PROJECT REPORT FORM

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PROJECT NO. 1684
COOPERATOR Institute
REPORT NO. 1
DATE October 7, 1952
NOTE BOOK 899
PAGE 71 TO 76
SIGNED Frans Vaurio

Frans Vaurio

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SIZING WITH SODIUM METHYL SILICONATE

General Electric SC 50 is a water solution of sodium methyl siliconate. The total solids content is 31.2%. The pH of the solution as received is given as approximately 13. This material has been suggested as a possible water repellent treatment for paper and paper products. A few preliminary experiments were made to determine its efficiency as a sizing agent. The first test of sizing efficiency was run as a tub sizing application, since such an application would give better control over the retention of the material. This report covers the work on these initial experiments.

PROCEDURE

Two types of stock were used in these tests. One was St. Mary's southern unbleached kraft and the other was a standard bleached sulfite. Handsheets were produced from the St. Mary's kraft beaten to a freeness of 620 Canadian standard. Standard bleached sulfite (510 Canadian standard) was used in making handsheets approximately the same weight as the kraft sheets.

The unbleached kraft sheets were dipped in diluted sodium methyl siliconate SC 50 solution of varied concentrations to get a range in per cent pick-up. The sheets were pressed between wet blotters at 65 p.s.i. and then dried for 5 minutes on a drum at 220°F. The standard bleached sulfite sheets were treated by neutralizing the sodium methyl siliconate solution with a 20% alum solution

so that the pH of the final mixture was 5.0. Sixty grams of sodium methyl siliconate solution were diluted with 240 grams of water then 106.6 ml. of 20% alum solution were added. The bleached sulfite sheets were dipped in this and pressed and dried.

It was felt that this last procedure caused too much precipitation of the sodium methyl siliconate, so another trial was run with the SC 50 partly neutralized with alum. Sixty grams of SC 50 were diluted with 240 ml. of water. Then 53.8 ml. of 20% alum were added to bring the pH to 6.5. The prepared handsheets were dipped in this solution, weighed, and then dipped in a 5% solution of alum and weighed again. The sheets were then dried and tested for sizing using the K and H (same as K.B.B.) galvanic size test.

RESULT

The results are shown in Tables I, II, and III.

TABLE I

TUB SIZING WITH G. E. SC 50 SODIUM METHYL SILICONATE
(8-1/2 x 8-1/2 inch Unbleached Kraft* Handsheets)

Code No.	Raw Wt. g.	Wet Wt. g.	SC 50 %	Pickup %	Size (K & H) sec. After 1 day	After 7 days
899-72-0	control	-	-	-	instantaneous	
899-72-1	4.70	19.02	0.10	0.3	7.5	53
2	4.92	19.30	0.10	0.3	73.0	149
3	4.92	18.50	0.03	0.09	4.2	12
4	4.68	17.75	0.03	0.09	2.9	6
5	4.82	18.75	0.17	.5	125.	245
6	4.57	17.95	0.17	.5	171	195
7	4.45	17.31	0.33	1.0	290	577
8	4.68	18.13	0.33	1.0	352	517
9	4.80	19.71	0.67	2.1	206	317
10	4.42	18.00	0.67	2.0	68	315
11	4.70	18.28	1.00	2.9	666	868
12	4.88	18.48	1.00	2.8	643	952
13	4.97	19.19	2.00	5.7	399	581
14	4.83	18.20	2.00	5.5	460	356

* St. Mary's Southern Kraft Freeness 620 Canadian Standard.

TABLE II

TUB SIZING WITH PREPRECIPITATED* G. E. SC 50 SODIUM METHYL SILICONATE
(8-1/2 x 8-1/2 inch Bleached Sulfite** Handsheets)

Code No.	Raw Wt.	Wet Wt.	SC 50 % Concentration	Pickup % SC 50	Sizing (K & H) Seconds After 1 day	After 7 days
Control		-----	----	0	instantaneous	2
899-73-1	4.65	14.90	0.17	0.4	94	181
899-73-2	4.59	14.20	0.17	0.4	81	176
899-73-3	4.65	14.81	0.50	1.1	155	205
899-73-4	4.61	14.91	0.50	1.1	122	201
899-73-5	4.66	14.78	1.00	2.2	276	247
899-73-6	4.62	14.20	1.00	2.1	221	292
899-73-7	4.64	14.40	2.00	4.2	414	697
899-73-8	4.63	14.50	2.00	4.3	426	737
899-73-9	4.66	14.80	4.00	8.7	215	312
899-73-10	4.66	14.80	4.00	8.7	78	234

* Diluted to
** 510 Canadian standard freeness

TABLE III

TUB SIZING WITH PARTIALLY NEUTRALIZED* SC 50
(8-1/2 x 8-1/2 inch Bleached Sulfite Handsheets)

