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Philadelphia Plant
November 14, 1946

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PHILADELPHIA PLANT - PROCESS & METHODS REPORT NO. 4
SODIUM VERSUS LEAD CATALYSTS IN RESIN MANUFACTURE

The attached report summarizes the results obtained in a study conducted for the purpose of evaluating sodium versus lead catalysts in the manufacture of resins. This study has now been completed at Philadelphia insofar as all the scheduled batches have been manufactured and the essential production and test data taken as outlined in the original program.

It was originally planned to incorporate the results of an exactly similar study to be conducted by the Toledo Plant. However, since these results are not yet available, we are forwarding Philadelphia's report for your preliminary consideration. As soon as the necessary data is available from Toledo, we will make any necessary correlations and submit same.

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PARLIN LABORATORY OFFIC
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PHILADELPHIA PLANT

PROCESS & METHODS REPORT NO. 4

EVALUATION OF SODIUM VS. LEAD CATALYSTS

ISSUED: NOVEMBER 14, 1946

PHILADELPHIA PROGRESS AND METHODS REPORT NO. 4

SODIUM VERSUS LEAD CATALYSTS IN RESIN MANUFACTURE

I. INTRODUCTION

The purpose of this report is to summarize the results of a study which was made for the purpose of evaluating the use of sodium versus lead catalysts in alkyd resin manufacture. This study was made as the initial phase of a comprehensive program to investigate the possibility of obtaining a reduction of manufacturing costs through elimination of resin filterpressing. The need for clarification of our resin liquid has been the subject of considerable thought and discussion for several years but no full scale program had ever been previously undertaken to develop the information which would be required to arrive at final decision in this matter. As a result of a series of discussions held early in 1946, it was decided to set up a program to evaluate the use of sodium-hydroxide catalyst with the ultimate objective of determining its full economy and desirability. Accordingly, in a meeting held at Philadelphia in May 1946 and attended by representatives of operating supervision of Toledo and Philadelphia, the Philadelphia Laboratory, and Process and Methods Groups, the first phase of this program was developed and outlined in detail. Plans were made for both Toledo and Philadelphia to produce the same type batches, conduct similar tests and to procure the same processing and filtration data. It is expected that the results obtained in this program will provide a background on which decision for future course of action can be based.

II. PROCEDURE

The following is a general description of the procedure which was followed in making this study:

1. Three batches of each of the following resins were manufactured using the normal lead oxide (litharge) catalyst.

   RC-103 - Chinawood Alkyd *
   RC-203 - Grinding Vehicle
   RC-114 - Soya Alkyd

   * This type resin was produced on the low Chinawood formula.

2. After completing the above, three batches of each of the same resins were manufactured, using sodium hydroxide catalyst in place of the lead oxide. Quantities of catalyst used in each resin are shown in Exhibit I. The Philadelphia Laboratory issued experimental formulas to cover this formulation change.

3. All batches were processed and otherwise handled in the standard manner:

   A. Batch size - 3,000 gallon finished resin
   B. Type processing - Solution method(mono and batch)
   C. Type of phthalic addition - Screw feed
   D. Catalyst addition - Slurry
   E. Condition of cooking kettle - Cleaned before each batch.

4. Samples of the unfiltered resins were taken and examined for appearance, cloud, etc.

5. All batches were filterpressed in the normal manner:

   A. All batches filterpressed from storage tanks.
   B. Type of filterpress - Shriver 24" plate and frame
   C. Type of press pump - Viking ZXM - 1½"
   D. Maximum pump pressure - 150#/sq. in.
   E. Pump Speed - 164 R.P.M.
   F. Type filter paper - Kraft .025"
   G. Type press screens - #18 gage perforated plate - 95 holes per sq.in. 7/64" centers
   H. Type filter aid - Johns-Manville Standard Super Cel
   I. Method of filter aid application - Pre-coat
   J. Pounds filter aid per coating - 3.0

II. PROCEDURE _ Continued

6. Complete manufacturing records and equipment data were taken. This included all available data in regard to cooking cycles, filterpressing rates, etc. See Exhibit III and Sample Data Sheet Exhibit VI.

