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Marshall Laboratory

Research Report

WATER SOLUBLE POLYMERS AS PRIMARY BINDERS FOR FINISHES

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ABSTRACT

Various routes to water-soluble polymers useful as primary film formers have been investigated. Ammonium salts of itaconic acid terpolymers were water soluble at lowest carboxyl content (5%) and converted to alkali-insoluble polyimides on baking. Using diamines as cross-linking agents, these soluble terpolymers gave films with attractive physical properties.

ABBREVIATIONS & FORMULAS

MMA	Methyl Methacrylate
BA	Butyl Acrylate
EA	Ethyl Acrylate
IA	Itaconic Acid
S	Styrene
AN	Acrylonitrile
V54 Alcohol	2-Vinyl-1,3-dioxolane-4-butanol
FA	Fumaric Acid
MA	Maleic Anhydride
2-EHA	2-Ethylhexyl . Acrylate

WATER-SOLUBLE POLYMERS AS PRIMARY BINDERS FOR FINISHES

INTRODUCTION:

The rapidly growing demand and large potential market for water-based finishes indicates successful development of new water-based coatings with competitive advantages should provide F. & F. with increased sales and profits. This project was started to scout various routes to new types of water-soluble polymers useful as primary film formers for finishes. This Research Report deals with the progress made in this field. Meanwhile, a systematic study of these water-soluble polymers as adjuvants for emulsion latices has also been started and will be reported separately.

OBJECTIVES:

The main objective has been to scout broadly various routes to new water-soluble polymers useful as primary film-formers and to develop coating systems with competitive advantages over conventional finishes.

SUMMARY AND CONCLUSIONS:

Itaconic acid acrylic terpolymers as ammonium salts continue to show most promise in providing water solubility at lowest carboxyl content (5%) and conversion to alkali-insoluble polyimides on baking. Using diamines as cross-linking agents, films with attractive physical properties and high degree of water resistance have been obtained. Itaconic acid copolymers and terpolymers of methyl methacrylate, ethyl and butyl acrylates, acrylonitrile and styrene have been made and used as the polymer backbone. Diamines such as ethylene diamine, hexamethylene diamine, 2,4-diaminotoluene and bis(4 -aminocyclohexyl)methane have been used for cross-linking. Diamine-terminated polyamides such as $NH_2CH_2CH_2NHCO(CH_2)_5NH_2$ made by the reaction of caprolactam and ethylene diamine have also been used to obtain an attractive balance of flexibility and hardness.

Typical primer and topcoat formulations have been evaluated and show attractive hardness/flexibility balances. An automotive sheet metal primer formulation based on ammonium salts of 40/50/10 styrene/ethyl acrylate/itaconic acid and hexamethylene diamine has shown excellent corrosion resistance and direct adhesion to "Lucite"* Acrylic Lacquer without sealer.

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The same vehicle also provides promising formulation for aluminum strip coatings, and appliance finishes. These leads will be investigated further in continuing work.

A search for water-soluble polymers that convert to insoluble films at ambient temperature has been made. Water-soluble sulfonium type polymers derived from poly-2-ethylthio-ethyl methacrylate and the V54 modified ammonia-soluble polymers such as MMA/2-EHA/Maleic-V54 half ester/AA interpolymers (30/60/5/5) have shown promise in early tests and are being studied further under P-1201.

Itaconic acid terpolymers also formed water-soluble trimethylsulfonium salts which were converted to the corresponding methyl esters on low bakes. However, room temperature conversion reactions were very slow and did not yield water insensitive films. The by-product (dimethyl sulfide) evolved during baking was odorous and this would limit the general usefulness of these trimethylsulfonium salts in finishes.

ACTION TAKEN OR PROPOSED:

The writer has been reassigned to another project (P-1204). Further evaluation and scale up of the itaconic acid terpolymers and diamine modified vehicles will be continued.

PATENT INFORMATION:

The prior art and known patents in the field of water-soluble polymers up to December, 1958, were summarized in Research Report R-59-35.

