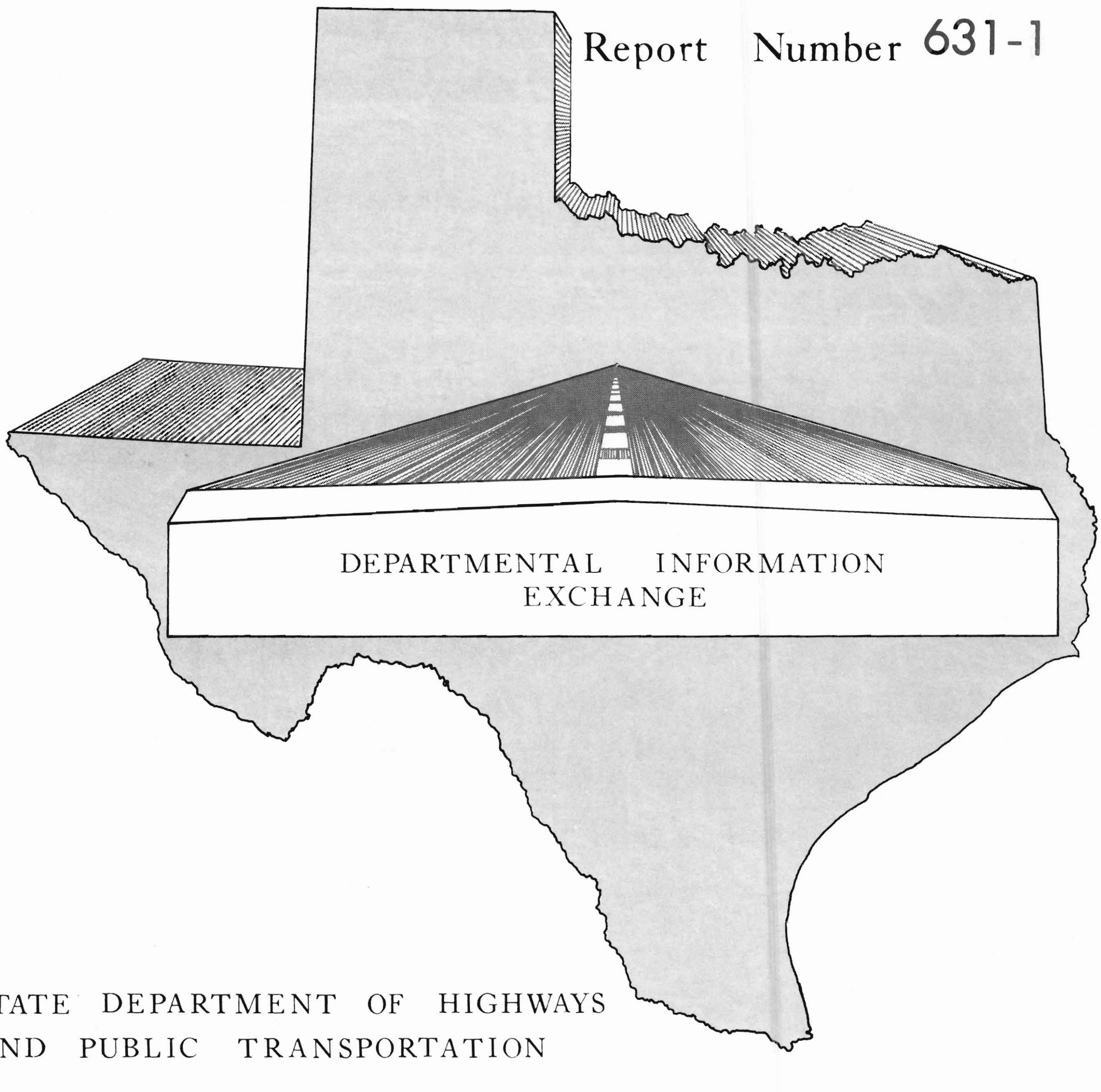
EXPERIMENTAL PROJECTS

EVALUATION OF ASPHALT LATEX RUBBER BLENDS

Report Number 631-1



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16. Abstract

The purpose of this project was to evaluate the properties of AC-5 and AC-10 modified with latex and to compare Polysar XE-275 latex with Goodyear Pliopave L-170. Laboratory samples were blended of all possible combinations of the two latexes, two grades, and the two producers' products. Standard asphalt tests were run along with several special tests, including a heat stability test. The conclusions were that the decrease in temperature susceptibility achieved in a latex-modified asphalt is a function of how temperature susceptible the asphalt originally was; though both latexes raise the viscosity of the asphalt they are added to and give better low temperature properties, the Goodyear L-170 asphalt seems slightly better than Polysar XE-275 modified asphalt.

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EVALUATION OF ASPHALT-LATEX RUBBER BLENDS
(Field Service No. 5C3593)

Standard Specification Item 300, Asphalts, Oils and Emulsions, contains requirements for a butadine-styrene rubber latex emulsion for modification of asphalt-cement. The majority of the latex supplied under this item has been Goodyear's Pliopave L-170. Item 300 also states that the asphalt used shall be either AC-3 or AC-5.

Refinery 204 has supplied AC-3 or AC-5 modified with Pliopave L-170 for a number of years, primarily to West Texas Districts. Departmental Research Number 180-1F presented work done on modification of AC-3 and AC-5 with various polymers.

District 15 developed an interest in using AC-10 modified with latex and proposed to include this material in a portion of their 1983 seal coat program. Polysar Incorporated, a firm which manufactures latex, approached us with regard to possible use of their Polysar XE-275, which they indicated was equivalent to the Goodyear Pliopave L-170 with the exception that the butadine-styrene ratio is approximately 75/25.