7. Complete laboratory control tests were made on all batches and recorded. See Exhibit IV.

8. Records were kept of all finished product enamels into which sodium catalyzed resins were consumed.

9. Filtration tests were run on all unfiltered batches using the Parlin Filtration Test for Nitrocellulose #718 and results recorded. See Exhibit V.

III. SUMMARY OF RESULTS

The results obtained in this study are summarized and discussed under separate headings as follows:

1. All batches of both types were normal in respect to mono and batch cooking cycles with the exception of one RC-114, sodium catalyzed, in which it was necessary to add additional G-218 to obtain the monoglyceride. This single batch was extremely poor in cooking cycle, clarity and filtration properties.

   Both RC-114 and RC-203, sodium catalyzed, required longer mono and batch cycles than the corresponding lead batches while all sodium RC-103's reached mono stage in 30% less time than the lead RC-103's.

2. Clarity of the unfiltered resins was definitely better in the case of the sodium batches. All lead batches were considerably cloudy whereas six of the nine sodium batches were clear or only very slightly cloudy. This was more pronounced in the case of the sodium RC-103's, two of which could have passed control laboratory clarity tests in unfiltered state.

   This difference in clarity was noticed in the case of two of the three sodium RC-114's which were better than the corresponding lead batches. However, the third sodium RC-114 was extremely cloudy.

   The difference in clarity was least noticeable in the case of the RC-203's. However, the sodium batches were slightly better than the corresponding lead batches.

3. All batches successfully passed all laboratory control tests. No trouble was experienced with drying time in the case of the sodium batches. See Exhibit IV.

4. Filtration cycles of all sodium batches were shorter than in the case of the lead. In the case of the sodium RC-103's this difference amounted to almost 50%.

5. Filtration rates in gallons of resin filtered per hour per square foot of press area were higher in the case of all sodium batches. Here again, the greatest difference was in the case of the RC-103's, the sodium batches showing about 45% better than the lead.

6. In gallons filtered per change of papers on press, the sodium RC-103's again showed better performance. However, the performance of sodium RC-114's and RC-203's was poorer than in the case of the corresponding lead batches. Part of this can be attributed to the one single heavy clouded sodium RC-114 which required six changes of papers.

III. SUMMARY OF RESULTS Cont'd

7. The results of the Parlin Filtration Tests on the unfiltered resins varied over wide limits. However, in general the rates obtained checked fairly closely with the rates of resin filtered per change of press papers. The sodium RC-103's performed better while the RC-114's and RC-203's were poorer than the lead.

8. The color of the sodium resins was noted to be darker than those of the corresponding lead batches in the case of RC-114 and RC-203 while the RC-103's were about equal. This condition may possibly be attributed to color of raw materials which may have varied to that extent between the periods of these tests.

9. All sodium catalyzed batches contained less precipitated materials, such as phthalates and other types of seed, than the corresponding lead batches. Practically no sediment was noticed in the case of all sodium RC-103's and two of the three sodium RC-114's, while the sodium RC-203's showed very little precipitated matter. All lead batches contained some quantity of whitish-gray sediment which varied from slight in the case of RC-103's to heavy for RC-203's.

10. No failure to pass routine control tests of the finished product enamels into which the sodium-catalyzed resins were consumed was noted.

IV. CONCLUSIONS

Although all phases of this evaluation were conducted according to the program as planned and as uniformly as possible, there were a number of conditions on which control was neither possible nor practical. The following items appear to be among the more significant:

1. Due to recurring shortages in oils, glycerine and phthalic anhydride and because of the type batches, it was necessary to extend these tests over a four-month period. Thus, changes in raw material characteristics could have had some effect on the results. Probably more uniform or consistent rates could have been attained through use of the same lots of materials for similar batches. However, this was not possible under the existing operating conditions.

2. Filterpressing was performed in as uniform a manner as possible. However, since all batches must necessarily be filterpressed from pre-filter storage tanks and since storage time before pressing varied from .5 hour to 80 hours, it is quite probable that some batches "settled out" to varying degrees and others may have "picked up" quantities of sediment in the tanks. These conditions may have affected the pressing rates for all batches. Also, temperature of batches being filtered varied from 150°F. to 224°F. which undoubtedly caused some difference in rates.

