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RESEARCH DEPARTMENT
Minerals and Chemicals Division
Engelhard Minerals and Chemicals Corporation

FINAL REPORT

TITLE: FORD MOTOR CO. POLYESTER PREMIX HEATER HOUSING FORMULATION

Project Charge No. [redacted] 215	Reported by J. C. Nease
Report No. [redacted] 35	Approved by
60-302	Date November 26, 1968

SUBJECT: FORD MOTOR CO. POLYESTER PREMIX HEATER HOUSING FORMULATION

KEYWORDS:

OBJECTIVE: To formulate a premix compound without asbestos that will be equivalent to the present Ford formula in physical properties and cost.

SUMMARY: Ford Motor Co. is experiencing severe bulk handling problems with asbestos used in the manufacture of heater housings from a polyester premix compound. In an effort to design an alternate compound to alleviate these problems, the following five compounds were mixed, molded and tested in the Menlo lab and duplicate moldings were tested by Ford at the Sheldon Road Plant, Plymouth, Michigan:

1. The present Ford asbestos/$CaCO_3$ formula.
2. The old Ford ASP 400P/$CaCO_3$ asbestos formula.
3. Experimental formula containing ASP 400P and $CaCO_3$.
4. Experimental formula containing ASP 600 and $CaCO_3$.
5. Experimental formula containing Attaclay and $CaCO_3$.

The results show:

1. Slightly lower cost for the experimental formulations and the old Ford formula compared with the present Ford formula.
2. Good correlation between Menlo and Ford on flexural strength measurements, but fairly poor correlation on flexural modulus.
3. The [redacted] Ford formulation yields the highest flexural strength followed by the Attaclay, ASP 600, old Ford, and ASP 400P formulas in decending order. Only the present Ford formula consistently meets the Ford specification for this property.
4. The present Ford formula is within the specification for flexural modulus whereas all other formulas yield higher (out-of-specification) modulus values.

Copies to: [redacted] CTH, HAB, REB, WHA, ALY, ACT, GAHa, Max Davey, AJR, [redacted] GAH, GAHe, CFD

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Summary Con't:

5. All of the formulations except the Attaclay and the old Ford formulas meet the Izod impact requirements.
6. R. M. hardness, Barcol hardness and specific gravity are equivalent for all the formulations.

RECOMMENDATIONS

It is recommended that all formulations be presented to Jim Simmons of Ford. Jim is equipped to make 200 lb. premix batches and he should be encouraged to evaluate formulas 1724-30-2 (Attaclay) and 1724-30-3 (ASP600) on this scale.

It is further recommended that every effort be made to insure a maximum of 1.0% F. M. Attaclay, especially if a small quantity is shipped to Ford for evaluation.

INTRODUCTION

Until the labor strike in the kaolin industry during 1965, Ford Motor Co. purchased large quantities of bagged ASP400P for use in a polyester resin premix formulation to product heater housings for automobiles and trucks. Ford reformulated to an asbestos and calcium carbonate system when the ASP400 was not available during the 1965 kaolin work stoppage.

Recently, however, Ford relocated to a molding plant that is designed as a model plant for materials handling. As a result, all fillers (asbestos, calcium carbonate) and reinforcement (sisal fiber) are now received in bulk quantities and are handled in bulk facilities within the plant. Since the switch to bulk handling, the new plant has been continually plagued with problems in handling the asbestos. The system plugs frequently and requires constant "poling" and attention by an extra operator and the problem has become virtually intolerable.

[redacted]

As a result, Jim Simmons of Ford requested that Engelhard attempt to design an alternate formulation using clay and calcium carbonate to alleviate the handling problem with asbestos. It is also suspected that Ford may be concerned about the carcinogenic effect of asbestos that has been recently reported.

It was requested by Sales that various ratios of ASP 400P, ASP 600, and Attaclay in combination with Snowflake (Chemcarb 22) Calcium Carbonate be investigated in modifications of the Ford formulation. Flexural strength, Izod impact and cost were listed as the most important parameters. Ford agreed to do the impact testing since our Plastics Lab is not equipped to make these determinations.

