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Mr. R. M. Cole

SHELL CHEMICAL CORPORATION
DENVER PLANT

MEMORANDUM OF DISCUSSION

Subject: DENVER MANUFACTURE OF EPON ADHESIVE VI

Dates of Discussion: January 19, 20 and 21, 1955

Date Written: February 10, 1955

Participants:

Denver Plant	New York Head Office
P. R. Bolenbaker	H. H. Geissler
J. Ferentchak	
J. H. Knaus	**Emeryville**
C. C. McKenna (part time)	
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A meeting was held between Denver, New York and Emeryville representatives to discuss manufacturing procedures for Epon Adhesive VI with regard to difficulties encountered at Denver in preparing an adhesive of comparable viscosity to that produced at Emeryville. These discussions were occasioned by Marketing's request for a pilot batch of adhesive for a potential 25,000 lb order. While this adhesive could be produced at the Emeryville pilot plant, its production at Denver was preferable since the 25,000 lb order might be a precursor for larger future orders that could not be filled at Emeryville.

It was decided, with concurrence of Head Office Manufacture, that the pilot batch should be made by a new blending procedure developed at the Denver Laboratory rather than by the standard Emeryville procedure. From data that were reported on Denver laboratory and plant batches, it appeared that an adhesive thus prepared would prove to be a more saleable material than that prepared by the Emeryville method utilizing Denver Plant equipment even though the 1 M cp viscosity limitation might be exceeded.

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This conclusion was subsequently borne out by results of this pilot batch. Preliminary data indicated the adhesive was below the 1 M cp maximum viscosity. From observations during the preparation of this batch, it appeared that the difference in adhesive viscosity resulted primarily from differences in mixing intensity between Denver and Emeryville equipment. According to the Emeryville representative, Mr. DeJong, the action of the Denver unit appeared much milder than that of the Emeryville machine.

Lack of equipment for presolution of the Vinylite AYAF in AGE had in the past caused differences in operating procedure between Denver and Emeryville. For this batch an AYAF-AGE solution was premixed using a 35 gallon, agitated, steam-heated, stainless steel kettle. However, the AYAF-AGE premix was added prior to the addition of asbestos rather than afterward as is done at Emeryville. The technique appeared to result in a less viscous, unfilled adhesive, better suited for dispersing the asbestos with the milder action of the Denver machine.

In the discussion prior to preparation of the pilot batch, past experience with both laboratory and plant blending was examined to ascertain where essential differences lay between the Denver and Emeryville operation. Data presented on the effect of batch composition and of mixing sequence are noted in the attached tabulation. It may be seen that Denver batches have met the USAF specification on tensile strength. They have not met the 1 M cp tentative maximum viscosity limit. Emeryville plant batches have normally given an adhesive viscosity less than 1 M cp. Denver laboratory batches prepared in exactly the same manner have exceeded 2 M cp. Early Denver plant batches using a different mixing sequence because of equipment limitations have also exceeded a 2 M cp viscosity. The viscosity of early Emeryville laboratory batches was not known because viscosity requirements had not been established at that time.

From a review of factors affecting these results, it appeared that the ingredients used by Denver and Emeryville were generally comparable in all cases. Minor variations in composition were not found to have as significant an effect on viscosity as they did on tensile strength.

Considerable difference was noted in the degree and type of agitation obtained with the Denver plant and laboratory mixers as compared to the Emeryville units. Although quantitative factors were lacking, it was shown that the Denver Plant unit was equipped for much greater energy input per unit of volume than it was using. The kneading action of the sigma blades did not appear to be as effective as the Emeryville unit. The possible effect of increased speed was discussed without arriving at any conclusion. Microscopic examination was reported to not be sufficient

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to establish any difference in the degree of dispersion between Denver and Emeryville batches. The Denver laboratory mixing was reported to correlate with the plant mixing although after observing the preparation of batches in the plant and in the laboratory, there remained some difference of opinion in this regard. In view of the limited information on the mixing characteristics of all three machines, it was concluded that an investigation into the effect of mixing would be merited.