A recent competitive patent, U.S. 2,906,724 (9/29/59) issued to American Cyanamid Company claimed a composition of a water-soluble potentially thermosetting polymethyl ether of a polymethylol melamine and a water-soluble ammonium salt of an acrylic copolymer of an alpha, beta-ethylenic unsaturated carboxylic acid.

PATENT PROTECTION:

FFD-1699 covers water-soluble ammonium salts of itaconic acid terpolymers as lacquer compositions.

FFD-1713 covers polyalkylthioethyl methacrylates and their water-soluble sulfonium derivatives.

FFD-1714 covers methacryloxyethyloxazolidines, monomers and polymers thereof.

FFD-1719 covers itaconic acid terpolymers and diamines.

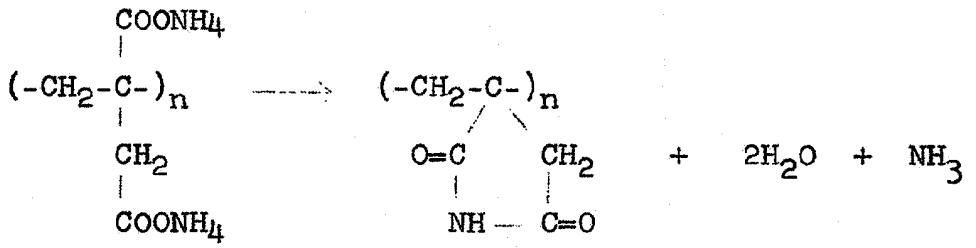
PUBLICATION STATUS:

The work on water-soluble sulfonium polymers based on 2-ethyl thioethyl methacrylate will be proposed for publication after the patent application has been filed.

H. P. Brown U.S. 2,981,721 (B.F. Goodrich) April 25, 1961
Mixtures of Carboxyl-containing polymers of butadiene and unsatd acid monomer, acylate interpolymer cross-linked with a diamine NH_2-R-NH_2

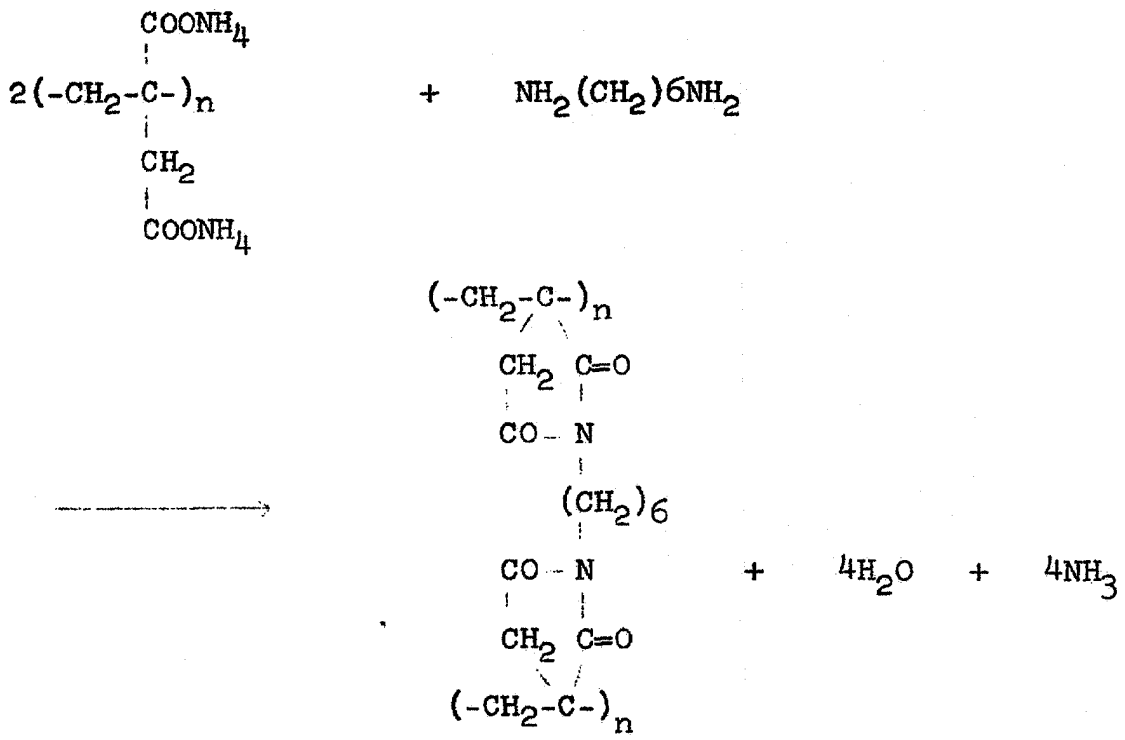
DISCUSSION:

