



SHELL DEVELOPMENT COMPANY

EMERYVILLE, CALIFORNIA

January 20, 1953

PLAINTIFF'S EXHIBIT

SH-1090

TELEPHONE OLYMPIC 3-2100

AIR MAIL

SHELL CHEMICAL CORPORATION
50 West 50th Street
New York 20, New York

Attention: Mr. F. S. Swackhamer

Gentlemen:

EPON ADHESIVE VARIABLES

In accordance with Mr. Walb's request to Dr. Elam by telephone on January 8, we hereby submit the following data taken from our research records on adhesives:

1) Effect of Allyl Glycidyl Ether Concentration in Adhesive VIII:

PHR of Allyl Glycidyl Ether	Tensile Shear Strength at 180°F
2 (standard formula)	3488
4	2820
6	1930
8	1342
10	728

When graphically plotted these strengths are a straight line function of allyl glycidyl ether concentration.

2) Effect of Various Fillers:

Since we have not evaluated various fillers in Adhesive VIII, we shall present the following values for various fillers formulated in Adhesive VII base which consists of:

100 parts (w) EPON 828
10 parts EPON 1009
12 parts Paraplex G60

It would seem reasonable to assume that these fillers would act similarly in Adhesive VIII base. These are explanatory experiments made in

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searching for a filler that would specifically impart high strength, especially at elevated temperature. There are apparent inconsistencies in the results that have not been resolved, and intercomparisons between the various sets of data, which were obtained at different times, are probably not very reliable. You will note that while considerable differences were observed, no one filler was found that consistently gave the outstandingly high strength we were seeking. The more promising fillers suffer the disadvantage (for aircraft applications) of being very heavy.

a) The following are data using similar concentrations of fillers:

Filler	Amount of Filler Per 100 Grams of Adhesive VII Base	Tensile Shear Strength at	
		R.T.	180°F
		(Average of 3 samples)	(Average of 3 samples)
No filler	--	3180	2135
Zinc oxide	37.5	2113	3420
Titanium dioxide	37.5	2720	3200
Mercuric oxide	37.5	2790	2830
Calcium oxide	37.5	3020	3057
Nickelous oxide	37.5	2193	1610
Nickelic oxide	37.5	2953	3107
Lead oxide	37.5	3300	3493
Manganese dioxide	37.5	3010	3220
Cupric oxide	37.5	3037	3223
Silver oxide	37.5	460	--
Stannic oxide	37.5	2590	3123
Ferric oxide	37.5	2953	3517
Alumina	37.5	3167	3203
Bentone No. 34	37.5	2377	2303
Glass Floc	25	2970	2633
Hi-Sil	20	2620	3747
Mica	37.5	1443	1003
Magnesol	37.5	663	2737
Solka-floc	20	2487	2223
Acetylene Black	25	2057	2343
Santocel	5	2517	3113
Asbestos 7TF (as in Adhesive VII formula)	18.5	3060	3067

b) The following are data using various concentrations of filler in an attempt to incorporate the maximum amount and still have an adhesive of desirable consistency:

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Filler	Amount of Filler Per 100 Grams of Adhesive VII Base	Tensile Shear Strength at	
		R.T.	180°F
		(Average of 3 samples)	(Average of 3 samples)
No filler	--	2713	1353
Zinc oxide	100	2397	2660
Titanium dioxide	133.3	2467	3080
Calcium oxide	87	2833	2680
Nickelic oxide	20	2370	3053
Lead oxide	217	2473	3413
Manganese dioxide	283.3	2610	2807
Cupric oxide	313.3	2533	1920
Stannic oxide	106.7	2507	2817
Ferric oxide	100	2793	3480
Alumina	70	2833	3250
Glass Floc	30	3187	1840
Hi-Sil	16.7	3483	3077
Solka-floc	6.6	2513	1820
Santocel	6.6	2243	1823
Asbestos 7TF (standard VII formula)	25.3	3330	2797
Nylon floc (NYL-60)	20	3287	2007
Nylon floc (N-706)	20	3163	2093
Lufkin Husk-Fill	50	2887	2013

c) The following data pinpoint some of the best fillers found for Adhesive VII:

Filler	Amount of Filler Per 100 Grams of Adhesive VII Base	Tensile Shear Strength at		
		-70	R.T.	180°F
Titanium dioxide	166.7	1493	1547	2067
	150	1700	1857	2683
	100	2083	2040	2523
	66.7	2333	2727	1760
Nickelic oxide	233.3	2223	1797	2620
	216.7	1803	1927	2330
	166.7	2120	2053	2437
	90	2020	2020	2670

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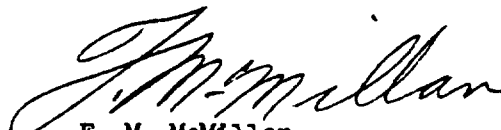
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Filler	Amount of Filler Per 100 Grams of Adhesive VII Base	Tensile Shear Strength at		
		-70	R.T.	180°F
Lead oxide	250	1813	2093	2930
	233.3	2217	2203	3773
	183.3	2157	2390	3153
	150	2527	2720	2763
Ferric oxide	133.3	2203	2460	3683
	108.9	1937	3057	3203
	83.3	2543	2630	2900
	66.7	2387	2880	2763
Alumina	103.3	2050	1923	2490
	86.7	2060	2433	2817
	53.3	2463	2700	2677
	36.7	2020	3073	2157
Hi-Sil	23.3	2287	3220	2237
	20	2370	3313	1817
	13.3	2540	2893	1657
	10	2210	2907	1777

Very truly yours,

SHELL DEVELOPMENT COMPANY



F. M. McMillan

FWL:jp

cc: Shell Chemical Corporation, N.Y., E.D., Mr. D. C. Wells
 Shell Chemical Corporation, N.Y., H.O., Mr. T. G. Nock
 Shell Chemical Corporation, S.F., Mr. S. T. Raycraft
 Shell Chemical Corporation, Union, Dr. D. S. Herr

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