PARALOID™ KF-710

Gloss Control Agent for Polymer Systems

PRODUCT DESCRIPTION

PARALOID™ KF-710 gloss control agent is a unique acrylic polymer designed to provide gloss control in Vinyl products, both rigid and flexible, and in other polymer systems. Processing thermoplastic resins normally produces surfaces with a high gloss, but low gloss is preferable in many applications. Processes can be designed to give products with reduced gloss by mechanical techniques, operation at lower temperature, incorporation of inorganic pigments, or a combination of these.

Though these methods may control gloss, they may at the same time limit output rate and restrict flexibility in operations and can often severely impair the physical properties of Vinyl products. Incorporation of PARALOID KF-710 gloss control agent, however, offers a simple economical means of gloss control without affecting processing operations or sacrificing physical properties.

The advantages of using this polymer as an additive in Vinyl polymers and in other systems are:

Effect On Surfaces

Economical Gloss Reduction: Gives low gloss using low levels (1-5 phr) of additive

Stable Gloss Control: Gives effective gloss control; unchanged by thermoforming or other subsequent processing

Reduced Blocking: Lower blocking in flexible Vinyl products

Increased Slip: Decreases coefficient of friction and provides "dry hand"

Effect on Processing

Efficient Production: Permits manufacture of products having different gloss levels without interrupting operations or changing equipment

Increased Output: Allows higher output rates in calenders and extruders without "glossing"

Versatile Formulation: Controls gloss in rigid and flexible Vinyl with clear (frosted) and pigmented formulations

Versatile Processing: Effective in all mixing and manufacturing procedures, except for plastisol processing; Can be incorporated by low shear methods

Effect on Processing

At the recommended low levels, PARALOID KF-710 gloss control agent shows little or no impairment of thermal stability, melt flow, tensile strength, toughness, and low temperature properties.

Effect on Other Polymer Systems

Preliminary results indicate effective gloss control with ABS polymer systems.

PHYSICAL DESCRIPTION

Chemical Description: Acrylic polymer-based compound

Appearance: Free-flowing white fine-ground powder

Particle Size: Less than 0.50 mm (0.02 inch)

Bulk Density (packed): 0.62 g/cc

Screen Analysis: 99.5% through 35 mesh screen

Performance Testing in Vinyl

This data sheet gives results obtained in laboratory studies and in pilot runs using commercial equipment. The formulations cited in this presentation are those employed in the various tests and merely suggest some possibilities for combining PARALOID KF-710 gloss control agent with various Vinyl compounds.

EFFECTS ON SURFACE PROPERTIES

Gloss Control

Unpigmented flexible, semi-rigid, and rigid formulations and pigmented flexible formulations were made up to compare the gloss control of PARALOID KF-710 gloss control agent and amorphous silica gel (Tables 1, 2, 3). In all cases, the acrylic additive is substantially more efficient in reducing gloss.

TABLE 1
GLOSS CONTROL IN UNPIGMENTED SEMI-RIGID VINYL FORMULATIONS

Gloss Control Agent	Level, Parts	60° Gloss, %
None	0	56
Silica Gel	2	15
PARALOID KF-710	2	7

FORMULATION	Parts
Vinyl (K=69)	100
DOP	25
Gloss Control Agent	0 or 2
ADVASTAB™ TM-181 Tin Stabilizer	2
Stearic Acid	0.25

TABLE 2
GLOSS CONTROL IN UNPIGMENTED IMPACT-MODIFIED RIGID VINYL FORMULATIONS

Gloss Control Agent	Level (X), parts	60° Gloss, %
None	0	14
Silica Gel	1	12
	5	8
PARALOID KF-710	1	11
	5	6
	10	5

FORMULATION	Parts
Vinyl (K=62)	100
PARALOID BTA Impact Modifier (MBS)[1]	5 - 8
PARALOID K-120ND Processing Aid	3
Gloss Control Agent	X
ADVASTAB TM-181 Tin Stabilizer	2
ADVALUBE F-1005 Lubricant	0.75
Paraffin Wax	0.75

[1]For clear formulations, PARALOID BTA-730L modifier at 8 phr is the recommended impact modifier. For opaque or pigmented formulations, use PARALOID BTA-753 modifier at 5 phr.

TABLE 3
GLOSS CONTROL IN PLASTICIZED VINYL FORMULATIONS

Gloss Control Agent	Parts	60°Gloss, %	Formulation	Parts
No Pigment				
None	0	66	Vinyl (K=69)	100
Silica Gel	2	38	DOP	50
PARALOID™ KF-710	2	12	Gloss Control Agent	X
			ADVASTAB TM-181 Tin Stabilizer	2
			Stearic Acid	0.25
Black Pigment				
None	0	42	Vinyl (K=69)	100
Silica Gel	2	25	DOP	50
	3.5	23	Gloss Control Agent	X
	5	24	ADVASTAB TM-181 Tin Stabilizer	2
PARALOID KF-710	2	19	Stearic Acid	0.25
	3.5	13	Carbon Black	3
	5	10	Calcium Carbonate	5
White Pigment				
None	0	100	Vinyl (K=69)	100
Silica Gel	2	52	DOP	50
PARALOID KF-710	2	18	Gloss Control Agent	X
			ADVASTAB TM-181 Tin Stabilizer	2
			Stearic Acid	0.25
			Titanium Dioxide	5
Colorant (10% dispersion in polyester plasticizer)				
Monofast Blue				
None	0	74	Vinyl (K=69)	100
Silica Gel	2	55	DOP	50
PARALOID KF-710	2	20	Gloss Control Agent	X
			ADVASTAB TM-181 Tin Stabilizer	2
			Stearic Acid	0.25
			Titanium Dioxide	2
Parisian Red				
None	0	70	Colorant Dispersion	2
Silica Gel	2	44		
PARALOID KF-710	2	18		