The purpose of this project was to evaluate the properties of AC-10 modified with latex and also to compare the Polysar XE-275 latex with Pliopave L-170. It was determined that AC-10 + latex would probably be supplied by Refinery 204 which normally supplies AC-5 + latex or Refinery 209 which had not had commercial experience with latex modification, but indicated they planned to supply the product. Our evaluation, therefore, involved the latex modification of AC-5 and AC-10 for Refineries 204 and 209.

The approach taken was to blend laboratory samples of all possble combinations of the two latexes, two grades, and the two producers' materials and run a battery of tests on these blends. Standard asphalt tests were run along with several special tests. As in Report Number 180-1F, a heat stability test was run and the heat stability tested material was subjected to the same battery of tests as the original material. The blends prepared and tested were as follows:

Refinery	Grade	*Additive
204	AC-5	None
204	AC-5	2% Goodyear Pliopave L-170
204	AC-5	2% Polysar XE-275
204	AC-10	None
204	AC-10	2% Goodyear Pliopave L-170
204	AC-10	2% Polysar XE-275
209	AC-5	None
209	AC-5	2% Goodyear Pliopave L-170
209	AC-5	2% Polysar XE-275
209	AC-10	None
209	AC-10	2% Goodyear Pliopave L-170
209	AC-10	2% Polysar XE-275

* Weight percent based on rubber solids.

CONCLUSIONS

Adding latex to asphalt is supposed to increase the viscosity, change the temperature susceptibility, and provide better low temperature properties than an untreated asphalt. This is what is generally seen in Tables 1 and 3. The viscosity of a given grade is elevated by latex addition and the low temperature properties (i.e., brittleness and ductility) are enhanced.

There are several properties which are not readily apparent by looking at the Tables. One such property is the amount of aging which occurs in the thin film oven test. This property can be seen by the ratio of viscosity (at 140°F) after the thin film oven test to the viscosity (at 140°F) before aging. The amount of aging occurring is substantially less in rubberized samples than in non-rubberized samples.