Water-soluble polymers have long been recognized to have attractive possibilities as vehicles for finishes. The major objective of this research program has been to find promising vehicle systems which would provide outstanding properties as water-borne finishes. The field of water-soluble polymers was broadly and systematically assessed in earlier work under this program. Several preferred routes had been selected for our synthetic studies. (See Report R-60-13, P.4-5 for the detail). On basis of our systematic assessment and current synthetic studies, acrylic terpolymers containing 5-10% itaconic acid have been found to be most promising. Itaconic acid terpolymers have shown solubility in aqueous ammonia at a low level (5%) of carboxyl content and convertibility on baking to essentially non-ionic imide structure.



From literature information, ammonium salts of C_4 dicarboxylic acids such as succinic acid form imides in good yields (82-83%) by simple heating. (1)

Ammonium and ethanolamine salts of a 50/50 styrene/itaconic acid were made and their aqueous solutions baked at 200°F, 250°F and 300°F for 30 minutes. Analytical data indicated polyimide structures were formed on baking. (Nitrogen content 4.91% as against 6.13% of the theoretical polyimide). Recently, it was found that combination of an organic diamine with ammonium salts of itaconic acid terpolymers gave cross-linked polyimide structures on baking. The resulting films were insoluble in organic solvents (methyl ethyl ketone and dimethyl formamide) and showed a high degree of water resistance. Itaconic acid copolymers and terpolymers of acrylonitrile, methyl methacrylate, ethyl and butyl acrylate and stryene have been used in the polymer backbone. Organic diamines such as ethylenediamine, hexamethylenediamine, 2,4-diaminotoluene and bis(4-aminocyclohexyl)methane have been used for the cross-linking.



Preparation of Itaconic Acid Copolymer and Terpolymers (a typical example). Styrene/Itaconic acid copolymer (D-95087-1 NB 7107 p. 109).

Fifty grams of styrene, 50 g.of itaconic acid, 100 g. of dioxane and 1 g. of benzoyl peroxide were charged into a pop-bottle. The bottle was flushed with nitrogen, capped, and heated at 85°C for 16 hours in a tumbling bath. The conversion of monomers to copolymer was quantitative as indicated by solids determination.

The preparation of other itaconic acid copolymers and terpolymers is listed in Table I.

From literature information, sulfonium compounds have been shown to be water-soluble and to convert to water-insoluble compounds on standing or mild heating (References 4 and 5).

$$RCH_2CH_2\overset{+}{S}(CH_3)_2 \quad \overset{-}{OH} \longrightarrow \begin{cases} RCH{=}CH_2 + (CH_3)_2S + H_2O \\ RCH_2CH_2SCH_3 + CH_3OH \end{cases}$$

In 1956, E. L. Buhle found that dodecyl methyl phenyl sulfonium acetate, a water-soluble cationic dispersant, converted to water-insoluble product under "air-dry" conditions, (2 and 3).