Effects of Temperature on Gloss Retention

A black post-embossed calendered sheet was made from a formulation containing 25 phr of plasticizer and 2 phr of PARALOID KF-710 gloss control agent. The 60° gloss was measured on samples heated 3 minutes in a circulating hot air oven at 300-340°F. (Table 4).

Gloss reduction with PARALOID KF-710 gloss control agent resists exposure to high temperatures.

Rigid Vinyl containing the additive shows uniform gloss reduction before and after thermoforming.

TABLE 4
GLOSS RETENTION AT 300-340˚F

		60˚ Gloss, %			
Gloss Control Agent	**Heating Temperature,˚F :**	**Room**	**300**	**320**	**340**
None		28	40	50	58
PARALOID KF-710		13	12	10	7

Blocking Resistance

Blocking is the tendency of a film to stick to itself during processing, storage, or contact. Though gloss control agents in general can decrease the blocking tendency of plasticized Vinyl, PARALOID KF-710 gloss control agent is a particularly effective anti-blocking agent. Adaptation of ASTM D-1893-67 provides a quantitative measure of the blocking force observed at various temperatures. As little as 1 phr of PARALOID KF-710 gloss control agent reduces the blocking force of plasticized Vinyl films by 70% at 170°F, whereas even 4 phr of silica gel is totally ineffective (Table 5).

TABLE 5
BLOCKING FORCE IN PLASTICIZED VINYL FILMS

		Blocking Force, lbs./in. at Conditioning Temperature, ˚F[1]		
Gloss Control Agent	**Parts (X)**	**150**	**170**	**190**
None	0	0.14	0.32	4.0[2]
Silica Gel	1	-	0.29	-
	2	0.11	0.39	4.1[2]
	4	-	0.31	-
PARALOID KF-710	1	-	0.10	-
	2	0.07	0.11	2.45
	4	-	0.08	-

[1]3 hrs., 1 psi [2]Nearly fused

FORMULATION	Parts
Vinyl (K=69)	100
DOP	50
Gloss Control Agent	X
ADVASTAB TM-181 Tin Stabilizer	2
Stearic Acid	0.25
Calcium Carbonate	5

Slip

Another way to compare the stickiness of surfaces is to measure the coefficient of friction (ASTM D-1894). The degree of slip of an object in contact with a surface increases with decreasing value of the coefficient. Low levels of PARALOID™ KF-710 gloss control agent greatly increase the slip of clear and pigmented Vinyl films. Similar tests show that silica is ineffective in the absence of additional pigment (Table 6).

TABLE 6
COEFFICIENT OF FRICTION OF PLASTICIZED VINYL FORMULATIONS (ASTM D-1894)

	Coefficient of Friction			
Gloss Control Agent	**Static**	**Kinetic**	**Formulation**	**Parts**
None	7.63	7.53	Vinyl (K=69)	100
Silica	6.85	7.15	DOP	50
PARALOID KF-710	3.92	2.53	Gloss Control Agent	0 or 2
			ADVASTAB TM-181 Tin Stabilizer	2
			Stearic Acid	0.25
			Formulation	
None	5.55	4.92	Vinyl (K=69)	100
Silica	1.75	1.38	DOP	50
PARALOID KF-710	1.48	1.21	Gloss Control Agent	0 or 2
			ADVASTAB TM-181 Tin Stabilizer	2
			Stearic Acid	0.25
			Calcium Carbonate	5
			Monofast Blue	1.2

Resistance to Soiling and Staining

PARALOID KF-710 gloss control agent imparts outstanding resistance to soiling and staining of plasticized Vinyl sheets. By contrast, the incorporation of amorphous silica gel decreases the resistance to soiling in both clear and pigmented formulations (Table 7). Table 7 below compares the effect of gloss control agents on the resistance of a clear Vinyl film to staining.

TABLE 7
SOIL RESISTANCE OF PLASTICIZED VINYL FORMULATIONS

			Soil Rating					
Gloss Control Agent	**Cycles: 0**	**200**	**600**	**800**	**1000**	**1500**	**2000**	**2500**
Clear								
None	0	0	0-1	1	1	1-2	1-2	2
Calcium Silicate (2 parts)	0	0-1	1	2-3	2-3	2	7	10
PARALOID KF-710 (2 parts)	0	0-1	1	2	2	2-3	2-3	4
White	**Cycles: 0**	**100**	**250**	**500**	**1000**	**1500**	**3000**	**4000**
None	0	2	3	4	5	6-7	7	8
Silica (2 parts)	0	2-3	3-4	4-5	6	7	8	9
PARALOID KF-710 (2 parts)	0	1	2	2	3	4-5	6	6-7