Some consideration was also discussed regarding potential applications for this material. Since uncertainty still exists on the nature of complaints about the high viscosity Adhesive VI, some question was raised regarding the effect of marginal increases in viscosity over 1 M cp. This appeared important because recent data indicated a progressive increase in viscosity with aging. It was also observed that there appeared to be some separation of the AYAF-AGE solution and some discoloration of the dye during storage.

It is expected that these discussions and observations made during the mixing of this batch will lead to a better understanding of the factors affecting the product viscosity, and will contribute to design considerations for the Houston Resin Development Unit.

J. E. Means

JEM/sam

cc: Participants
JGB/TGM
EML
GBM
Tech File 866-a

Attachments

LAM 029018

ABS-018224

TABLE I

DENVER LABORATORY TEST RESULTS

Properties of EPON Adhesive VI

Produced by Old Denver Plant Mixing Procedure

Batch No.*	Viscosity, $\bar{M}$ cp at 77°F and 2 RPM	Tensile Shear Strength, PSI	
		R. T.	+180°F
4	2.56	3634	1971
5	2.16	3535	2666
6	2.80	3605	1657
9	-	3297	2453
P-3	2.79	-	-
P-4	2.85	-	-

Produced by Emeryville Mixing Procedure

Batch No.	Viscosity, $\bar{M}$ cp at 77°F and 2 RPM	Tensile Shear, PSI		Remarks
		R. T.	+180°F	
P-5	2.21	-	-	
P-7a	1.79	-	-	
P-28	2.53	-	-	Emeryville asbestos & AYAF used.
P-29	2.68	-	-	Mixing extended to 9 hours.
P-17	1.11	3515	1725	AGE increased to 15%w.
P-23	2.59	-	-	0.1% HaC added.
P-30	0.60	3363	1100	2½% H_2O added.
P-63	Avg= 1.80	-	-	Two runs - asbestos sifted in.
P-45	2.06	-	-	Undyed.

* P-numbers refer to laboratory pilot batches - others are plant batches.

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TABLE I (Cont'd.)

Revised Denver Mixing Procedure (Asbestos added to unfilled VI)

Batch No.	Viscosity, $\bar{M}$ cp at 77°F and 2 RPM	Tensile Shear, PSI RT	180°F	-70°F	Remarks
P-58	1.15	4010	2575	3035	Asbestos added in 10 to 30 min; mixing continued 15 to 40 minutes
P-65a	1.20	4165	2225	2935	
5-1	0.79	-	-	-	
P-73a	1.28	-	-	-	Mixed 15 min. after asbestos in.
P-73b	1.86	-	-	-	Mixing of preceding batch continued for 2 hr after asbestos addition.
P-72	1.44	-	-	-	Mixed 1 hr after asbestos in.

TABLE II

EPON Adhesive VI

Change in Viscosity with Time

Emeryville Plant Production:

Batch No.	9/15/54 Viscosity, MMCPS 2 RPM	9/15/54 Viscosity, MMCPS 10 RPM	1/18/55 Viscosity, MMCPS 2 RPM	1/18/55 Viscosity, MMCPS 10 RPM
2604-126-1	0.864	0.301	1.248	0.454
2604-126-2	0.992	0.358	1.344	0.499
2604-126-3	0.960	0.358	1.312	0.544
2604-126-4	0.992	0.346	1.312	0.487
2604-126-5	0.992	0.358	1.344	0.493

Denver Laboratory Production:

Batch No.	Viscosity ($\bar{M}$ op @ 77°F and 2 RPM) at Time After Mixing: 1 day	6 days	5-6 Months
P-9a	1.22	1.60	2.56
P-7a	1.79	-	2.62
P-14	1.40	1.33	2.36
P-16	1.27	1.24	2.08
P-18	1.49	1.89	2.11
P-21	1.28	1.40	2.24
P-22	1.67	1.43	2.24