A phase of our scouting program has been to utilize this principle in the field of water-soluble, room temperature convertible sulfonium polymers. Anionic trimethyl sulfonium polymers have been made by neutralizing MMA/BA/IA terpolymers with trimethyl sulfonium hydroxide.

$$\begin{array}{l} CH_2COOH \\ (CH_2\text{-}C\text{-})_n \\ COOH \end{array} + 2(CH_3)_3\,S^+OH^- \longrightarrow \begin{array}{l} CH_2COO^-\ S^+(CH_3)_3 \\ (-CH_2\text{-}C\text{—})_n \\ COO^- \qquad S(CH_3)_3 \end{array}$$

Anionic Trimethylsulfonium Polymers

These polymers have been shown to convert to corresponding methyl ester on low bakes. However, room temperature conversion reaction were slow and did not yield water-insensitive films. Cationic sulfonium polymers derived from poly-2-ethylthioethyl methacrylate have also been made.

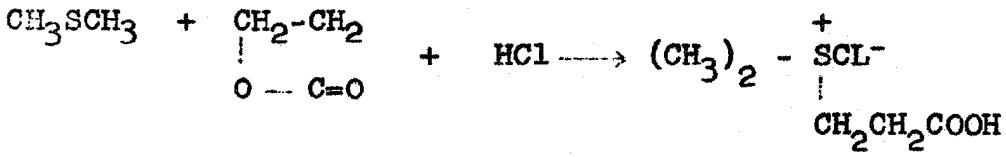
$$\begin{array}{l} CH_3 \\ (CH_2\text{-}C\text{-})_n \\ COOCH_2CH_2\text{-}S\text{-}C_2H_5 \end{array} + CH_3X \longrightarrow \begin{array}{l} CH_3 \\ (-CH_2\text{-}C\text{—}) \\ COOCH_2CH_2\text{-}S\text{-}R \end{array}_{n} + X^-$$

$$CH_3$$

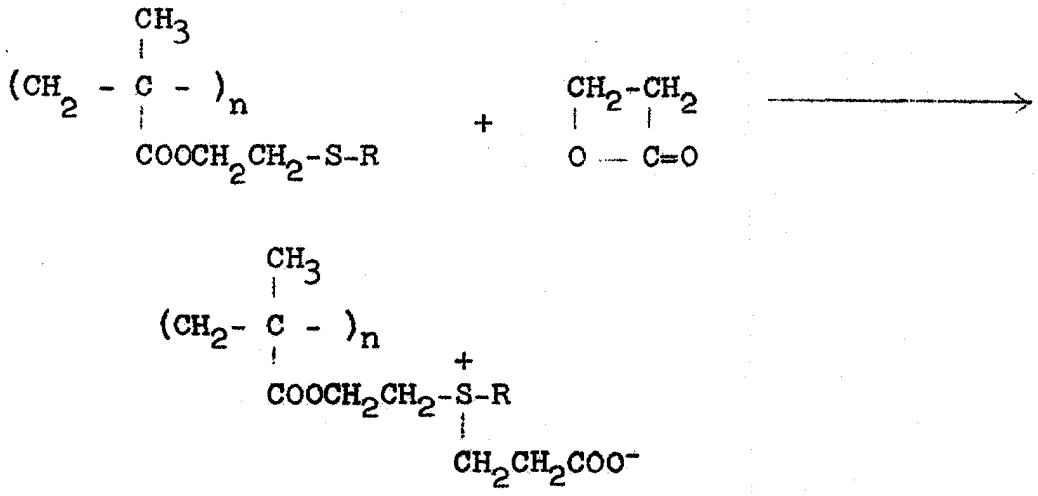
X = Methyl Sulfate, iodide, acetate, etc.

Cationic Sulfonium Polymers

The acetate salt of the above polymer appears to show promise as the room temperature convertible system. From the literature information (Reference 6), dimethyl sulfide has been shown to react with beta-propiolactone to give dimethyl-beta-propiothetin salts in good yield.



Attempts to prepare propiothetin polymers by reacting poly-2-ethythioethyl methacrylate with beta-propiolactone have been unsuccessful.