FORMULATION	Clear	White
Vinyl (K=69)	100 parts	100 parts
DOP	50	50
Gloss Control Agent	0 or 2	0 or 2
ADVASTAB TM-181 Tin Stabilizer	2	2
Stearic Acid	0.25	0.25
Titanium Dioxide	–	5

RATING: Chrysler Corp. Soil Resistance Test
Wyzenbeck abrasion tester
Scale 0-10: 0 = no soiling
10 = severe soiling

TABLE 8
STAINING RESISTANCE OF PLASTICIZED VINYL COMPOUNDS

	Stain Rating After 30 Minutes	
Gloss Control Agent	**Catsup**	**Lipstick**
None	0-1	1-2
Silica (2 parts)	0-1	4
PARALOID KF-710 (2 parts)	0-1	2

FORMULATION	Parts	Rating: Low numbers indicate
Vinyl (K=69)	100	low degree of staining
DOP	50	
Gloss Control Agent	0 or 2	
ADVASTAB TM-181 Tin Stabilizer	2	
Stearic Acid	0.25	

Contact Clarity

Despite the dull or matte appearance of plasticized Vinyl films containing PARALOID KF-710 gloss control agent, there is only a slight effect on contact clarity, as seen from the undiminished transmission of light. Silica, however, reduces the contact clarity, because it is completely incompatible with the Vinyl polymer and has a very different refractive index. In rigid or semi-rigid Vinyl films, PARALOID KF-710 gloss control agent actually increases the clarity, but silica gives completely hazy films (Table 9).

TABLE 9
CONTACT CLARITY OF VINYL FILMS

Plasticizer	Gloss Control Agent	White Light Transmission %	Haze %	Formulation	Parts
DOP	None	89.4	6	Vinyl (K=69)	100
	Silica	83.5	98	Plasticizer	50
	PARALOID KF-710	90.0	16	ADVASTAB TM-181 Tin Stabilizer	2
Butyl Benzyl	None	90.6	4	Stearic Acid	0.25
Phthalate	PARALOID KF-710	90.5	5	Gloss Control Agent	0 or 2
Polyester Plasticizer A	None	90.0	4		
	PARALOID KF-710	89.4	10		
Polyester Plasticizer B	None	89.7	16		
	PARALOID KF-710	87.0	75		
				Formulation	
DOP	None	88.7	12	Vinyl (K=69)	100
	Silica	76.4	10	DOP	25
	PARALOID KF-710	90.4	7	ADVASTAB TM-181 Tin Stabilizer	2
				Stearic Acid	0.25
				Gloss Control Agent	0 or 2
				Formulation	
None	None	79.0	10	Vinyl (K=69)	85
	Silica	56.2	100	PARALOID BTA Impact Modifier (MBS)[1]	5 - 8
	PARALOID KF-710	83.0	6	PARALOID K-120N Processing Aid	3
				ADVASTAB TM-181 Tin Stabilizer	2.25
				ADVALUBE F-1005 Internal Lubricant	0.8
				Oxidized Polyethylene Wax	0.2
				Gloss Control Agent	0 or 3

[1]For clear formulations, PARALOID BTA-730L modifier at 8 phr is the recommended impact modifier. For opaque or pigmented formulations, use PARALOID BTA-753 modifier at 5 phr.

EFFECTS ON PHYSICAL PROPERTIES

Hardness

At normal use levels, PARALOID KF-710 gloss control agent has essentially no effect on the hardness of clear plasticized or semi-rigid Vinyl films. Silica increases the hardness, especially in combination with polymeric plasticizers (Table 10).

TABLE 10
SHORE A HARDNESS OF VINYL FILMS

		Gloss Control		Shore A Hardness			
Plasticizer	**Parts (X)**	**Agent**	**Parts**	**Initial**	**After 10 sec.**	**Formulation**	**Parts**
DOP	47	None	0	79	77	Vinyl (K=69)	100
		Silica	3	82	80	Plasticizer	X
		PARALOID KF-710	3	80	78	Barium-Zinc Stabilizer	2.8
Polyester Plasticizer B	59	None	0	73	72	Epoxidized Soya Oil	3
		Silica	3	81	78	Gloss Control Agent	0 or 3
		PARALOID KF-710	3	75	73		
						Formulation	
DOP	25	None	0	89	88	Vinyl (K=69)	100
		Silica	3	92	89	DOP	25
		PARALOID KF-710	3	91	88	ADVASTAB TM-181 Tin Stabilizer	2
						Stearic Acid	0.25
						Gloss Control Agent	0 or 3

ABOUT ROHM AND HAAS PLASTICS ADDITIVES...

Rohm and Haas Plastics Additives is a worldwide supplier of additives and acrylic resins used in a large variety of applications for Vinyl, polyester, polycarbonate and other engineering plastics or blends. Products from Rohm and Haas Plastics Additives impart significant performance attributes like impact strength, clarity, chemical resistance, color retention, heat resistance, heat stability and weatherability. They also provide important processing benefits like greater output rates, melt strength and lubrication.

For nearly half a century, Rohm and Haas Plastics Additives has been a pioneer in the development of plastics additives, introducing in 1956 the first MBS impact modifier. Two years later, Rohm and Haas Plastics Additives introduced the first processing aid and in 1968, the company developed the first all-acrylic impact modifier.