3. Only three batches of each type resin were produced and used as a basis in this study. This small number of tests limits the degree of dependability which can be placed on the averages of the results obtained.

The results obtained in this study appear to justify the following conclusions:

1. Resins of the type RC-103, RC-114, and RC-203 can be successfully catalyzed with sodium hydroxide and produced in the normal manner. They require about the same percentage of catalyst as in the case of lead catalyzed resins of the same type.

2. It is possible that some increase in total batch cooking cycle may occur in the case of sodium catalyzed RC-114's and RC-203's. However, it is felt that a greater number of tests would be needed to completely evaluate this factor.

3. Sodium catalyzed resins can be successfully used in all finished product enamels into which lead catalyzed resins are consumed.

IV. CONCLUSIONS - Cont'd

4. Sodium-catalyzed resins, in unfiltered state, contain less sediment and cloud than lead batches. Clarity, especially in high acid number resins, is often nearly equal to that obtained by filterpressing.

5. Filterpressing of sodium-catalyzed resins is equal to or better than in the case of lead batches in considering overall pressing rates. No marked improvement in gallons of resin per press change can be expected.

6. The Parlin Nitrocellulose Test Method #718 can probably be applied to checking resin filtration rates but its accuracy has not been clearly demonstrated in this small number of tests. Additional tests are being run on regular production batches to procure further data.

Although no specific recommendations regarding the next steps to be taken in this evaluation would be advisable until results are available from Toledo, the results obtained in our tests indicate that plant-scale production of sodium-catalyzed batches could be made and filterpressing of some type batches eliminated for a definite trial period. A suggested procedure for this was outlined in Dr. P. Robinson's letter of April 17, 1946 to M. A. Dibble. Various modifications of this plan can be made and it should be considered in setting up the next step in this program. As pointed out in the above letter, the effect of unfiltered sodium-catalyzed resins on finished product enamels has never been conclusively evaluated. Production and testing on a laboratory basis is usually not comparable to plant-scale operation. Therefore, no true picture can be obtained until a series of batches is produced in the plant and evaluated in finished product enamels.

SODIUM VS. LEAD CATALYSTS

EXHIBIT I

% CATALYSTS

CODE	CATALYST	NAME	FORMULA % CATALYST USED *
103	W-603	Lead Oxide (Litharge)	.093
103	G-218	Sodium Hydroxide	.087
114	W-603	Lead Oxide (Litharge)	.027
114	G-218	Sodium Hydroxide	.026 **
203	W-603	Lead Oxide (Litharge)	.087
203	G-218	Sodium Hydroxide	.085

* Based on percentage of catalyst in oils only, not including glycerine.

** One batch required an additional charge of G-218 to complete reaction. Total charge of G-218 was .041% in this single batch.

SODIUM VS. LEAD CATALYSTS

EXHIBIT II

CODE	TYPE CATALYST	AVERAGE COOKING CYCLE-HOURS			FILTRATION TIME HOURS PER BATCH	GALLONS FILTERED PER PRESS CHANGE	GALLONS FILTERED PER SQ. FT. PRESS AREA PER HOUR
		MONO	BATCH	TOTAL			
RC-103	Lead	3.48	3.70	7.18	4.76	2250	9.41
RC-103	Sodium	2.64	4.26	6.90	3.22	3000	13.75
RC-114	Lead	4.19	11.08	15.27	5.69	1500	5.83
RC-114	Sodium	5.39	12.21	17.60	5.67	820	7.17
RC-203	Lead	3.00	10.91	13.91	5.67	3000	7.54
RC-203	Sodium	3.31	13.74	17.05	4.83	1800	9.13