EVALUATION RESULT OF ITACONIC ACID TERPOLYMERS CROSS-LINKED WITH DIAMINES

A. Typical Example

Five grams of a 40/50/10 S/EA/IA terpolymer (D-95123 as a 50% solution in butyl carbitol, H-648) was neutralized with 5 ml conc. ammonium hydroxide and diluted with 20 ml distilled water to give a clear and homogeneous solution. To this solution, 0.223 g. of hexamethylenediamine (m.p. 39-42°C, chemically pure grade, supplied by Matheson, Coleman & Bell Lot #6115 HX-315) was added. The amount of hexamethylene diamine was calculated on the basis of one mole of diamine for two moles of itaconic acid in the terpolymer. The ammonium salt of itaconic terpolymer and the diamine solution was doctor bladed over four Bonderite steel panels and then baked at 300°F for 30 minutes. Film properties such as adhesion (TM-37) were excellent; impact (TM-386-A) was excellent; humidity (TM-214) was 10 and solvent resistances to MEK and xylene were very good.

Other aqueous ammonia soluble itaconic acid terpolymers including 50/40/10 MMA/EA/IA, 52.8/42.2/5.0 MMA/BA/IA and 59/31/10 AN/BA/IA have been used as the polymer backbones. Other diamines including ethylenediamine, 2,4-diaminotoluene and bis(4-aminocyclohexyl)methane have been used as the cross-linking agent. However, the hexamethylenediamine cross-linked films gave the best flexibility-hardness balance.

PREPARATION OF EXPERIMENTAL AUTOMOTIVE SHEET PRIMER (W-20925 NB 7297 p. 44)

Vehicle Used

400 g.	40/50/10 S/EA/IA in 50% butyl cellosolve (W-20908B)
40 ml	distilled water
7.6 g.	hexamethylenediamine (MC & B HX-315) in
80 ml	distilled water

Pigment Used

11.1 g.	M-50 Lead Silicochromate (supplied by National Lead Co.)
10.8 g.	W-222 Molacco Black
73.4 g.	W-138 Micronized Talc
147.2 g.	W-1008 Aluminum Silicate

Thinner

200 ml Distilled water

The above ingredients were ground in a gallon porcelain mill filled with pebbles.

The primer had a solids of 30.4% by weight and a viscosity of 16 seconds (#15 Parlin cup) or 3 minutes 3 seconds (#3 Zahn cup). The fineness of the primer was less than 0.5 mil.

Evaluation results of the above experimental primer are listed in Table II.

PREPARATION OF EXPERIMENTAL APPLIANCE ENAMEL (W-20938 NB 7297 p. 65)

Vehicle Used

800 g.	40/50/10 S/EA/IA as a 50% solution in butyl cellosolve (W-20908B)
80 ml	conc. ammonium hydroxide
320 g.	Distilled water
15.2 g.	Hexamethylenediamine (MP 39-41°C) supplied by Matheson, Coleman & Bell Lot No. HX-315) in
160 g.	distilled water

Pigment Used

400 g. W-43 titanium dioxide

The vehicle and the pigment were ground in a "47 Process" (2 passes). Additional amount of water (100 g.) was added during and after the grinding to adjust to the desired viscosity. The fineness of the enamel was 0.5 mil and the yield was 1450 g. Solids of the enamel = 43.5%. Pigment/binder ratio = 100/100.

Note: The amount of hexamethylenediamine was calculated on the basis of 85% of the theory.

Evaluation of the Experimental Appliance Enamel.

The experimental appliance enamel (W-20938) was evaluated briefly. This enamel was doctor bladed over

Bonderite 1000 panels and baked at 300°F for 30 minutes. The resulting films had a hardness of 22.8 (Knoop), a gloss of 88.4 (85°). These films have shown good resistance to xylene and methyl ethyl ketone and good resistance to humidity (100% RH at 120°F for 2 weeks).