	Raw Wt. g.	Wet Wt. g.	SC 50 % conc.	5% Alum Wet Dip Wet Wt.	Pickup Alum %	Pickup SC 50 %	Size (K & H) sec. After 1 day	After 1 day
74-1	4.53	16.22	4.00	---	---	10.3	67.	120
2	4.57	16.22	4.00	---	---	10.2	74.	107
3	4.60	14.55	4.00	---	---	8.7	2.7	105
4	4.55	13.95	4.00	14.75	0.9	8.3	97.	78
5	control	-----	----	----	---	0	.5	1.0
6	control	-----	----	---	---	0	1.0	2.0
7. V	Control 2% IPC Wax Emulsion 2% Rosin						121	--
8. V	"		"				131	--
9. V	"		"				125.4	--
10. VI	"		"				39.5	--
11. VI	"		"				34.1	--

* The pH of SC 50 was dropped from 11.5 to 6.5 first.
The treated sheets were given a dip in 5% alum

DISCUSSION AND CONCLUSION

Very good sizing efficiency was obtained with the straight G. E. SC 50 sodium methyl siliconate. This is somewhat unusual for an alkaline material to produce such good sizing. The sizing efficiency seems to drop off after having reached the peak at approximately 3% pickup. The sizing improves with aging.

The alum neutralized or preprecipitated SC 50 also gave good sizing, although somewhat lower than with the straight SC 50.

The test with a partly neutralized SC 50 were not too significant since the per cent pickup was far beyond the maximum indicated by the first two trials. Table III shows for comparison, the results with 2% IPC wax emulsion and 2% rosin. These sheets were deemed satisfactory for a diaper material, and according to Dr. Howells, tests with these sheets allowed a puddle of water to remain in a cup produced from the sheets without penetration for several days. The maximum K and H* sizing noted for these sheets was 131 seconds.

Additional tests will be made to try this material as a beater sizing agent.

* Kelvin and Hughes, Ltd., Glasgow

fv/sk

PROJECT REPORT FORM

PROJECT NO. 1684
COOPERATOR The Institute
REPORT NO. 2
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NOTE BOOK 899
PAGE 80 TO 97
SIGNED Frans Vaurio

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EVALUATION OF DU PONT ELCHEM 1273

Du Pont ELCHEM 1273 is an alkali-soluble vinyl polymer which has been suggested as a water based greaseproof coating for paper. The following description is offered by the supplier (The Field Research Section, Electrochemicals Department, E. I. du Pont de Nemours and Company, Wilmington, Delaware).

Appearance	Beads-clear to white
Odor	Mild, pleasant
Bulk density	710 grams per liter (5.9 lbs. per gallon)

Solubility in water:

The amount of ammonia or alkali required to effect solubilization is as follows:

NH_4OH (as 24% NH_3 solution)	9.8% based on weight of Elchem 1273
Na_2CO_3	7.2% based on weight of Elchem 1273
NaOH	5.5% based on weight of Elchem 1273

Viscosities of aqueous solutions:

Aqueous solutions of either the ammonium or sodium salt of Elchem 1273 have a steep viscosity-vs-concentration curve. These relationships are shown in the following table:

TABLE I

Per Cent Na Salt	Specific Gravity 20°/20°C.	Viscosity - Centipoises 20°C.	40°C.	60°C.
5	1.012	1.085	1.02	0.685
10	1.024	4.6	1.8	1.1

TABLE I (Continued)

Per Cent Na Salt	Specific Gravity 20°/20°C.	Viscosity - Centipoises 20°C.	40°C.	60°C.
15	1.035	75	9.6	4.9
20	1.047	over 100.00	27,000	8,400

Solubility in Organic Solvents:

Elchem 1273 resin is soluble up to at least 5% in methanol, trichlorethylene, or benzene, yielding clear solutions of relatively low viscosity. It is soluble (forming somewhat hazy solutions) in ethyl or butyl acetate, tetrahydrofuran, acetone, methyl ethyl ketone, methyl isobutyl ketone, and cyclo hexanone. It is soluble at elevated temperatures (about 80°C.) in ethanol or toluene; insoluble in heptane, naphtha, turpentine, isopropanol, or xylene.

Applications (of possible interest to the paper industry):

Adhesives with heat sealing characteristics.

Paper coatings with good water vapor resistance, excellent greaseproofness and high gloss.

Since Elchem 1273 can be re-dissolved in mild alkalis, broke recovery is simplified.

A preliminary examination of the coatings produced from Elchem 1273 water solutions was made to serve as a basis for evaluation by the individual mill. No solvent solutions were used since the major interest, it was assumed, would be in its use in aqueous systems. The two characteristics considered were greaseproofness and water vapor permeability.

Preparation of Solutions

The following solutions were prepared according to the suggestion offered by the supplier.

	80-1	80-2	93-1	93-2	93-3	93-4
Ammonium hydroxide (24% NH_3)	---	4.92	19.6	(diluted 93-1 solution)		
Sodium carbonate (anhydrous)	3.74	-----	-----			
Water	474.9	457.7	870.3			
Elchem 1273	52.0	50.2	200.0			
Per cent solids	10.0	10.0	23.3	13.7	15.7	18.7

The water was heated to 65°C. then the alkali was added and the Elchem 1273 was sprinkled in with strong agitation.