Today, Rohm and Haas Plastics Additives is the leading provider of processing aids, impact modifiers and stabilizers to the Plastics Industry worldwide.

Tensile and Dielectric Properties

PARALOID KF-710 gloss control agent has only minimal effect on the tensile and dielectric properties of Vinyl. Silica and calcium silicate decrease the elongation and toughness (modulus) at ambient temperature and raise the brittle point (Table 11).

TABLE 11
TENSILE AND DIELECTRIC PROPERTIES OF VINYL FILMS

Plasticizer	Parts (X)	Property	Gloss Control: None	Silica	PARALOID KF-710
DOP	47	60° Gloss, %	81	31	15
		Tensile Strength, psi	3020	2010	2970
		Ultimate Elongation, %	305	167	345
		Modulus at 100% Elongation, psi	1860	1610	1690
		Brittle Point (T_B), °C	-25	-17	-17
		$T_{135,000}$, °C	-25	-20	-20
		Dielectric Strength (RT), volts/mil	425	465	455
Polyester Plasticizer	59	60° Gloss, %	36	21	18
		Tensile Strength, psi	2860	2870	3040
		Ultimate Elongation, %	390	360	400
		Modulus at 100% Elongation, psi	1580	1620	1520
		Brittle Point (T_B), °C	-14	-11	-11
		$T_{135,000}$, °C	-13	-12	-13
		Dielectric Strength (RT), volts/mil	470	450	460

FORMULATION	Parts		Parts
Vinyl (K=69)	100	Barium-Zinc Stabilizer	2.8
Plasticizer	X	Gloss Control Agent	0 or 3
Epoxidized Soya Oil	3		

Plasticizer	Parts (X)	Property	Gloss Control: None	Silica	PARALOID KF-710
DOP	25	60° Gloss, %	56	15	7
		Tensile Strength, psi	3570	3620	3540
		Ultimate Elongation, %	290	230	270
		Modulus at 100% Elongation, psi	3290	3360	3400
		Brittle Point (T_B), °C	-32	-23	-30

FORMULATION	Parts		Parts
Vinyl (K=69)	100	Stearic Acid	0.25
DOP	25	Gloss Control Agent	0 or 2
ADVASTAB TM-181 Tin Stabilizer	2		

TOUGHNESS/IMPACT RESISTANCE

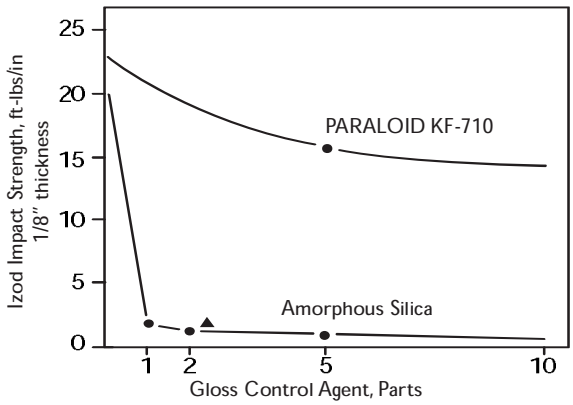
Impact Strength

As little as one part of silica gel completely destroys the impact strength of impact-modified rigid Vinyl. As Figure 3 shows, the incorporation of as much as 10 parts of PARALOID™ KF-710 gloss control agent provides a high level of impact strength.

Fold Endurance

Fold endurance was measured on blown films (average thickness 2 mils) of impact-modified rigid Vinyl. Because of poor hot melt strength, films could not be blown from the formulation containing silica gel. Calcium silicate therefore replaced silica, but the resulting films gave much poorer fold endurance than unmodified Vinyl. The films containing PARALOID KF-710 gloss control agent greatly exceeded the fold endurance of the silicate-modified film (Table 12).

FIGURE 3
IMPACT STRENGTH



FORMULATION	Parts		Parts
Vinyl (K=61)	100	ADVASTAB TM-181 Tin Stabilizer	2
PARALOID BTA Impact Modifier (MBS)[1]	12	ADVALUBE F-1005 Internal Lubricant	0.75
PARALOID K-120N Processing Aid	3	Paraffin Wax	0.75

TABLE 12
SCHOPPER FOLD ENDURANCE OF IMPACT-MODIFIED RIGID VINYL

	Average Folds to Break			
Gloss Control Agent	Machine Direction	Cross Direction	Formulation	Parts
None	7840	4565	Vinyl (K=61)	100
Calcium Silicate	705	1506	PARALOID BTA Impact Modifier (MBS)[1]	5-8
PARALOID KF-710	3455	3744	PARALOID K-120ND Processing Aid	2.5
			ADVASTAB TM-181 Tin Stabilizer	2
			ADVALUBE F-1005 Internal Lubricant	0.7
			Paraffin Wax	0.3
			Gloss Control Agent	0 or 5

[1]For clear formulations, PARALOID BTA-730L modifier at 8 phr is the recommended impact modifier. For opaque or pigmented formulations, use PARALOID BTA-753 modifier at 5 phr.