Figures 1,2,3,and 4 show the changes in viscosity with temperature for each grade of each producer before and after latex treatments. The slope of each of the lines represents the temperature susceptibilty of that sample. Addition of latex makes the asphalt less temperature susceptible (i.e., the lines are flatter). A less temperature-susceptible asphalt will perform better in cold weather (lower brittleness and higher ductility) and better in warm weather (higher viscosity) for a given asphalt grade. All latex-modified materials seem to exhibit lower temperature susceptibility than the base asphalt cements; however, AC-10 from Refinery 209 seems to get only a small amount of benefit from either rubber additive (Goodyear or Polysar). This is because the AC-10 from Refinery 209 is not as temperature susceptible as other asphalts (Refinery 204, for example) to begin with.

Tables 2 and 4 show results of tests on heat stability tested material. In the heat stability test, a quart of treated asphalt is stored at 325°F for three days, then examined to see if any seperation or incompatibility exists. Afterward, the same battery of tests are run as on the original material. The results on heat stability tested materials indicate that a degradation of rubber-induced properties occurs. This degradation is probably a function of time and temperature.

In comparing the results, both latex additives are compatible with Refinery 204 and Refinery 209, AC-5 and AC-10. Both latexes raise the vicosity of the asphalt they are added to and give better low temperature properties. The decrease in temperature susceptibility achieved is a function of how temperature susceptible the asphalt originally was. A highly temperature-susceptible asphalt will receive more benefit from the rubber than one which is not as temperature susceptible to begin with. Although both latex additives affect asphalt properties in a positive way, the Goodyear Pliopave L-170 seems to produce a modified asphalt that is slighty better than Polysar XE-275 modified asphalt. Rubber-modified asphalts stored for several days will suffer from degradation of the rubber and associated properties.

REFINERY 204

Tests on Original Material	AC-5	AC-5 w/2% Goodyear Pliopave L-170	AC-5 w/2% Polysar XE-275	AC-10	AC-10 w/2% Goodyear Pliopave L-170	AC-10 w/2% Polysar XE-275
Viscosity @ 140 F	473	776	769	899	1709	1388
Viscosity @ 275 F	1.8	4.6	4.0	2.5	5.3	4.8
Sp Gr @ 77 F	1.018	1.014	1.014	1.023	1.019	1.017
Flash, C.O.C.	600	600	600	600	600	600
Penetration @ 77 F	145	133	131	95	83	85
Penetration @ 32 F, 100 g, 5 sec	4	4	12	2	3	3
Penetration @ 32 F, 200 g, 60 sec	32	27	23	18	16	20
Ductility @ 39.2 F, 5 cm/min	14	141	110	6	46	33
Brittleness	56	45	39	55	50	50
Tests on TFO Residue:						
Loss on TFOT	0.03	0.05	0.07	0.04	0.07	0.08
Viscosity @ 140 F	1053	1397	1384	2094	2819	2586
Penetration @ 77 F	80	85	82	54	56	55
Penetration @ 32 F, 100 g, 5 sec	2	6	2	1	3	2
Penetration @ 32 F, 200 g, 5 sec	16	20	20	12	15	13
Ductility @ 39.2 F, 5 cm/min	9	95	67	6	22	19
Brittleness, F	55	50	55	65	55	55

TABLE 1

REFINERY 204

HEAT STABILITY TESTED

Tests on Original Material	AC-5 w/2% Goodyear Pliopave L-170	AC-5 w/2% Polysar XE-275	AC-10 w/2% Goodyear Pliopave L-170	AC-10 w/2% Polysar XE-275
Viscosity @ 140 F	931	975	1664	1536
Viscosity @ 275 F	5.0	4.5	5.7	5.6
Sp Gr @ 77 F	1.017	1.019	1.023	1.021
Flash, C.O.C.	600	600	600	600
Penetration @ 77 F	120	120	80	85
Penetration @ 32 F, 100 g, 5 sec	7	6	3	5
Penetration @ 32 F, 200 g, 60 sec	18	23	18	15
Ductility @ 39.2 F, 5 cm/min	98	79	45	40
Brittleness	43	46	53	50
Tests on TFO Residue:				
Viscosity @ 140 F	1495	1494	3742	4050
Penetration @ 77 F	82	80	46	46
Penetration @ 32 F, 100 g, 5 sec	3	4	2	2
Penetration @ 32 F, 200 g, 5 sec	24	23	14	14
Ductility @ 39.2 F, 5 cm/min	55	29	18	19
Brittleness	44	43	48	55
Appearance	Smooth	Smooth	Smooth	Skin formed on surface