The viscosities of the solutions were measured at different temperatures using a Brookfield Sychrolectric viscometer.

Coating of Paper

The base stock used in coating with Elchem 1273 was a patent coated board with a basis weight of approximately 80 pounds per 1000 square feet and a caliper of .021 inch. This material had good receptivity and handled well in the laboratory coating operations.

The coatings were applied in two ways, one by hand with wire wound rods and the other with a knife application using the Martinson laboratory coater modified with a power drive.

Some of the solutions were heated because the viscosity was so great that wire marks were left in the coating. This helped but was not

too satisfactory even when the rods were heated because the coating cooled so rapidly on the paper.

The coatings applied with the Martinson knife coater were varied in weight by changing the knife clearance over the board. A feeler gage was used in setting the knife clearances.

The coating weights were determined from the wet weight of coating which was applied to a sheet cut to a given size. A triple beam balance fitted with a special aluminum pan was used to get the raw and wet coated weights. The per cent solids of each solution was determined by drying down a measured amount of the solution at 105°C. in an air circulating oven. The dry coating weight was then calculated in pounds per 1000 square feet.

The coatings were dried in air in some cases and the rest in an oven at approximately 250°F.

Testing

The grease resistance of the coated board was tested with turpentine according to TAPPI T 454 m, and a modification of this test using dyed peamut oil. Tests were also made with a hydrogenated oil (Spry) by noting the time for penetration of a small dab of the material applied to the coated surface.

The water vapor permeability of the coatings was determined by the Institute Method 541 in which the specimen is sealed to a cup containing saturated ammonium dihydrogen phosphate and the loss in weight noted while

being held at 100°F. and 20% relative humidity. The system is allowed to come to equilibrium and the water vapor permeability calculated in grams per 24 hours per square meter. The coated side of the specimen was placed toward the high humidity.

TABLE I

VISCOSITY OF ELCHEM 1273 SOLUTIONS

Ammonium salt solutions of Elchem 1273

No.	Temp. °C.	Spindle no.	Speed	Range	Reading	Viscosity, cps.
93-1	25	4	6	0-100	Too high to measure	
93-2	26	2	60	0-100	5	25
93-2	63	1	60	0-100	5	5
93-3	26	2	60	0-100	43.7	218
93-3	74	1	60	0-100	6.7	6.7
93-4	25	4	6	0-100	12.8	12,800
93-4	25	4	30	0-100	64.5	12,900
93-4	25	4	60	0-100	Too high to measure	
93-4	34	2	12	0-100	36	900
93-4	34	2	30	0-100	88.7	887
93-4	70-5	2	60	0-100	6.5	32.5

TABLE II

COATING PAPER BOARD WITH ELCHEM 1273

	Raw Weight Grams	Size, in.	Wet Weight Grams	Coating Solution No.	Temp. °C.	% Solids	Methods of Drying	Coating wt. lbs./1000 sq. ft.
(The following are 6 x 6 inch sheets coated on Martinson coater)								
-1	8.86	6 x 6	13.01	93-3		15.7	Air	6.6
-2	8.80	6 x 6	13.58	93-3		15.7	3 min. 250°F.	6.6
-3	8.95	6 x 6	---	93-3		15.7	3 min. 250°F.	6.6
-4	8.91	6 x 6	13.66	93-3		15.7	Air dry	6.6
-5	8.95	6 x 6	---	93-3		15.7	2 min. 250°F.	3.6
-6	9.07	6 x 6	11.66	93-3		15.7	2 min. 250°F.	3.6
(The following are 6 x 12 inch sheets coated with wire wound rods)								
		Rod no.						
-1	17.46	16	---	93-1	26	23.3	5 min. 250°F.	---
-2	17.96	16	19.36	93-1	26	23.3	Air dry	1.44[1]
-3	17.85	16	19.41	93-1	26	23.3	5 min. 250°F.	1.60[1]
-4	17.70	16	19.95	93-1	26	23.3	5 min. 250°F.	2.32[1]
-5	17.64	16	19.54	93-2	48	13.7	Air dry	1.15
-6	17.67	16	19.78	93-2	26	13.7	2 min. 250°F.	1.28
-7	17.33	16	19.19	93-3	26	15.7	2 min. 250°F.	1.29
-8	17.63	16	19.44	93-3	26	15.7	2 min. 250°F.	1.26
-9	17.75	16	19.22	93-3	26	15.7	Air dry	1.02
-10	17.62	24	18.74	93-3	26	15.7	2 min. 250°F.	0.78
-11	17.70	34	19.77	93-3	26	15.7	2 min. 250°F.	1.44[1]
-12	17.53	34	21.00	93-3	46	15.7	2 min. 250°F.	2.41
-13	17.80	34	20.72	93-4	54	15.7	2 min. 250°F.	2.03

TABLE II (Continued)

Raw Weight Grams	Rod no.	Wet Weight Grams	Coating Solution No.	Temp. °C.	% Solids	Methods of Drying	Coating wt. lbs./1000 sq. ft.
17.33	34	20.32	93-4	60	18.7	2 min. 250°F.	2.46[1]
17.64	34	20.34	93-4	60	18.7	2 min. 250°F.	2.22[1]

[1] Re marks

Results

The results (see Table III) indicate that good greaseproofness, especially as tested with peanut oil, can be achieved with Elchem 1273 as a coating on patent coated board. No failure was found in 408 hours of contact when the tests were discontinued.

