MHP, vinyl acetate, Vinsol, and dewaxed damar."

V.

Formulations Containing Half-Second Butyrate

"Half-Second Butyrate possesses many properties of interest to a lacquer formulator, and preliminary work has shown that it is a versatile raw material. Much work remains to be done in refining formulas that have been made in the laboratory. But to serve those who wish to have basic formulas to start from, the following information is presented.

TABLE 3.

Lacquers for Paper

Ingredient	Composition, Wt. % 1	2	3	4
Half-Second Butyrate	20	20	20	20
Santolite MHP	--	10	--	--
Arocolor 1260	--	--	20	--
Paraplex G-40	3	--	--	3
Acetone	15	10	10	1
Isobutyl Acetate	22	10	10	--
Ethyl Alcohol	10	10	10	17
Toluene	30	40	30	59
	100	100	100	100
Nonvolatile, %	23	30	40	23
Viscosity, cps.	300-500	400-600	500-700	300-500

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"The nonvolatile of lacquer 1 is almost entirely Half-Second Butyrate plasticized with a small amount of Paraplex G-40. The solvent combination can be varied considerably to suit the needs of any particular application. This lacquer produces a slight curl to paper which is dried in individual sheets. The curl can be partially remedied by a change in the solvent combination or by the use of a resin such as Santolite MHP and Aroolor 1260 as in formulas 2 and 3. The second formula yields a film with slightly higher gloss than the first. Formulas 3 and 4 are low cost paper lacquers.

TABLE 4.

Clear Lacquers for Metals
Brass, Steel, Aluminum

Ingredient	Composition, Wt. %	
	1	2
Half-Second Butyrate	15	12
Rezyl 92-5 (60%)	13	--
Plaskon RS-2 (44%)	--	2.25
Acetone	31	16
Isobutyl Acetate	17	20
Ethyl Alcohol	9	10
Butyl Cellosolve	8	9.75
Toluene	7	30
	100	100
Nonvolatile, %	23	13
Viscosity, cps.	80-90	50-70

"It has been found that a high acetone concentration is conducive to good adhesion on metals. However, formula 2 has better all-around adhesion. These lacquers are not affected by a 24-hour immersion in water after the film has dried for three days. The solvent combination can be varied from those shown, but these formulations may be used as starting points.

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TABLE 5.

Wood Lacquer System

	Composition, Wt. %			
	1 Filler	2 Sealer	3 Finish	4 Finish
Half-Second Butyrate	7	14	9	10
Arochem 404	--	--	9	--
Dewaxed damar	--	--	--	10
Aroclor 5460	15	--	--	--
Paraplex G-62	--	--	4.5	--
Asbestine X	45	--	--	--
Acetone	--	41	--	--
Ethyl Acetate	--	--	12	12
Isobutyl Acetate	22	16	13	13
Butyl Cellosolve	--	10	8	10
Ethyl Alcohol	--	9	14	14
Butyl Alcohol	5	--	--	--
Toluene	6	10	17.25	17.75
Xylene	--	--	13	13
Phenyl Salicylate			0.25	0.25
	100	100	100	100
Nonvolatile, %	67	14	22.5	20
Viscosity, cps.	2000	50-75	40-56	40-57

"These formulas represent our first attempts at wood finishes with this particular polymer. Formula 1 shows the use of Half-Second Butyrate in a filler, where good clarity is essential.

"The second formula shows a sealer composed of Half-Second Butyrate as the only film former in a solvent containing a high proportion of acetone. High acetone concentrations have been found to contribute considerably to adhesion on wood. Such a sealer gives slight clogging at two hours with ordinary sandpaper, but with stearated sandpaper it performs very nicely. Zinc stearate has been omitted in an effort to obtain optimum adhesion throughout the system. A top finish high in aromatic hydrocarbon content will, for the reasons mentioned under the section on solubility, benefit the sealer. The third formula shows a finish that gives good resistance to water and 60-proof alcohol, gives a Sward hardness of 18 at two hours and 40 at 24 hours, has moderately good cold check resistance, and rubs well after drying overnight.

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"The fourth formula is a result of the observation that dewaxed damar gave good tensile strength and elongation. A finish was prepared without plasticizer and applied to a maple panel. This panel was subjected to a wear test on an interior hall floor. It was the only one of a series of lacquers that retained its high gloss after six months of wear. The integrity and color of the film were also very good after this exposure.

TABLE 6.