EXPERIMENTAL & DISCUSSION

The present Ford premix formula (1) is shown in Table I on the following page, but it was modified (2) slightly for simplification on the recommendation of Jim Simmons of Ford. Formula (3) in Table I is the proposed starting point for this evaluation.

TABLE I

Formulations

FORMULA	1	2	3
Identification	Ford	Modified Ford	Engelhard
Ingredients, %			
Polyester Resin	29.00	30	29
Snowflake	36.27	37	12
7 T 15 Asbestos	21.97	23	-
Sisal	10.01	10	10
ASP 400 P	———	[redacted]	———
Zinc Stearate	1.81	(1)	(1)
Benzoyl Peroxide	0.44	(2)	(2)
Black Iron Oxide	0.51	(3)	(3)
Total	100.01	100	100

(1) 1.5% added on total formula wt.

(2) 1.5% added on total resin wt.

(3) 0.5% added on total formula wt.

Formulations 2 and 3 were mixed in the Read Standard Sigma Blade Mixer according to the following procedure:

1. Add resin, zinc stearate, black iron oxide, and benzoyl peroxide and mix until homogenious.
2. Add the fillers slowly and mix until the batch is wet.
3. After the fillers are wet-out completely, slowly add the sisal fibers and stop the mixer.
4. Remove the compound and scrape the walls free of undispersed ingredients.

5. Return the compound to the mixer and mix until a homogenious compound is obtained.

6. Remove the compound and place it in a polyethylene bag.

The compounds were then extruded one pass under vacuum in the pilot plant piston extruder using a 1 inch die. The extrusion process serves to remove air and to provide easy-to-handle charges for molding. Approximately 480 grams (approx. 10% excess) of extruded "rope" was placed in the press and compression molded for 5 minutes at 250°F. The cured panels, 12"x12"x0.120", were trimmed and 8 flexural strength samples were cut from the center of the panel parallel to the direction of molding. Flexural strength and flexural modulus were determined according to standard ASTM procedures.

Formulation 3 was slightly stiff after mixing and the molded panel contained a number of voids. This compound was reformulated to the desired consistency and the results are shown in Table II as formulation 1724-30-5. The modified Ford control formula is also shown in Table II as formulation 1724-30-1.

After several trial compounds, successful formulations containing ASP 600 and Attaclay were produced as shown in Table II and identified as 1724-30-3 and 1724-30-2 respectively. In addition, the old Ford formula (1724-30-4) used before 1965 was included in this evaluation since Jim Simmons said that a small amount of asbestos might be considered if there was no other means to meet the physical property specifications.

TABLE II

PHYSICAL PROPERTIES OF PANELS SENT TO FORD

Formulation 1724 -		30-1	30-2	30-3	30-4	30-5
Ingredients, %	Cost, $/lb. (1)					
Plaskon 9520	0.1800	30	30	30	30	29
Chemcarb 22	0.0139	37	45	18	12	15
J-M 7T15 Asbestos	0.0280	23	--	--	5	--
Sisal	0.2600	10	10	10	10	10
ASP 400P	0.0189	--	--	--	43	46
ASP 600	0.0206	--	--	42	--	--
Attaclay	0.0167	--	15	--	--	--
	Total	100	100	100	100	100
Zinc Stearate, %*		1.5	———	———	———	———
Black Iron Oxide, %*		0.5	———	———	———	———
Benzoyl Peroxide Paste (50%), %**		1.5	———	———	———	———
Cost, $/lb. (2)		0.0915	0.0888	0.0912	0.0912	0.0912

*Calculated on total formula weight
**Calculated on total resin weight

MENLO TEST DATA

Flexural Strength, psi		7290	6230	5510	5200	5570
Flexural Modulus, psi X10^{-5}		13.0	11.5	11.6	11.3	11.6

FORD TEST DATA

	Direction(3)					
Flexural Strength, psi (6500 psi Min.)	A	7380	6500	4690	5782	4550
	B	6790	5770	5990	4990	5360
Flexural Modulus, psi X10^{-5} (7.5-13.0 psi X10^{-5})	A	13.0	14.5	13.0	13.5	14.6
	B	12.8	13.6	15.4	13.1	14.5
Izod Impact, ft.lb./in. (1.8 Min.)	A	2.0	2.1	2.1	2.0	1.8
	B	2.6	2.1	2.0	1.3	3.2
Rm Hardness (45-90)		54-65	55-69	54-67	50-65	53-65
Barcol Hardness (40-70)		38-42	44-46	45-51	44-50	48-50
Specific Gravity (1.55-1.85)		1.78	1.78	1.80	1.78	1.78

(1) Cost figures shown here are the delivered cost to the Sheldon Road Ford plant for each ingredient.