The tests using lard and Spry were not as satisfactory as those with peanut oil. Also the best or most resistant coatings were those on the patent coated side.

The gloss was not very good in these low weight coatings. The water vapor permeability is too high to consider for moisture-vapor proofing applications.

Conclusions

This material should prove of interest as a greaseproofing agent for papers. Despite the high cost ($ .75 per pound) it may find application in cases where a solvent-type coating is impractical and should become of definite interest to the paper industry as the price comes down.

It is purported to have some resistance to water vapor which would place it above polyvinyl alcohol in this aspect. Our test results however, showed high permeability for these coatings. There was good gloss developed in some of the coatings. Higher gloss apparently requires a heavier application. The coating itself appears brittle and hence would require plasticization for good scoring resistance and for use on flexible sheets.

The coatings are claimed to be heat sealing in the range of 70 to 80°C. No tests were made on heat sealing, however.

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PROJECT REPORT FORM

PROJECT NO. 1684
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SCORING DEVICE FOR TESTING COATINGS ON PAPERBOARD

One of the possible applications for barrier type (water vapor and grease resistant) coatings is for folding box production. The coating must be able to withstand the crease or score used to permit a good bend needed in shaping the paper box.

The type of paperboard used in the evaluation of various water-based resins as coatings has been standardized to permit a comparison of the various resins on a reasonable basis. This permitted us to design a scoring test instrument with the fewest possible sources of variation (See Fig. 1).

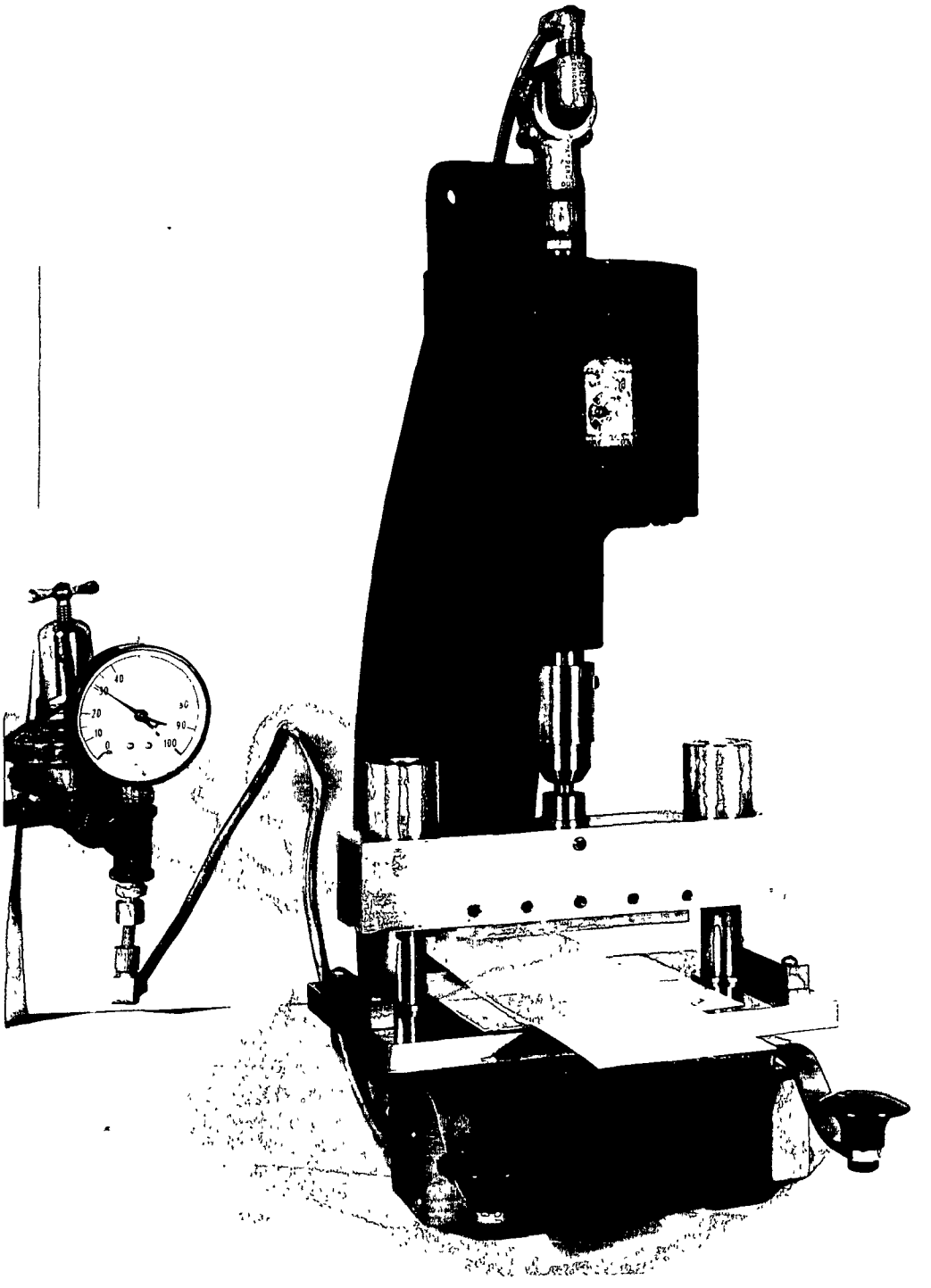
The scoring is accomplished with a section of a commercial scoring knife fastened rigidly to a metal block actuated by a pneumatic press. The knife used is 0.0275 inch thick and 4.75 inches long. The blade protrudes from the female block so that 0.375 inch of the blade width is exposed. When the blade is down, there is a distance equal to the caliper of the paperboard plus 0.003 inches between the blade and the base plate.