SODIUM VS. LEAD CATALYSTS

EXHIBIT III

PRODUCTION & FILTRATION DATA

Code	Type Catalyst	Batch Number	Date Produced	Mono Temp. at Catalyst Addition - °F.	Cooking Cycle Hours			Hours in Storage Before Pressing	Number of Press Plates Used	Average Resin Temp. °F. During Pressing	Press Changes Per Batch Incl. Set-Up	Final Press Pressure - Lbs. Per Sq. Inch	Pressing Time Hours Per Batch	Press Man Hours Per Batch	Gallons Filtered Per Sq. Ft. Press Area Per Hour	Gallons Filtered Per Press Change
					Mono	Batch	Total									
RC-103	Lead	56056	6/10/46	200	4.00	3.33	7.33	1.0	17	165	2	150	5.57	2.37	7.92	1500
		56095	7/10/46	200	3.25	3.58	6.83	20.0	17	180	1	15	4.50	3.00	9.80	3000
		56096	7/10/46	200	3.20	4.20	7.40	22.0	17	190	1	10	4.20	2.20	10.50	3000
RC-103 (PROP-53644)	Sodium	55119	7/25/46	200	2.83	4.50	7.33	16.0	17	170	1	0	3.50	2.00	12.60	3000
		55120	7/25/46	200	2.25	4.17	6.42	8.0	17	180	1	10	3.00	3.00	14.70	3000
		55121	7/29/46	225	2.83	4.10	6.93	6.0	17	185	1	15	3.16	2.00	13.96	3000
RC-114	Lead	57445	5/22/46	235	3.00	11.25	14.25	.5	24	206	2	150	5.58	2.79	5.60	1500
		56274	6/25/46	200	4.90	10.85	15.75	2.0	22	205	3	150	5.50	5.00	6.20	1000
		55328	7/24/46	200	4.67	11.13	15.80	12.0	22	190	1	20	6.00	5.00	5.68	3000
RC-114 (PROP-53646)	Sodium	55125	7/30/46	200	4.00	10.30	14.30	26.0	22	170	1	10	5.00	3.00	6.82	3000
		52120	10/4/46	200	5.08	10.92	16.00	80.0	17	150	46	150	6.00	6.00	7.35	750
		52133	10/7/46	200	7.08	15.42	22.50	15.0	17	170	6	150	6.00	6.00	7.35	500
RC-203	Lead	57410	5/29/46	250	2.75	10.58	13.33	3.5	18	210	1	60	5.25	2.62	7.94	3000
		57321	6/5/46	260	2.75	11.16	13.91	.5	18	224	1	25	6.25	3.95	6.67	3000
		57391	6/18/46	250	3.50	11.00	14.50	5.0	17	200	1	50	5.50	2.25	8.02	3000
RC-203 (PROP-53645)	Sodium	55122	8/2/46	245	3.40	14.18	17.58	72.0	17	170	1	10	4.75	4.75	9.29	3000
		55123	8/15/46	230	3.20	15.38	18.58	3.0	17	210	1	15	5.00	5.00	8.82	3000
		55124	10/15/46	200	3.33	11.67	15.00	48.0	17	180	3	150	4.75	4.75	9.29	1000