Resistance to Chemicals and Extractants

The weight gain of plasticized Vinyl films containing gloss control agents was measured after immersion in water or aqueous solutions of acid or alkali at room temperature for 7 days. Little difference was noted between the absorbency of films containing PARALOID KF-710 gloss control agent and the control films. Films containing silica, which is an absorbent material, picked up more weight than the control in water or dilute acid or alkali (Table 13A). Gloss control agents had little or no influence on the amount of weight loss in aqueous soap solution, hexane, or mineral oil (Table 13B).

Weathering Resistance

Accelerated weathering studies have been carried out. No significant changes in the appearance of films containing 2 phr of the gloss control agents were noted after 2,000 hours of exposure in the Weather-ometer or Fade-ometer.

TABLE 13
A. CHEMICAL RESISTANCE OF PLASTICIZED VINYL FILMS

Plasticizer	Parts (X)	Gloss Control Agent	Parts	% Weight Loss After 7 Days Immersion in Water	10% HCl	37% HCl	10% NaOH	37% NaOH
DOP	47	None	0	0.45	0.06	1.93	0.13	0
		Silica A	3	0.55	0.11	2.29	0.12	-0.08
		Silica B	3	0.68	0.13	1.98	0.17	-0.13
		PARALOID KF-710	3	0.47	0.04	2.11	0.08	-0.04
Polyester Plasticizer	59	None	0	0.90	0.09	-12.65	0	-0.23
		Silica A	3	1.08	0.11	-13.96	10.24	-0.20
		Silica B	3	1.12	0.14	-13.02	3.10	-0.26
		PARALOID KF-710	3	0.94	0.06	-13.59	0	-0.16

TABLE 13
B. EXTRACTION LOSSES FROM PLASTICIZED VINYL FILMS

Plasticizer	Parts (X)	Gloss Control Agent	Parts	Weight Loss, % 1% Soap 24 hr./90˚C	Hexane 2 hr./25˚C	Mineral Oil 10 day/25˚C	Formulation (A and B)	Parts
DOP	47	None	0	6.0	19.0	4.1	Vinyl (K=69)	100
		Silica A	3	6.2	20.0	4.2	Plasticizer	X
		Silica B	3	5.9	19.0	4.3	Epoxidized Soya Oil	3
		PARALOID KF-710	3	6.2	17.0	3.8	Barium-Zinc Stabilizer	2.8
							Gloss Control Agent	0 or 3

EFFECTS ON THERMAL STABILITY AND MELT FLOW

Brabender Plasticorder Test

PARALOID® KF-710 gloss control agent incorporated into a rigid (not impact-modified) formulation produced some reduction in viscosity and no effect on thermal stability when observed in the Brabender Plasticorder. Silica gel, however, increased the viscosity and lowered thermal stability (Table 14).

Oven Stability

No effect by PARALOID KF-710 gloss control agent on thermal stability was noted in plasticized Vinyl in oven tests. An indication of improved stability was obtained in the Brabender Plasticorder (Table 15).

TABLE 14
BRABENDER PLASTICORDER TESTS

Gloss Control Agent	Torque, meter-grams Flux	Equilibrium	Melt Temperature ˚F	Minutes to Degradation
None	4000	2500	370	>45
Silica Gel	>5000	2700	372	35-40
PARALOID KF-710	3600	2450	370	>45

FORMULATION	Parts		Parts
Vinyl (K=62)	100	ADVASTAB TM-181 Tin Stabilizer	2
PARALOID K-120ND Processing Aid	2.5	ADVALUBE F-1005 Internal Lubricant	0.7
Gloss Control Agent	0 or 5	Paraffin Wax	0.3

TABLE 15
THERMAL STABILITY OF PLASTICIZED VINYL

Gloss Control Agent	Initial Color Change	Hours at 350˚F to Dark Yellow	Hours at 350˚F to Char	Brabender Plasticorder Time to Degradation Minutes
None	0.75	2	5	67
Silica Gel	0.75	1.5	4	—
PARALOID™ KF-710	1	2.5	5	90

FORMULATION	Parts		Parts
Vinyl (K=72)	100	Barium-Zinc Stabilizer	2.5
DOP	37	Stearic Acid	0.5
Epoxidized Soya Oil	5.25	Gloss Control Agent	0 or 4.5

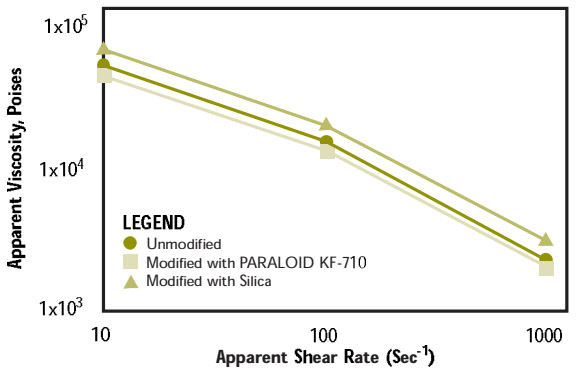
Melt Viscosity

PARALOID KF-710 gloss control agent caused essentially no change in viscosity of plasticized, semi-rigid, and impact-modified rigid formulations (Table 16) measured in the Sieglaff-McKelvey Rheometer. Adding up to 5 parts of silica gel, by contrast, increased the melt viscosity of plasticized and semi-rigid formulations significantly.