The female mold consists of two sheets of the same folding board cemented to the base of the tester with Shell Chemical Company Epon Adhesive No. 6. The width of the space in the female mold is equal to the thickness of the blade plus twice the caliper of the board. The average caliper of the board is 0.017 inch.

The pneumatic press (Mead Specialties Company Model 122) is driven by air pressure at 30 p.s.i. The force produced by the press is estimated to be about 360 pounds. Two metal blocks act as stops at each side of ram crosshead. A universal joint between the ram crosshead and the piston rod reduces difficulties due to any misalignment. Two fingertip type air valves and a restricted clearance under the blade are important safety features.

The scorer has shown value in its ability to differentiate between scoring resistance of different coatings.

fv/rm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PROJECT NO. 1684
COOPERATOR Institute
REPORT NO. 4
DATE May 12, 1954
NOTE BOOK 1271 (pp.'s 12-15, 18-20
PAGE N.B. 899 PP. 107,110,113,114,
SIGNED Frans Vaurio 118.
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A NEW ACRYLIC RESIN AS A PAPER COATING MATERIAL
RHOPLEX AC-33—ACRYLIC RESIN EMULSION

Rhoplex AC-33 is an acrylic resin dispersion in water. It is produced by the Rohm and Haas Company of Philadelphia.

The manufacturer gives the following typical characteristics for this material:

Solids content	46 ± 0.5 %
Emulsion viscosity	65-80 Krebs units
pH	9.0-9.5
Appearance	Milky liquid
Specific gravity	1.04
Weight per gallon	8.67 lbs.
Specific gravity of solids	1.09

This latex was included in this project because it is a new product based upon the low-cost Reppe process for synthesizing acrylic monomers directly from acetylene, carbon monoxide and alcohol.

Although it is primarily recommended as a base for water paint it appeared to have potential value in paper applications for the following reasons according to the manufacturer's claims.

No protective colloid is needed.

No problems of putrefaction.

No additives needed to increase viscosity.

High mechanical stability.

Unaffected by hard water.

Excellent chemical stability.

Good freeze-thaw stability.

Excellent storage stability.

Wide tolerance for pigments.

Excellent pigment binder.

Wide compatibility with other film formers.

Excellent sealing properties.

Unexcelled color retention.

Long film life.

Good adhesion.

Low odor.

Excellent scrub resistance.

Easy removal of stains.

The first series of screening tests that were made on this product included a study of the latex itself followed by applications of the latex on paper and paperboard and evaluating the coated products for water-vapor permeability, grease resistance, blocking and ability to take a score.

TESTS ON RHOPLEX AC-33

The solids content of the Rhoplex AC-33 was found to average 46.6% by drying approximately 4 to 5 grams of the latex for two hours at 110°C.

The viscosity at 25°C. was determined with a Brookfield Synchro-Lectric viscometer at a number of different rates of shear as shown in Table I.

PREPARATION OF COATED SPECIMENS

The Rhoplex AC-33 was applied to two types of base stock. One was a virgin sulfite folding board with a basis weight of approximately 73.5 pounds per 1000 square feet and a caliper of 0.017 inch. The other was a 39 pound per ream (24 x 36—500) bleached kraft with a machine finish. The coatings were applied as draw-downs using wire wound rods or a Martinson laboratory knife coater. Some of the coatings ere air dried and others were oven dried at 250°F. for 5 minutes. Free films were cast to get some idea of the polymer characteristics.

EVALUATION OF COATINGS

The coated board was tested for water-vapor permeability at 100°F. with 91% R. H. next to the coated side and 20% R. H. on the other side. The results are shown in Tables II and III together with the results on grease resistance.