(2) Formulation cost does not include zinc stearate, iron oxide and benzoyl peroxide since these are the same for all formulations.

(3) Samples "A" cut 90° to samples "B"

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TABLE II

PHYSICAL PROPERTIES OF PANELS SENT TO FORD

Formulation 1724-		30-1	30-2	30-3	30-4	30-5
Ingredients, %	Cost, $/lb.(1)					
Plaskon 9520	0.1800	30	30	30	30	29
Chemcarb 22	0.0139	37	45	18	12	15
J-M 7T15 Asbestos	0.0280	23	-	-	5	-
Sisal	0.2600	10	10	10	10	10
ASP 400P	0.0189	-	-	-	43	46
ASP 600	0.0206	-	-	42	-	-
Attaclay	0.0167	-	15	-	-	-
	Total	100	100	100	100	100
Zinc Stearate, %*		1.5	→	→	→	→
Black Iron Oxide, %*		0.5	→	→	→	→
Benzoyl Peroxide Paste (50%), %**		1.5	→	→	→	→

*Calculated on total formula weight
**Calculated on total resin weight

Cost, $/lb.(2)		0.0915	0.0888	0.0912	0.0912	0.0890

MENLO TEST DATA

Flexural Strength, psi		7290	6230	5510	5200	5570
Flexural Modulus, psi X10^{-5}		13.0	11.5	11.6	11.3	11.6

FORD TEST DATA

	Direction(3)					
Flexural Strength, psi	A	7380	6500	4690	5780	4580
(6500 psi Min.)	B	6790	5770	5990	4990	5360
Flexural Modulus, psi X10^{-5}	A	13.0	14.5	13.0	13.9	14.6
(7.5-13.0 psi X10^{-5})	B	12.8	13.6	15.4	13.1	14.5
Izod Impact, ft.lb./in.	A	2.0	2.1	2.1	2.0	1.8
(1.8 Min.)	B	2.6	1.1	2.0	1.3	3.2
RM Hardness (45-90)		54-65	55-69	54-67	30-65	53-65
Barcol Hardness (40-70)		38-42	44-46	45-51	44-50	48-50
Specific Gravity (1.55-1.85)		1.78	1.78	1.80	1.78	1.78

(1) Cost figures shown here are the delivered cost to the Sheldon Road Ford plant for each ingredient.

(2) Formulation cost does not include zinc stearate, iron oxide and benzoyl peroxide since these are the same for all formulations.

(3) Samples "A" cut 90° to samples "B"

and the old Ford formula, 1724-30-4.

The R. M. and Barcol hardness values and the specific gravity of the experimental compounds are well within the Ford specification.

The older Ford formulation, 1724-30-4, containing ASP 400P fares rather poorly in this evaluation. It is apparent that Ford has increased the specifications for flexural strength since the change to the present formula was made. This fact is also verified by work done in MCP report 5050-24 (Aug, 1964) when Ford reported that the average flexural strength was 5200 psi.

Without knowing the formulations of the five test panels, Jim Simmons reported to John Colbeck of the A.E. Fleming Co. that he was interested enough to further investigate 1724-30-1, 1724-30-2, and 1724-30-3. However, Jim suspected that one of these three was his present formula since he had been told that it was included for comparison purposes.

CONCLUSIONS

Compared to the present Ford formula, the experimental formulas containing ASP 400P, ASP 600, and Attaclay in various combinations with Chemcarb 22 and asbestos show:

1. Lower flexural strength
2. Higher flexural modulus
3. Equivalent Izod impact with the possible exception of those formulations containing Attaclay and ASP 400P.
4. Equivalent R. M. hardness, Barcol hardness, and specific gravity.
5. Slightly lower cost.

FUTURE WORK

No future work is proposed unless information returned by Ford Motor Co. indicates that further investigations should be made.