TABLE 2

REFINERY 209

Tests on Original Material	AC-5	AC-5 w/2% Goodyear Pliopave L-170	AC-5 w/2% Polysar XE-275	AC-10	AC-10 w/2% Goodyear Pliopave L-170	AC-10 w/2% Polysar XE-275
Viscosity @ 140 F	455	615	640	1180	1535	1674
Viscosity @ 275 F	2.09	4.3	3.8	4.6	6.5	6.2
Sp Gr @ 77 F	1.005	1.008	1.008	1.017	1.033	1.012
Flash, C.O.C.	600	600	600	600	600	600
Penetration @ 77 F	142	130	127	93	95	95
Penetration @ 32 F, 100 g, 5 sec	2	2	2	3	2	1
Penetration @ 32 F, 200 g, 60 sec	15	20	16	15	15	14
Ductility @ 39.2 F, 5 cm/min	0	141	141	0	141	71
Brittleness	62	51	52	63	58	58
Tests on TFO Residue:						
Loss on TFOT	0.06	0.11	0.08	0.07	0.126	0.09
Viscosity @ 140 F	840	959	1041	2067	2670	2426
Penetration @ 77 F	90	97	96	66	68	68
Penetration @ 32 F, 100 g, 5 sec	1	3	1	1	1	1
Penetration 2 32 F, 200 g, 5 sec	14	20	8	9	12	14
Dictility @ 39.2 F, 5 cm/min	0	0	0	0	0	0
Brittleness	64	52	52	68	58	60

TABLE 3

REFINERY 209

HEAT STABILITY TESTED

Tests on Original Material	AC-5 w/2% Goodyear Pliopave L-170	AC-5 w/2% Polysar XE-275	AC-10 w/2% Goodyear Pliopave L-170	AC-10 w/2% Polysar XE-275
Viscosity @ 140 F	777	926	1939	1841
Viscosity @ 275 F	4.9	4.7	6.8	6.6
Sp Gr @ 77 F	1.007	1.010	1.018	1.016
Flash, C.O.C.	600	600	600	600
Penetration @ 77 F	130	127	88	91
Penetration @ 32 F, 100 g, 5 sec	3	4	3	3
Penetration @ 32 F, 200 g, 60 sec	24	25	21	21
Ductility @ 39.2 F, 5 cm/min	60	141	0	0
Brittleness	57	54	56	54
Tests on TFO Residue:				
Viscosity @ 140 F	1022	1146	2391	2685
Penetration @ 77 F	95	90	69	68
Penetration @ 32 F, 100 g, 5 sec	2	1	2	2
Penetration @ 32 F, 200 g, 5 sec	17	12	16	15
Ductility @ 39.2 F, 5 cm/min	0	24	25	11
Brittleness	55	55	54	54
Appearance	Smooth	Smooth	Smooth	Smooth