TABLE 16
MELT VISCOSITY OF VINYL FORMULATIONS
SIEGLAFF-MCKELVEY RHEOMETER

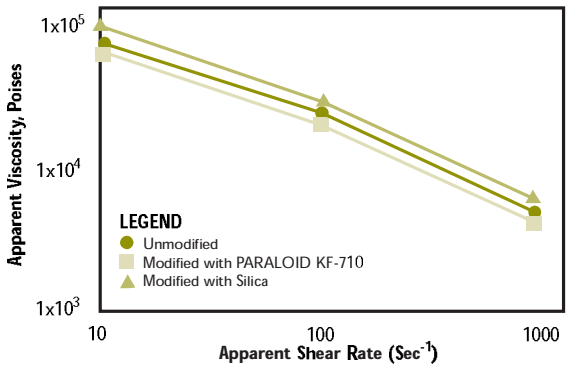
Gloss Control Agent	Parts (X)	Conditions of Test	Melt Viscosity Poise	Formulation	Parts
Plasticized		400˚F, 1000 sec^{-1}		Vinyl (K=69)	100
				DOP	50
None	0		1460	Gloss Control Agent	X
Silica	2		1600	ADVASTAB TM-181 Tin Stabilizer	2
	5		1900	Stearic Acid	0.25
PARALOID KF-710	2		1460		
	5		1460		
Semi-rigid		400˚F, 1000 sec^{-1}		Vinyl (K=69)	100
None	0		3355	DOP	25
Silica	2		3650	Gloss Control Agent	X
	5		3790	ADVASTAB TM-181 Tin Stabilizer	2
				Stearic Acid	0.25
PARALOID KF-710	2		3210		
	5		3210		
Rigid Pigmented		400˚F, 1000 sec^{-1}		Vinyl (K=50.5)	85.5
Impact Modified				PARALOID KM-334 Impact Modifier	12
				PARALOID K-175 Lubricant/ Processing Aid	1.5
None	0		2260	Gloss Control Agent	X
PARALOID KF-710	5		2300	ADVASTAB TM-181 Tin Stabilizer	2
	10		2260	Paraffin Wax	2.7
	20		2260	Polyethylene Wax	0.3
				Titanium Dioxide	3
				Carbon Black	0.125

FIGURE 4
MELT VISCOSITY VS. SHEAR RATE OF PLASTICIZED VINYL



FORMULATION	Parts		Parts
Vinyl (K=69)	100	Stearic Acid	0.25
DOP	50	Gloss Control	0 or 3
ADVASTAB TM-181 Tin Stabilizer	2	Agent	

FIGURE 5
MELT VISCOSITY VS. SHEAR RATE OF RIGID VINYL



FORMULATION	Parts		Parts
Vinyl (K=61)	100	ADVALUBE F-1005	0.75
PARALOID K-120N Processing Aid	3	Internal Lubricant Paraffin Wax	0.75
ADVASTAB TM-181 Tin Stabilizer	2	Gloss Control Agent	0 or 3

Figures 4 and 5 show that a hundred-fold change in the shear rate does not influence the effect of gloss control agents on the melt viscosity of plasticized Vinyl at 350°F and rigid Vinyl at 400°F, respectively.

Dispersibilty

PARALOID™ KF-710 gloss control agent gives rapid dispersion with plasticizer levels up to at least 80 phr. Various conventional mixing processes can be used on a commercial scale to blend this gloss control agent with Vinyl formulations. No special difficulties were noted in continuous or Banbury mixers, calenders, and extruders using blends prepared in ribbon blenders or intensive mixers. In general, the greater the degree of shear exerted during the mixing and processing, the more readily does the agent disperse into the Vinyl materials to provide the required gloss reduction efficiency and other physical properties.

PROCESSING CHARACTERISTICS

Blending Procedures

In general, any conventional mixing technique can be used to incorporate this gloss-reducing polymer into Vinyl formulations. The additive may also be charged at any stage of the blending process to provide the required gloss control or other properties.

Mill Processing

Table 17 compares the mill processing characteristics of Vinyl formulations containing gloss control agents. PARALOID™ KF-710 gloss control agent gave a good rolling bank and hot melt strength and seemed to shorten the fluxing time. For the full achievement of certain important properties, the time of milling is influential and indicates the dependence of performance on process variables such as melt viscosity, shear, and the design of equipment.

Extrusion of Plasticized Vinyl Sheets

Extruding soft Vinyl polymer formulations containing PARALOID™ KF-710 gloss control agent with a two-stage screw having a low compression ratio gave excellent dispersion and gloss reduction (Table 18).

Extrusion of Rigid Vinyl Profiles

Profiles were extruded through a channel die from rigid Vinyl formulations containing 3 phr of the gloss control agent. PARALOID™ KF-710 gloss control agent gave a high degree of gloss reduction and increased output up to 65% over the unmodified formulation (Table 19). An increased output rate was also obtained in extruding rods containing PARALOID™ KF-710 gloss control agent (Table 20).