Apparently the Rhoplex AC-33 has excellent resistance to turpentine, peanut oil and hydrogenated vegetable oil (Spry) at coating weights above one pound per 1000 square feet. There was little difference between the air-dried and oven-dried coatings. The water-vapor permeability is apparently too high to consider Rhoplex AC-33

TABLE I

BROOKFIELD VISCOSITY OF RHOPLEX AC-33
ROOM TEMPERATURE

Speed r.p.m.	Spindle	Viscosity, centipoises
6	3	2260
12	3	1490
30	3	860
60	3	592
6	4	3000
12	4	1850
30	4	1060
60	4	710

TABLE II

AIR-DRIED RHOPLEX AC-33

Run	Coating Weight lb./1000 sq. ft.	Grease Resistance, Time to Fail[a] Turpentine	Peanut Oil	Spry	Water Vapor Permeability g./sq. m./24 hrs.[b]
8-0	0.0	5 sec.	7 sec.	5 min.	1335
8-1	1.0	480 sec.	17 hr.	5 hr.	942
7-7	3.9	1800+sec.[c]	1 week+	1 week+[d]	728
7-5	4.8	1800+sec.	1 week+	1 week+[e]	650
7-3	5.6	1800+sec.	1 week+	1 week+[f]	644
7-1	6.8	1800+sec.[g]	1 week+	1 week+	521
7-1	19.9	348 sec.	91 hr.	46 hr.	554

[a] Based on Five specimens

[b] Average of two specimens. R.H. 91% inside the cup and 20% outside the cup at 100°F.

[c] One specimen failed in 540 seconds.

[d] One specimen failed in 118 hours.

[e] Two specimens failed in 10 hours.

[f] One specimen failed in 118 hours.

[g] One specimen failed in 240 seconds.

TABLE III

OVEN-DRIED RHOPLEX AC-33

	Coating Weight lb./1000 sq. ft.	Grease resistance, time to fail[a] Turpentine	Peanut Oil	Spry	Water vapor Permeability g./sq. m./24 hrs.[a]
-0	0.0	5 sec.	7 sec.	5 min.	1335
-2	1.0	126 sec.	24 hr.	2 hr.	916
-8	4.0	1800+ sec.	1 week+	1 week+	700
-6	4.6	1800+ sec.	1 week+	1 week+[c]	628
-4	5.8	1800+ sec.	1 week+	1 week+	598
-2	6.4	1800+ sec.	1 week+	1 week+[c]	533
-2	21.8	330 sec.[e]	1 week+[d]	16 hours	528

[a] Based on five specimens

[b] Average of two specimens. R.H. 91% inside the cup and 20% outside the cup at 100°F.

[c] One specimen failed in 144 hours

[d] One specimen failed in 72 hours

[e] One did not fail

for water-vapor barrier purposes.

Scoring tests were made with the new scoring device. Two scores were made at a distance of 1/2 inch from each other on both the coated and the uncoated sides of the paperboard. Colored kerosene (kerosene mixed with DuPont Oil Red Dye) was used to wet the coated side of the paperboard in the area of the scores. The kerosene was wiped off after 5 seconds and the score lines were examined for coating failures. A scoring failure is evident where the kerosene strikes through to the fibers. The Rhoplex AC-33 did not fail the scoring test. However, it was noticed that kerosene tests indicated a discontinuous coating in the case of the one lb./1000 sq. ft. coatings.

The coated board was tested for blocking tendency by means of the gradient temperature blocking plate apparatus. The blocking was tested over a period of 17 hours under a pressure of 0.28 p.s.i. (produced by a steel bar 2.64 x 2.54 x 60.9 cm. weighing 3,069 grams). See Table IV for the results.

TABLE IV

BLOCKING TESTS

Run	Coating Wt. lb./1000 sq. ft.	Blocking point, °C			
		Slight Sticking	Marring	Transfer	Complete
899-114-2	16.0	39	—	46	46
899-114-1	15.6	42	45	—	54
399-118-1	1.2	47	50	60	—*

*There was no complete (fiber disruption) blocking up to 97°C. due to starved surface.

PROJECT REPORT FORM

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COOPERATOR I.P.C.
REPORT NO. 5
DATE May 18, 1954
NOTE BOOK
PAGE TO
SIGNED Frans Vaurio

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Don Ford
Don Ford

James Throne
James Throne

Notebook 899: Pages 99, 106, 126-133
Notebook 1271: Pages 11, 14, 20-26

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PLASTICIZED POLYSTYRENE LATEX AS A COATING MATERIAL FOR PAPER

LUSTREX X-620

The Monsanto Chemical Company Lustrex X-620 is a plasticized polystyrene latex.

The manufacturer gives the following information concerning Lustrex X-620.

Form - Water dispersion

Solids content - 39 to 41%

Specific gravity at 25°C. - 1.04

Weight per gallon (pounds) - 8.7

Viscosity at 25°C. - 5-15 centipoises

Particle charge - Negative

Average particle size - 0.05 microns

pH - 8 to 9

Plasticizer - Santicizer 160

Plasticizer content (% of dry solids) - 33

Dilutability (water) - Infinite

Effect of freezing and thawing - Coagulates

Suggested uses (of interest to paper applications). Paper Coating--on decorative papers to give a flexible film with improved water and scuff resistance. Laminates--as a saturant for sheets in preparation of laminates. Saturant for paper, pulp--to impart water resistance and modified physical properties.