TABLE 4

VISCOSITY - TEMPERATURE CHART

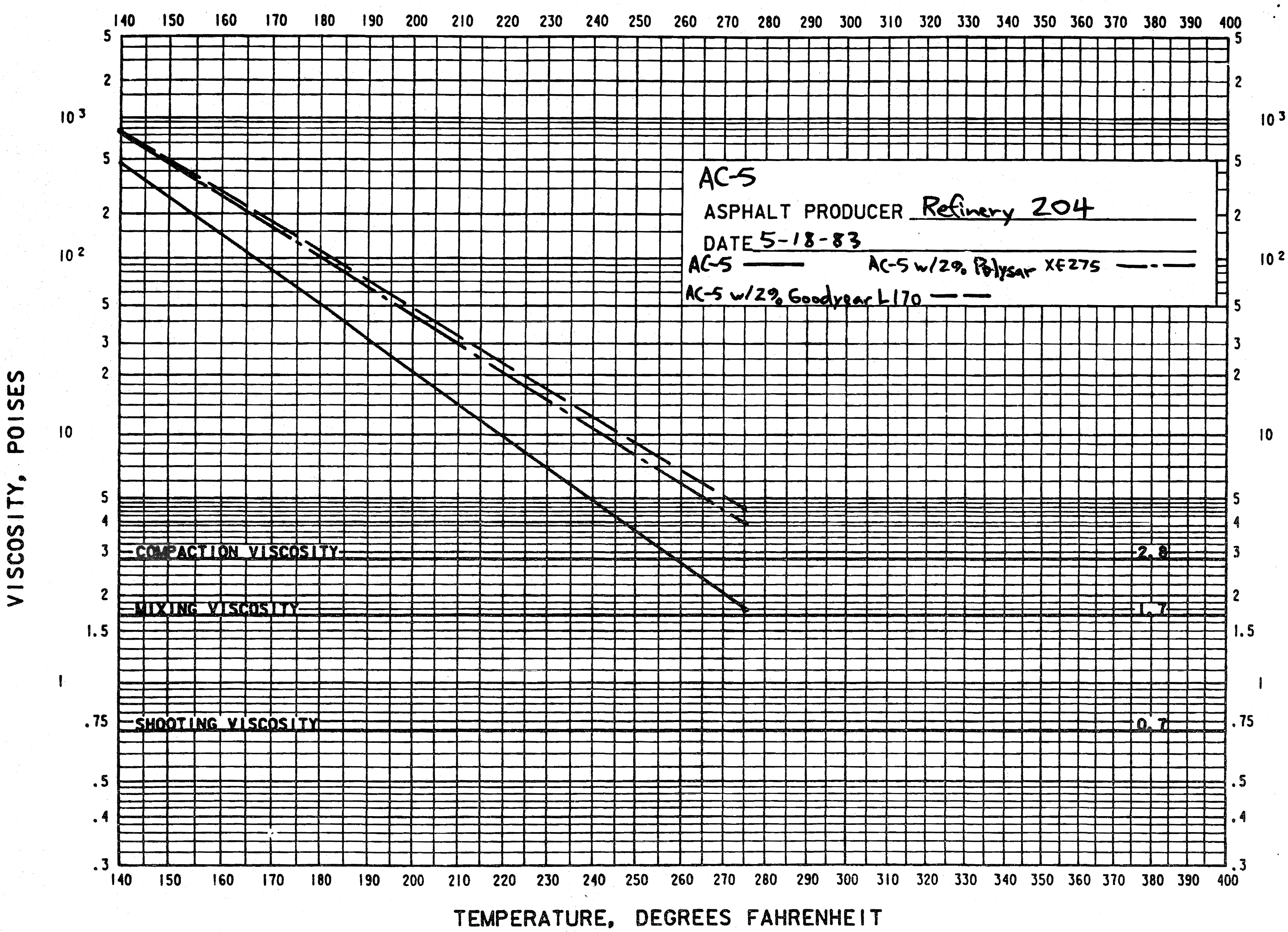


Figure 1

VISCOSITY - TEMPERATURE CHART

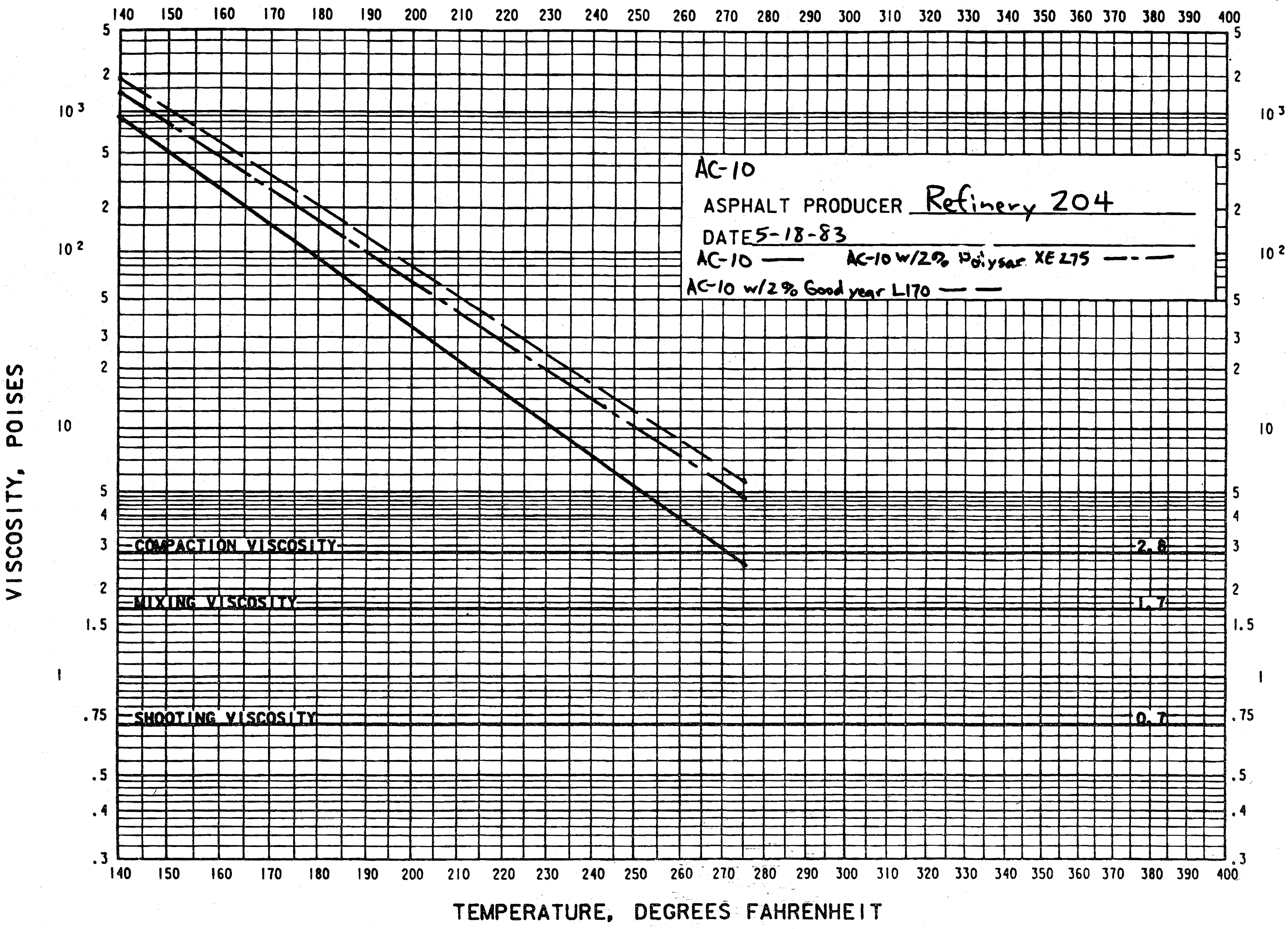
