



PAROIL 54-NR

FLAME RETARDANT PVC PLASTISOL ADHESIVE PAROIL 54-NR, CHLORINATED ALKANE, AS CO-PLASTICIZER

Alternate methods are available for flame retarding flexible polyvinyl chloride laminates. Conventional techniques are directed toward flame retarding the formulated polyvinyl chloride. The laboratories of Dover Chemical Corporation have developed a method of choice in which the adhesive used in a typical vinyl to nylon scrim laminate is flame retarded by chlorinated alkane, thereby eliminating the use of flame retarded polyvinyl chloride and providing a cost saving to the processor. Flame retardancy of the adhesive can also be achieved with phosphate esters but a considerable formulation cost advantage is obtained by the use of chlorinated alkane and appropriate synergists.

Paroil 54-NR, a Dover Chemical product containing 54% chlorine, was evaluated as a flame retarding co-plasticizer for use in plastisols as adhesives. The plasticizer level was higher than that generally used in plastisols, partly due to the thixotropic behavior of the synergists and partly due to the end-use requirement of the product.

The data in Table I establishes that partial replacement of DOP by **Paroil 54-NR**, keeping the same level of Sb_2O_3 , (Columns 1 and 4) will give better flame retardancy and equal physical properties at a slightly higher cost. However, by replacing a portion of the DOP with **Paroil 54-NR**, the level of Sb_2O_3 can be reduced as shown by Column 3. The level of Sb_2O_3 can be lowered from 15 to 10 parts to give a product with improved flame retardancy, better physical properties and at a reduced cost.

Formulation 1 was used as a control in a viscosity study; plastisol viscosities were taken with a Brookfield viscometer using a #4 spindle at 20 rpm and at $23 \pm 1^\circ\text{C}$. Viscosities were obtained after 6 hours, 1, 2, 5, 10, 15, 21 and 28 days. Results are reported in Table II and plotted in Graph 1.

TABLE I
PLASTISOL FORMULATIONS

Additive	1	2	3	4
PVC	125	125	125	125
DOP	125	100	100	100
Paroil 54-NR	--	50	50	50
Antimony Oxide	15	5	10	15
Alumina Trihydrate	25	25	25	25
Molybdenum Oxide	--	5	--	--
Stabilizer	2	2	2	2
Flame Retardancy				
UL-94	V-O	V-O	V-O	V-O
Oxygen Index (ASTM D-2863-70)	25.5	27.3	26.8	27.5

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Additive	1	2	3	4
% Smoke, Arapahoe	13.8	9.9	13.5	12.5
Physical Properties*				
Shore A-2 Hardness	52	47	45	45
Specific Gravity	1.262	1.356	1.290	1.302
Tensile (psi)	182	622	340	166
% Elongation (at break)	72	229	138	68
Raw Material Cost, \$/lb.	\$0.394	\$0.388	\$0.364	\$0.387
Pound-Volume Cost	0.497	0.526	0.470	0.504

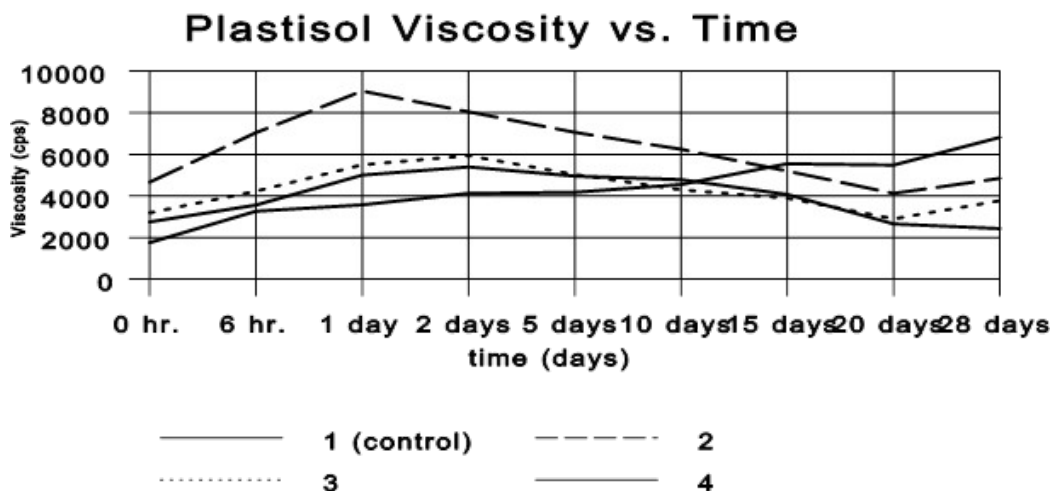
*The plastisols were molded in a cavity mold at 325°F. for 5 minutes; test bars were cut from the molded plaques. Test plaques were 1/8" thick.

TABLE II
PLASTISOL VISCOSITIES* VS. TIME

Formula	0 hr.	6 hr.	1 day	2 days	5 days	10 days	15 days	20 days	28 days
1 (control)	1750	3260	3570	4120	4170	4550	5550	5480	6820
2	4660	7040	9040	8050	7060	6250	5200	4120	4850
3	3190	4230	5500	5940	5030	4300	3900	2900	3770
4	2750	3560	5000	5390	4950	4780	4070	2650	2430

Brookfield Viscometer, #4 Spindle, 20 rpm at 25°C.
Plastisols were not mixed after initial formulation.

GRAPH I



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Typical Properties	Paroil 54-NR
Chlorine, Wt. %	54
Specific Gravity, 25°C/25°C	1.28
Viscosity, poise/25°C	20
Color, Gardner	1
Thermal Stability, % HCl 4 hrs. @ 175°C	0.1

Raw materials	Source
Paroil 54-NR	Dover Chemical Corp.
PVC	ICC Industries Inc.
DOP	Ashland Chemical
Antimony Oxide	ICC Industries
Alumina Trihydrate	Akron Chemical Co.
Molybdenum Oxide	Amax-Climax Molybdenum Corp.
Stabilizer	
Calcium Stearate	Fisher Scientific Co.

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