SCALE UP OF STYRENE/ETHYL ACRYLATE/ITACONIC ACID TERPOLYMERS (W-20941 NB 7297 p. 70)

To a 3-liter, 3-neck flask equipped with stirrer, thermometer, nitrogen lead, reflux condenser and dropping funnel, and heated by an electric heating mantle, was charged 128 g. of butyl cellosolve (H-224). The charge was heated to reflux (130-142°C) under a nitrogen blanket and the mixed monomers-initiator-solvent charge was added in four equal portions at one hour intervals while reflux was maintained.

Monomers-Initiator-Solvent Charge

700 g. Sytrene (rubber grade H-710)
200 g. EA (Rohm & Haas #1669)
100 g. IA (Eastman #2690)

538 g. H-224 Butyl Cellosolve

20 g. Di-tert-butyl Peroxide (H-640)

The polymerization was somewhat exothermic. This was controlled by proper heating input and by the refluxing of the solvent. After the addition of the monomer charge, the heating was continued for an additional hour. The temperature of the reaction was maintained between 130-142°C throughout the polymerization. At this point, the polymerization was essentially completed. The solids were 59.7% which was calculated to be 99.4% conversion.

After cooling the polymer solution, it was neutralized with 200 ml conc. ammonium hydroxide and 1134 ml of distilled water to give a clear and viscous solution. The solids of this aqueous solution was 33.7% and the yield was nearly quantitative.

TRIMETHYLSULFONIUM SALT OF 50/50 STYRENE/ITACONIC ACID COPOLYMER

Twenty grams of 50/50 styrene/itaconic acid copolymer in dioxan was neutralized with 49 ml of 1.57N trimethylsulfonium hydroxide (DS-44731, supplied by Crown Zellerbach Corp.) and diluted further with 31 g. distilled water. The resulting solution was clear and homogeneous. This polymer solution was doctor-bladed on eight 5" x 7" glass panels. Eight panels were divided into four duplicate sets. One was air-dried at the room temperature for 48 hrs. Other three sets were baked at 200°F, 250°F and 300°F for 30 minutes, respectively. These films (except the air-dried one which was tacky after 48 hours at the room temperature) were scraped from the glass panels and submitted for analysis. The results of the analysis are shown in Table.

Analysis of Baked Films of Trimethyl Sulfonium Salts of 50/50 Styrene/Itaconic Acid Copolymer.

BAKING TEMPERATURE	SULFUR CONTENT	ACID NUMBER	SAPONIFICATION NO.
200°F	1.17%	19.9	232.8
250°F	0	27.3	193.0
300°F	0	-	-
Theoretical	15.5%	0	390

PREPARATION OF 2-ETHYLTHIOETHYL METHACRYLATE (D-95126, NB 7107 p. 155)

Methyl Methacrylate Monomer H-428	500 g.
2-Ethylthioethanol (Pennsalt DS-44791)	106 g.
Hydroquinine (Fisher Chemical Lot #H-329)	5 g.
Sodium Methoxide (Matheson, Coleman & Bell 5943)	2 g.

The above materials were charged into a 2-liter, 3-neck flask equipped with stirrer, continuous water separator-condenser and thermometer. The reaction mixture was heated to reflux (92-110°C) for 4 hours. An azeotrope consisting of methanol and methyl methacrylate was distilled off.

The temperature of the distilling head was kept between 64-67°C. The reflux was continued for about one more hour after which time the reaction was nearly completed. The excess methyl methacrylate was stripped off under an aspirator vacuum and the product was distilled over at 59-68°C (0.4-0.6 mm). The yield of the crude product was 150 g. (78.5% of the theoretical).

This product was purified further by redistillation (b.p.59-62°C at 0.4-0.6 mm). Yield of the pure product was 60 g.