Films of Lustrex have a tensile strength of 818 p.s.i. and at 100% stretch the modulus is 309 p.s.i. The total elongation is 400%. The Clash-Berg softening point is +4°C.

SCREENING TESTS

The Lustrex X-620 was compounded as follows using Cellosize WSLM to obtain the viscosity required for good coating continuity.

Formulation	100-1
Lustrex X-620	500 grams
Cellosize WSLM	9 grams

Viscosity measurements were made with a Brookfield Synchro-Lectric viscometer.

TABLE I

VISCOSITY OF LUSTREX X-620
25°C.

As Received Speed, r.p.m.	Spindle	Viscosity, centipoises*
6	1	10
12	1	8
30	1	8
60	1	8
Thickened		
6	2	750
12	2	418
30	2	253
60	2	205

*Brookfield Synchro-Lectric Model LV Viscometer.

The solids content was found to be 39.3% by drying approximately 6.8 grams of Lustrex X-620 (thickened) for 16 hours at 110°C.

Coatings were applied by making drawdowns with wire wound rods. The base stocks used were a solid fiber sulfite folding board and a 39 lb. bleached kraft. Some of the coatings were air dried and others were oven dried for 5 minutes at 121°C.

The coated board was tested for grease resistance, water-vapor permeability and scoring. The coated paper was used for the blocking and heat sealing tests. The results are shown in Table II for grease resistance

and water-vapor permeability and Table III for blocking. The coatings all withstood the scoring test. At 1.4 pounds per ream coating weight there was noted a general film failure or discontinuity as brought out by the dyed kerosene test for scoring failure.

TABLE II

COATING PAPER WITH LUSTREX X-620

Number	Basis Wt. lb./1000 sq. ft.	Caliper, inch	Coating Wt. lb./1000 sq. ft.	Grease Resistance Turpentine, sec.	Grease Resistance Peanut Oil	Water-Vapor Permeability g./sq. m./24 hr.
Control	73.5	0.0171	None	5	7 sec.	1335
899-128-1	82.3	0.0195	7.4 (airdry)	348	1 week+	150
899-128-2	81.2	0.0190	7.7 (ovendry)	270	1 week+	150
899-129-1	79.7	0.0190	5.8 (airdry)	210	1 week+	207
899-129-2	80.0	0.0185	5.6 (ovendry)	198	1 week+	176
899-130-1	79.1	0.0187	4.5 (airdry)	180	1 week+	244
899-130-2	78.6	0.0183	4.6 (ovendry)	150	1 week+	212
899-131-1	77.7	0.0181	3.5 (airdry)	96	1 week+	277
899-131-2	77.2	0.0182	3.6 (ovendry)	132	1 week+	246
899-132-1	75.7	0.0176	1.4 (airdry)	Instantaneous	1465 min.	468
899-132-2	75.1	0.0178	1.5 (ovendry)	Instantaneous	598 min.	426

Note: The oven drying was at 121°C. for 5 minutes.

TABLE III

LUSTREX X-620 COATED PAPER
BLOCKING TEST

Number	Side	Blocking Temperature, °C. Sticking Slight	Sticking Strong	Marring Slight	Marring Strong	Transfer Slight	Transfer Complete
899-126-0	Face to face	21	45	—	—	—	51
899-126-1	Face to face	19	—	40	42	51	54
899-126-0	Face to back	26	—	31	62	93	—

SUMMARY AND CONCLUSIONS

The plasticized polystyrene latex appears to form continuous coatings when applied in sufficient amounts on paper. The Lustrex X-620 coatings were resistant to peanut oil for over one week but failed the turpentine test in a very short time. This is an illustration of the importance of establishing new methods for testing the grease resistance of plastic coated paper. The grease resistance is possibly adequate for materials with a short shelf life as in the case of certain bakery products.

The water-vapor resistance is unsatisfactory except for products with a short shelf life or where water-vapor resistance is not critical.

The ability to take a score appears to be satisfactory; however this may be dependent upon the type of board used and may vary under different circumstances.

The blocking resistance is probably unsatisfactory for many applications especially where automatic packaging or printing of sheets is involved. The formulation would need some modification in such cases.

fv/mab

PROJECT REPORT FORM

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Howells
Plastics Department

PROJECT NO. 1684
COOPERATOR Institute
REPORT NO. 6
DATE May 19, 1954
NOTE BOOK 899 p.107-9, 111,112,
PAGE 115-118, 119, 1271 p.
SIGNED Frans Vaurio
Frans Vaurio
Don Fird
James Throne
Don Fird
James M. Throne

CROSS-LINKING POLYVINYL ACETATE
POLYCO 507

The American Polymer Corporation (now American Polymer Company, Division of The Chemical Division of the Borden Company) has developed a new cross-linking polyvinyl acetate emulsion. The manufacturer lists the following characteristics for Polyco 507:

Form:	Nonionic emulsion
Total solids, %:	50
pH:	4.5
Viscosity:	1500 - 2000 centipoises (Brookfield)
Free monomer:	0.3% maximum
Solvent tolerance:	3
Mechanical stability:	Better than 30 minutes
Shelf stability:	3 to 4 months

Polyco 507 has the following advantages, according to the supplier, over standard polyvinyl acetate emulsions.