The temperatures of the melt and the die affect the gloss of extruded rigid channel profiles. Decreasing the temperature reduces the level of gloss in both the unmodified control and in the modified formulations, but to a much different degree. In the control, the melt temperature is changed by adjusting the screw speed and rises with increasing rate of rotation. In the modified formulation, the melt temperature can also be changed by adjusting the temperatures in the metering zone and die zone. PARALOID™ KF-710 gloss control agent gave the lowest degree of gloss by operation at relatively low die and melt temperatures. In addition, the output rates were again greater than the controls and were not affected by changing temperature (Table 21).

TABLE 17
MILL PROCESSING OF VINYL FORMULATIONS

Flexible Formulations: 325°F

Plasticizer	Parts (X)	Gloss Control Agent	Parts	Flux Time Minutes	Rolling Bank	Hot Melt Strength
DOP	50	None	0	0.75	G	G
		Silica	2	0.75	G	G
		PARALOID KF-710	2	0.5 - 0.75	G	G
	25	None	0	0.5 - 0.75	G	G
		Silica	2	0.5	G	G
		PARALOID KF-710	2	0.5	G	G

FORMULATION	Parts		Parts
Vinyl (K=69)	100	Stearic Acid	0.25
DOP	x	Gloss Control Agent	0 or 2
ADVASTAB™ TM-181 Tin Stabilizer	2		

Rigid Formulation: 350°F

Gloss Control Agent	Parts	Flux Time Min.	Rolling Bank	Hot Melt Strength	Release
None	0	0.25 - 0.5	G+	G	G+
Silica	2	0.75 - 1	F	G	G-
PARALOID KF-710	2	0.5 - 0.75	G+	G+	G+

FORMULATION	Parts		Parts
Vinyl (K=61)	100	ADVALUBE F-1005	0.75
PARALOID BTA Impact Modifier (MBS)[1]	5-8	Internal Lubricant	
PARALOID K-120N Processing Aid	3	Paraffin Wax	0.75
ADVASTAB TM-181 Tin Stabilizer	2	Gloss Control Agent	0 or 2

Rating: G = good F = fair

[1]For clear formulations, PARALOID BTA-730L modifier at 8 phr is the recommended impact modifier. For opaque or pigmented formulations, use PARALOID BTA-753 modifier at 5 phr.

TABLE 18
EXTRUSION OF PLASTICIZED VINYL SHEETS

Gloss Control Agent	Parts	Barrel Temperature, °F: Feed Zone	Transition Zone	Metering Zone	Die	Melt. Temp °F	Screw Speed rpm	Current Amperes	Output g/min	60° Gloss %
None	0	300	330	370	350	360	40	6.0	40	38
	0	300	330	360	354	365	61	6.2	69	44
PARALOID	5	300	335	355	350	358	40	5.9	46	18
KF-710	5	305	330	350	352	363	61	6.1	68	19

FORMULATION	Parts		Parts
Vinyl (K=69)	100	Stearic Acid	0.25
DOP	50	Atomite	35
Epoxidized Soya Oil	5	Pigment Dispersion	2
Barium-Zinc Stabilizer	2	Gloss Control Agent	0 or 5

Processing Conditions:

1-inch Killion extruder; 3-inch sheet die; low-compression two-stage screw; sheet thickness 1/8"

TABLE 19
EXTRUSION OF RIGID VINYL PROFILES

Gloss Control Agent	Parts	Barrel Temperature, ˚F: Feed Zone	Transition Zone	Metering Zone	Die	Melt. Temp ˚F	Screw Speed rpm	Current Amperes	60˚ Gloss %	Output g/min
None	0	300	345	350	352	368	22	5.5	76	29
		300	340	360	364	385	33	5.8	80	49
		300	350	355	360	395	56	6.0	83	69
PARALOID™ KF-710	3	295	352	351	359	373	22	5.6	18	47
		300	350	353	358	385	33	5.7	17	64
		315	348	351	358	393	56	6.2	22	79

FORMULATION	Parts		Parts
Vinyl (K=61)	100	Paraffin Wax	0.3
ADVASTAB TM-181 Tin Stabilizer	2	Titanium Dioxide	1
PARALOID K-120N Processing Aid	1.5	Carbon Black	0.5
ADVALUBE F-1005 Internal Lubricant	0.7	Gloss Control Agent	0 or 3

Processing Conditions:

1-inch Killion extruder; Channel die (1-inch wide, 0.25-inch high, 0.125-inch thick); high-compression two-stage screw

TABLE 20
EXTRUSION OF RIGID VINYL RODS

Gloss Control Agent	Parts	Barrel Temperature, ˚F: Feed Zone	Transition Zone	Metering Zone	Die	Melt. Temp ˚F	Screw Speed rpm	Current Amperes	60˚Gloss %	Output g/min
None	0	290	335	355	363	381	22	5.6	glossy	23
		310	342	350	362	384	33	5.8	v. glossy	54
		300	350	347	362	392	56	6.0	v. glossy	64
PARALOID™ KF-710	3	315	337	352	361	382	22	5.4	v. dull	31
		295	340	347	362	388	33	5.8	dull	59
		320	348	353	362	393	56	6.1	dull	81

FORMULATION	Parts		Parts
Vinyl (K=61)	100	Paraffin Wax	0.3
ADVASTAB TM-181 Tin Stabilizer	2	Titanium Dioxide	1
PARALOID K-120N Processing Aid	1.5	Carbon Black	0.5
ADVALUBE F-1005 Internal Lubricant	0.7	Gloss Control Agent	0 or 3