	% C	% H	% S
Anal. calc'd. for $C_8H_{14}O_2S$:	55.1	8.1	18.4
Found:	55.0	8.52	17.93

PREPARATION OF POLY-2-ETHYLTHIOETHYL METHACRYLATE

Twenty grams of 2-ethythioethyl methacrylate monomer (D-95126) 20 g. of acetonitrile and 0.5 g. azo-bis-isobutyronitrile (QY-602) were charged into a pop-bottle. The bottle was then flushed with nitrogen and tightly capped using a thin "Mylar"* film to prevent any contamination from the cork. The polymerization was carried out in a tumbling bath for 16 hours. The temperature of the polymerization bath was maintained at 85°C ± 0.5°C. The conversion of monomer to polymer was 98.4% indicated by a solids determination.

PREPARATION OF WATER-SOLUBLE SULFONIUM POLYMERS DERIVED FROM POLY-2-ETHYLTHIOETHYL METHACRYLATE

A. With Methyl Iodide

Ten grams of poly-2-ethylthioethyl methacrylate solution (0.0287 equivalent) in acetonitrile (D-95133) was thoroughly mixed with 10.0 g. methyl iodide (0.071 equiv.) in a 250 ml flask. The mixture was kept at the room temperature in a dark place for 16 hours. To the reaction mixture there was added 200 ml of anhydrous ethyl ether. The polymeric product that precipitated was decanted and washed twice with 200 mil portions of ether. The resulting polymer was dissolved in 27 ml distilled water to give a clear and somewhat viscous solution indicating

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that the sulfonium polymer had formed.

B. With Methyl Sulfate

Ten grams of poly-2-ethylthioethyl methacrylate solution (0.0287 equivalent) in acetonitrile (D-95133) was thoroughly mixed with 9.0 g. of dimethyl sulfate (0.072 equiv.) in a 250 ml flask. The mixture was kept at the room temperature overnight. To the reaction mixture, 200 ml of anhydrous ethyl ether was added to precipitate the polymeric product. The product was decanted from the liquid phase and washed twice with 200 ml portions of ether. The resulting polymer was dissolved in 26 ml of distilled water to give a clear and viscous solution.

C. Convertible Sulfonium Acetate Polymer

The sulfonium iodide salt solution of poly-2-ethylthioethyl methacrylate described under A, was treated with a lead acetate solution containing 5.45 g. (0.0143 equiv.) of $PbAc_2 \cdot 3H_2O$ and 20 ml of distilled water. The lead iodide precipitate was filtered off. The clear polymer solution was flowed out on a 5" x 7" glass plate. After overnight drying at room temperature, the film was no longer water-soluble.

ATTEMPTED REACTION OF POLY-2-ETHYLTHIOETHYL METHACRYLATE WITH BETA-PROPIOLACTONE.

A. Ten grams of a 50% solution of poly-2-ethylthioethyl methacrylate in nitromethane and 10 grams of beta-propiolactone were charged into a 3-neck, 250 ml flask equipped with a gas inlet tube, a magnetic stirrer, a thermometer and a reflux condenser. A stream of anhydrous hydrogen chloride was bulbed through the reaction mixture at a temperature of 25-30°C for one hour. The mixture was kept at room temperature for 54 hours. To this mixture, 200 ml of anhydrous ethyl ether was added to precipitate the polymer. The precipitate was washed by decantation twice with 20 ml portions of ether. The resulting polymer was not soluble in water indicating that poly-2-ethylthioethyl methacrylate did not react with beta-propiolactone.

JCF/McD
3/20/61

LITERATURE REFERENCES:

(1) Succimide was made in 83% yield by heating ammonium succinate.
Org. Syntheses Col. Vol. II, page 562.

(2) Convertible Dispersing Agents for Finishes.
Research Reports 1361, 1404, R-56-16, R-56-49 and R-57-35.

(3) Convertible Sulfonium Dispersants.
R-57-65.

(4) Thermal Decomposition of Sulfonium Hydroxides.
J. Chem. Soc., 533 (1933).

(5) Decomposition of Triethylsulfonium Bromide.
Trans. Faraday Soc., 23 605 (1927).

(6) Dimethyl-beta-propiothetin Hydrochloride was made by reacting dimethyl sulfide with beta-propiolactone.
J. Am. Chem. Soc., 73, 2355 (1951).