1. Decreased cold flow
2. Greater heat and solvent resistance
3. Improved adhesion to metals
4. Higher blocking temperatures
5. Increased wet tack

Suggested uses: base for all-purpose, room temperature curing adhesives. Polyco 507 has very good adhesion to wood, glass, steel, aluminum and laminated plastics.

SCREENING TESTS

This material was tested as a coating for paper and paperboard. The base stocks used were a virgin fiber sulphite foldingboard and a 39-pound per ream (24 X 36 - 500) bleached kraft with a machine finish.

The coatings were applied as draw-downs using wire wound rods and a Martinson knife coater. Some of the coatings were air dried and others were oven dried at 121°C. for 5 minutes. There was a tendency for streaks to form in the coatings. They appeared to be caused by resin agglomerates which were difficult to eliminate. These may be limited to the sample tested and which did not fit the suppliers specifications as to viscosity and solids content.

The solids content of the sample of Polyco 507 was checked and found to be 52.6%.

The viscosity, as determined with a Brookfield viscometer with the number 4 spindle varied only slightly with the speed of rotation.

Speed, r.p.m.	Viscosity, centipoises
6	3800
12	3550
30	3500
60	3520

The coated board was tested for water-vapor permeability, grease resistance and scoring. The coated bleached kraft was used for blocking tests.

The results of the grease resistance tests indicated excellent barrier characteristics against turpentine, peanut oil and hydrogenated vegetable oil (Spry). The coatings became discontinuous at coating weights below 4-pound per 1000 square feet.

The water-vapor permeability was too high to class Polyco 507 as a water-vapor barrier material. A six-pound coating weight had a water vapor-permeability of 446 grams per square meter per 24 hours according to the tests run as outlined in Institute Method 541.

The polyco 507 is apparently too brittle for use as a coating for folding boxes since it failed to pass the scoring test in each case.

The blocking resistance of oven-dried coatings is superior to that of air-dried coatings as shown in Table III.

TABLE I

OVEN-DRIED POLYCO 507 COATINGS

Run	Coating Weight lb./1000 sq. ft.	Greaseproofness, time to fail[a]			Water-vapor Permeability g./sq. m./24 hr.[b]
		Turpentine	Peanut Oil	Spry	
108-0	0.0	5 sec.	7 sec.	5 min.	1335
117-2	2.2	330 sec.[c]	1 week+[d]	16 hr.	528
108-9	4.4	362 sec.[e]	1 week+	1 week+[f]	471
108-7	6.0	661 sec.[g]	1 week+	1 week+[h]	446
108-5	6.2	1800+sec.	1 week+	1 week+[i]	421
108-3	9.8	1800+sec.	1 week+	1 week+	280
116-2	18.6	1800+sec.	1 week+	1 week+[j]	166

[a] Based on five specimens

[b] Average of two specimens. R.H. 91% inside the cup and 20% outside the cup at 100°F.

[c] One specimen did not fail.

[d] One specimen failed in 72 hours.

[e] Two specimens did not fail.

[f] One specimen failed in 24 hours.

[g] Two specimens did not fail.

[h] Two specimens failed in 48 and 144 hours, respectively.

[i] One specimen failed in 144 hours.

[j] Two specimens failed in 2.5 and 16 hours, respectively.

TABLE II

AIR-DRIED POLYCO 507 COATINGS

Run	Coating Weight lb./1000 sq. ft.	Greaseproofness, time to fail[a]			Water-vapor Permeability g./sq. m./24 hr.[b]
		Turpentine	Peanut Oil	Spry	
108-0	0.0	5 sec.	7 sec.	5 min.	1335
117-1	2.0	348 sec.	72 hr.	16 hr.	554
108-8	4.6	1800+ sec.	1 week+	1 week+	536
108-4	6.5	1800+ sec.	1 week+	1 week+[c]	448
108-6	6.6	1800+ sec.[d]	1 week+	1 week+[c]	422
108-1	8.0	1800+ sec.	1 week+[e]	1 week+[c]	377
116-1	18.1	1800+ sec.	1 week+	1 week+	197

[a] Based on five specimens

[b] Average of two specimens. R.H. 91% inside the cup and 20% outside the cup at 100°F.

[c] One specimen failed in 10 hours.

[d] Two specimens failed in 900 seconds or less.

[e] One specimen failed in 718 seconds.

Note: W.V.P. values are the average of two specimens; greaseproofness based on five specimens.

TABLE III

BLOCKING TEST

Polyco 507 Coating on Paperboard

No.	Base Stock	Coat Wt.	Dry	Blocking Temperature °C. Slight	Strong	Slight	Considerable	Slight	Complete
9-116-2	Board	18.6	oven	65	—	—	—	71	75
9-116-1	Board	18.1	air	44	—	56	—	60	67
9-115-0	Board	16.0	air	41.5	—	69.8	—	—	78.2
9-117-1	Board	2.0	oven	51	—	61	—	67	—*

* No complete blocking due to starved surface.