SODIUM VS. LEAD CATALYSTS
EXHIBIT IV
LABORATORY CONTROL TEST DATA

Code	Type Catalyst	Batch Number	Date Produced	Gallon Weight	Viscosity	Color	% Solids	Acid Number	Drying	Clarity	Cleanness	Clarity of Unfiltered Resin
RC-103	Lead	56056	6/10/46	7.98	1/2 L Z-1	4.0	49.3	23.7	O.K.	O.K.	O.K.	Medium Cloudy
		56095	7/10/46	7.96	1/5 H Z-1	3.8	49.25	21.9	O.K.	O.K.	O.K.	Medium Cloudy
		56096	7/10/46	7.96	1/5 H Z-1	3.8	49.25	21.9	O.K.	O.K.	O.K.	Medium Cloudy
RC-103 (PRCP-53644)	Sodium	55119	7/25/46	7.95	1/2 H Z	3.8	49.9	21.9	O.K.	O.K.	O.K.	Clear
		55120	7/25/46	7.95	1/2 H Z	3.8	49.9	21.9	O.K.	O.K.	O.K.	Clear
		55121	7/29/46	7.90	1/4 H Z-1	3.9	49.6	20.8	O.K.	O.K.	O.K.	Very Slightly Cloudy
RC-114	Lead	57445	5/22/46	7.90	1/4 L W	3.0	55.7	5.3	O.K.	O.K.	O.K.	Medium Cloudy
		56274	6/25/46	7.89	1/2 L V	3.25	56.0	5.88	O.K.	O.K.	O.K.	Very Cloudy
		55328	7/24/46	7.91	W	3.25	56.2	5.27	O.K.	O.K.	O.K.	Medium Cloudy
RC-114 (PRCP-53646)	Sodium	55125	7/30/46	7.88	V	3.25	57.4	4.52	O.K.	O.K.	O.K.	Clear
		52120	10/4/46	7.86	1/4 L W	3.80	55.2	4.47	O.K.	O.K.	O.K.	Slightly Cloudy
		52133	10/7/46	7.83	1/2 H U	3.80	54.5	5.15	O.K.	O.K.	O.K.	Very Cloudy
RC-203	Lead	57410	5/29/46	7.90	U	3.55	57.3	7.23	O.K.	O.K.	O.K.	Very Cloudy
		57321	6/5/46	7.90	1/4 L U	3.55	56.5	6.77	O.K.	O.K.	O.K.	Medium Cloudy
		57391	6/18/46	7.86	1/2 H S	3.55	55.0	6.78	O.K.	O.K.	O.K.	Medium Cloudy
RC-203 (PRCP-53645)	Sodium	55122	8/6/46	7.82	S	3.80	55.3	5.82	O.K.	O.K.	O.K.	Medium Cloudy
		55123	8/19/46	7.83	1/8 H U	4.0	55.1	4.72	O.K.	O.K.	O.K.	Slightly Cloudy
		55124	10/15/46	7.88	1/4 L U	3.8	56.4	5.78	O.K.	O.K.	O.K.	Medium Cloudy

SODIUM VS. LEAD CATALYSTS

EXHIBIT V

FILTRATION TEST METHOD #718 - DATA AND RESULTS

			P. T. M. 7 1 8		
Code	Type Catalyst	Batch Number	CC. Thru Filter	Grams Solid Resin Filtered Per Sq. Cm.	Average Grams Per Sq. Cm.
RC-103	Lead	56056	45	8.36	
		56095	25	4.63	5.75
		56096	23	4.26	
RC-103	Sodium	55119	50	9.37	
		55120	37	6.93	8.21
		55121	45	8.33	
RC-114	Lead	57445	145	30.14	
		56274	45	9.39	16.68
		55328	50	10.50	
RC-114	Sodium	55125	140	29.90	
		52120	30	6.15	13.02
		52133	15	3.02	
RC-203	Lead	57410	95	20.32	
		57321	150	31.63	20.92
		57391	53	10.82	
RC-203	Sodium	55122	50	10.21	
		55123	28	5.70	10.55
		55124	75	15.74	

EXHIBIT VI

DATA SHEET

SODIUM VERSUS LEAD CATALYSTS

I. BATCH DATA

No. in series _____

Code _____

Batch Card No. _____

Formula Date _____

Catalyst (Na or Pb) _____

Batch Size - Gallons _____

II. COOKING HISTORY

Condition of Cooking Kettle (Clean or No. of batches made since cleaning) _____

Processing Method-Monoglyceride (Fusion or Solution) _____

Processing Method-Batch (Fusion or Solution) _____

Phthalic Addition (Screw Feed or Gravity) _____

Catalyst Addition (Slurry or Dry) _____

Temperature of mono at catalyst addition _____

Monoglyceride cooking cycle - hours _____

Total Batch Cooking Cycle - hours _____

_____

III. FILTRATION

A. Equipment

Type Filter Press _____

Size of Press Plates _____

No. of Press Plates _____

Type of Press Pump _____

Press Pump Capacity _____

B. Filter Media

Filter Paper - Type and Thickness _____

Press Screens - Type and Mesh _____

Filter Cel - Type and Grade _____

Filter Cel - Lbs. used per press coating _____

Method of Filter Aid application(Pre-coat,etc.) _____

C. Processing

Indicate when batch was pressed (direct from mixer or after storage) _____

If stored, indicate hours of storage before pressing _____

Batch temperature during filterpressing _____

Initial Pressure - #/sq. in. _____

Final Pressure - #/sq. in. _____

Press changes per batch _____

Total press hours per batch _____

Total man-hours per batch(for filterpressing) _____

IV. MISCELLANEOUS

Batch Yield - % _____

Remarks & Special Notes-