TABLE I
PREPARATION OF ITACONIC ACID TERPOLYMERS

Polymerization Temperature 85°C., Time 16 Hours

Code	Compositions	% Conversion	Molecular Weight(1)	Solubility in NH_4OH (2)	NB 7297 page
W-20903-I	59/31/10 AN/BA/IA	89.8	-	Soluble	6
W-20903-II	33/57/10 AN/BA/IA	91.8	-	Soluble	6
W-20905-1	90/10 MMA/IA	100	72,000	Soluble	9
W-20905-2	90/10 EA/IA	97.6	65,000	Soluble	9
W-20908-A	50/40/10 MMA/EA/IA	100	72,000	Soluble	18
W-20908-B	50/40/10 EA/S/IA	99.6	38,000	Soluble	18
W-20908-C	50/40/10 MMA/EA/MA	100	-	Insoluble	18
W-20908-D	50/40/10 MMA/EA/IA	96.8	-	Insoluble	18
W-20912-A	56/29/15 AN/BA/IA	100	-	Soluble	24
W-20912-B	58/30/12 AN/BA/IA	100	-	Soluble	24
W-20916-A	59/31/10 AN/BA/IA	59	-	Soluble	28
W-20920	40/50/5/5 S/EA/IA/AA	100	-	Soluble	39
W-20939I	60/32/8 S/EA/IA	96.4	38,000	Partially Soluble	66

Table I Cont'd.

Code	Compositions	% Conversion	Molecular Weight(1)	Solubility in NH_4OH(2)	NB7297 Page
W-20939-III	70/22/8 S/EA/IA	95.8	-	Partially Soluble	66
W-20939-V	80/12/8 S/EA/IA	94.4	-	"	
W-20940-I	60/30/10 S/EA/IA	95.4	37,000	Soluble	67
W-20940-III	70/20/10 S/EA/IA	94.6	-	Soluble	67
W-20940-V	80/10/10 S/EA/IA	94.2	-	Soluble	67
W-20942	42/50/8 MMA/EA/IA	98.8	61,000	Soluble	72
W-20943	42/50/8 MMA/EA/IA (3)	98.8	-	Soluble	72

(1) Determined from relative viscosity in ethylenedichloride and the viscosity - molecular weight curve for polymethyl methacrylate.

(2) Soluble of polymer was determined by dissolving 1 g. polymer in 10 g. of 10% NH_4OH.

(3) Polymer made in 70% butyl cellosolve.

TABLE II

EVALUATION OF AUTOMOTIVE SHEET METAL PRIMER (NOTEBOOK 7297, p. 60-61)

PANEL	PRIMER	°F BAKE	SEALER	TOPCOAT	°F BAKE	160 HRS. BLISTER	25 CYCLE HUMIDITY-CRACK	60° GLOSS	TUKON	AD-HESION	GRAVEL-OMETER	165 HRS. SALT SPRAY (Primer Only)
1	W-20925	300 x 30	None	885-050	225 x 30	None	OK	53.6	8.0	Exc.	9	10
2	"	325 x 30	"	"	"	"	"	55.7	8.1	"	9.5	10
3	"	350 x 30	"	"	"	"	"	53.7	7.8	"	9.5	10
4	64-1690	400 x 20	881-94184	"	"	"	"	61.0	7.2	"	9.5	9.5
5	W-20925	300 x 30	None	794-73845	250 x 30	"	"	97.1	5.3	"	9	-
6	"	325 x 30	"	"	"	"	"	98.4	5.3	"	9	-
7	"	350 x 30	"	"	"	"	"	97.7	5.0	"	9	-
8	64-1690	400 x 20	"	"	"	"	"	97.1	5.0	"	9.5	-

Note: 64-1690 - Standard Alkyd Based Automotive Sheet Metal Primer
881-94184 - Standard Hydroxyaminopropyl Methacrylate Sealer
885-050 - "Lucite" White Acrylic Lacquer (Unbuffed)
794-73845 - "Dulux 100"