Processing Conditions:

1-inch Killion extruder; 1/4-inch rod die; high-compression two-stage screw

TABLE 21
EFFECT OF TEMPERATURE ON GLOSS AND OUTPUT RATES IN PROFILE EXTRUSION

Gloss Control Agent	Parts	Barrel Temperature, ˚F Feed Zone	Transition Zone	Metering Zone	Die	Melt. Temp ˚F	Screw Speed rpm	Current Amperes	60˚Gloss %	Output g/min.
None	0	300	345	355	362	370	22	5.6	68	27
		305	340	350	362	376	33	5.8	84	36
		300	345	350	362	383	56	6.2	92	64
PARALOID™ KF-710	3	305	345	350	362	370	22	5.5	23	40
		295	350	350	362	375	33	5.8	47	57
		325	352	348	362	384	56	6.2	42	76
	3	300	340	388	385	388	22	5.7	21	39
		315	345	377	382	400	33	5.9	33	55
	3	310	342	330	338	360	22	5.6	7	45
		310	350	342	340	370	33	5.9	10	57
		310	348	335	340	372	56	6.3	8	77

FORMULATION	Parts		Parts
Vinyl (K=61)	100	Paraffin Wax	0.3
ADVASTAB TM-181 Tin Stabilizer	2	Titanium Dioxide	1
PARALOID K-120N Processing Aid	1.5	Carbon Black	0.5
ADVALUBE F-1005 Internal Lubricant	0.7	Gloss Control Agent	0 or 3

Processing Conditions:

1-inch Killion extruder; Channel die (1-inch wide, 0.25-inch high, 0.125-inch thick); high-compression two-stage screw

TABLE 22
BLOWN RIGID VINYL FILM

Gloss Control Agent	Parts	Die Temp ˚F	Screw Speed rpm	Current Amperes	Processing Behavior	20˚ Gloss Ext.	20˚ Gloss Int.	60˚ Gloss Ext.	60˚ Gloss Int.	Schopper Fold Endurance Direction Machine	Schopper Fold Endurance Direction Cross
None	0	355	67	5.3	G	32	19	84	88	7840	4560
Calcium Silicate	5	360		5.2	G	10	12	32	38	705	1505
PARALOID™ KF-710	5	360		5.0	G	7	12	33	52	3455	3745

Legend: G = good; Ext. = exterior; Int. = interior

FORMULATION	Parts		Parts
Vinyl (K=61)	100	ADVALUBE F-1005 Internal Lubricant	0.7
PARALOID™ BTA Impact Modifier(MBS)[1]	5-8	Paraffin Wax	0.3
PARALOID™ K-120N Processing Aid	2.5	Toner	0.00035
ADVASTAB™ TM-181 Tin Stabilizer	2	Gloss Control Agent	0 or 5

Processing Conditions:

1-inch Killion extruder; small die manifold; high-compression two-stage screw; film thickness (average) 2 mils

[1]For clear formulations, PARALOID BTA-730L modifier at 8 phr is the recommended impact modifier. For opaque or pigmented formulations, use PARALOID BTA-753 modifier at 5 phr.

Blown Rigid Film

Blown film was produced from an impact-modified rigid Vinyl formulation. Using PARALOID™ KF-710 gloss control agent in the formulation gave smooth operation and only a slight amount of surging. The formulation containing silica showed severe surging and such poor hot melt strength that acceptable film could not be blown. The formulation with calcium silicate extruded well, but the film was not very tough and gave poor fold endurance (Table 22).

TABLE 23
GLOSS CONTROL OF ABS POLYMER SHEET

PHR PARALOID KF-710	60˚Gloss, %
0	85
3	47
5	29
10	19

Gloss Control of ABS Polymers

Table 23 gives the results obtained by incorporating 0-10 phr of PARALOID KF-710 gloss control agent into ABS polymer sheet by milling at 340°F.

STANDARD PACKAGING

PARALOID KF-710 gloss control agent is available in either a 100 lb. or 200 lb. fiber drum. Please check with your account representative for specific package availability as some packages are dependent upon density and demand of material.

STORAGE AND HANDLING
(see MSDS for details)

Standard recommended storage conditions are as follows:

- Store indoors, protected from weather (moisture)
- Temperature should not exceed 60°C
- Protect from unltraviolet light
- With stretch hood or stretch wrap intact (if applicable)

Unopened (if material is opened, it should not be left exposed and should be used within one month); ambient temperature preferred.

When stored correctly in the original packaging, the shelf life is:

2.5 years from date of manufacture

SAFE HANDLING INFORMATION

Avoid high concentrations of dust in the air and accumulation of dust on equipment. An airborne dust of this material can create a dust explosion. When handling and processing this material, local exhaust ventilation may be required to control dust and reduce exposure to vapors. To prevent dust explosions, employ bonding and grounding for operations capable of generating static electricity. Dispose by placing powder in air tight bags. Incinerate or landfill at a permitted facility in accordance with local, state and federal regulations.

MATERIAL SAFETY DATA SHEETS

Material Safety Data Sheets are available outlining hazards and safe handling methods. Contact Rohm and Haas for copies of the MSDS for this product and for other handling information.

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