Lacquers for Plastics

	Composition, Wt. %				
	1	2	3	4	5
Half-Second Butyrate	5	5	5	4.5	5
Acryloid B-72 (100%)	--	--	--	4.5	--
Acetone	19	19	19	18	28
Toluene	--	--	19	--	57
Butyl Cellosolve	76	--	57	73	--
Diacetone alcohol	--	76	--	--	--
Ethyl alcohol	--	--	--	--	10
	100	100	100	100	100
Nonvolatile, %	5	5	5	9	5
Viscosity, cps.	13	12	10	14	14
Surface	Acrylic and phenolic resins	Cello-phane	Cellulose nitrate	Cel. Acetate, poly-styrene, poly-cellulose acetate butyrate	Cel. Ace. acrylic poly-styrene, cellu-lose nitrate

"Applications on plastics include polishing, protection, decoration, and silk screening. For decoration and silk screening, pigmentation and increased concentration of nonvolatile ingredients are required. Half-Second Butyrate adheres well and gives glossy films on acrylic and phenolic resins, using a solvent combination consisting of acetone and Butyl Cellosolve. On cellophane, better adhesion is obtained by replacing Butyl Cellosolve with diacetone alcohol. The addition of a small amount of toluene to the first lac-

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quer permits application on cellulose nitrate. In order to get satisfactory results on cellulose acetate, cellulose acetate butyrate, and both high- and low- impact polystyrene, it was necessary in formula 4 to use Acryloid B-72. No doubt some variation in solvent combination can be made, (see formula 5) but these formulations can be used successfully.

TABLE 7.

Heat-Sealing Adhesives

Ingredient	Composition, Wt. % 1	2
Half-Second Butyrate	10	10
Vinyl Acetate (AYAA)	15	--
Vinsol	--	15
Acetone	40	40
Isopropyl alcohol	10	10
Toluene	15	15
VM and P naphtha	10	10
	100	100
Nonvolatile, %	25	25
Viscosity, cps.	40-50	30-38

Behavior of Coated Paper to Uncoated Paper

Blocking temperature (1 psi., 24 Hr.)	Over 175°F.	130°F.
Heat-sealing property (200°F., 50 psi., 5 sec.)	Very good	Very good

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"The first adhesive is water white and of high quality, whereas the second is colored brown and is of the low-cost type. The Half-Second Butyrate serves to reduce the blocking tendencies of vinyl acetate without interfering with its heat sealing properties. The blocking temperature of the second adhesive may be raised by increasing the Half-Second Butyrate content. Other modifying resins useful in this application are Abalyn, Flexalyn C, Newport V-40, Neolyn 40, Paraplex G-40, Heresite RO-88, and Santolite MHP.

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TABLE 8.

Melt Coating for Paper and Cloth*

Ingredient	Wt. %	Wt. %
Half-Second Butyrate	60	50
Dioctyl phthalate	39.9	9.9
Aroclor 1260	--	40
Ionol	0.1	0.1
	100	100

*Applied at 350°F.

"These coatings have extremely good flexibility. They may be prepared by heating the plasticizer to 350°F., then adding the Half-Second Butyrate with agitation. The melt coating may be applied by a knife and rolled smooth if desired. This application requires no solvent, and it is possible to apply films of almost unlimited thickness. To prevent development of color and odor, the melt should be kept hot for as short a time as possible. Such a melt coating may be pigmented for exterior exposure. For such use, it is suggested that phenyl salicylate and Ionol be incorporated, as shown in Table 9. The former absorbs radiation, and the latter acts as an antioxidant.

TABLE 9.

Melt Coating for Fiberboard*

Ingredient	Wt. %
Half-Second Butyrate	30.0
Dioctyl phthalate	20.0
Asbestine X	40.0
Ti Pure R-110	9.6
Phenyl salicylate	0.3
Ionol	0.1
	100.0

*Applied at 350°F.

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"Half-Second Butyrate also has possibilities in quick-gelling lacquers automotive finishes, alkyd varnishes, and hot-spray lacquers. Tests are already in progress on these applications and this information will be published as soon as possible."

VI.

Summary

"Half-Seoond Butyrate overcomes the obstacles of viscosity and adhesion which held back other medium butyryl esters. It dissolves quickly, has good clarity, is light stable, and has good film properties. It is soluble in esters and ketones, although a blend of 80 toluene and 20 ethyl alcohol will also dissolve it. Generally, those plasticizers used with vinyl copolymers may be used with it. It is compatible with many coatings resins.

"Half-Second Butyrate is a versatile raw material. It can be used to prepare lacquers for paper, metal, wood, and plastics; heat sealing adhesives; and melt coatings."

*****End of Bulletin*****

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