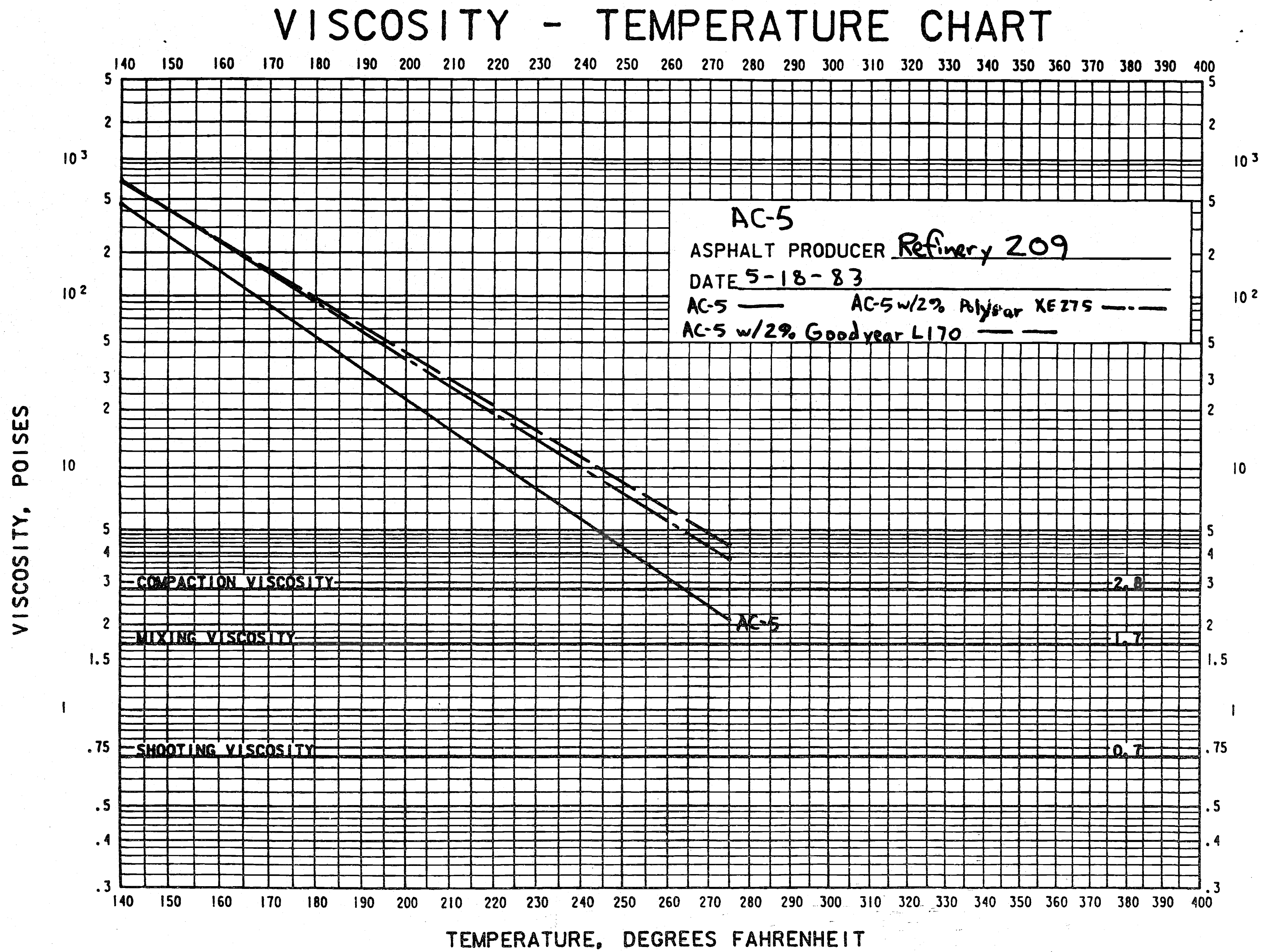


Figure 2



VISCOSITY - TEMPERATURE CHART
AC-5
ASPHALT PRODUCER Refinery 209
DATE 5-18-83
AC-5
AC-5 w/2% Polysar XE275
AC-5 w/2% Goodyear L170
COMPACTION VISCOSITY
2.8
MIXING VISCOSITY
1.7
SHOOTING VISCOSITY
0.7
AC-5
VISCOSITY, POISES
TEMPERATURE, DEGREES FAHRENHEIT

Figure 3

VISCOSITY - TEMPERATURE CHART

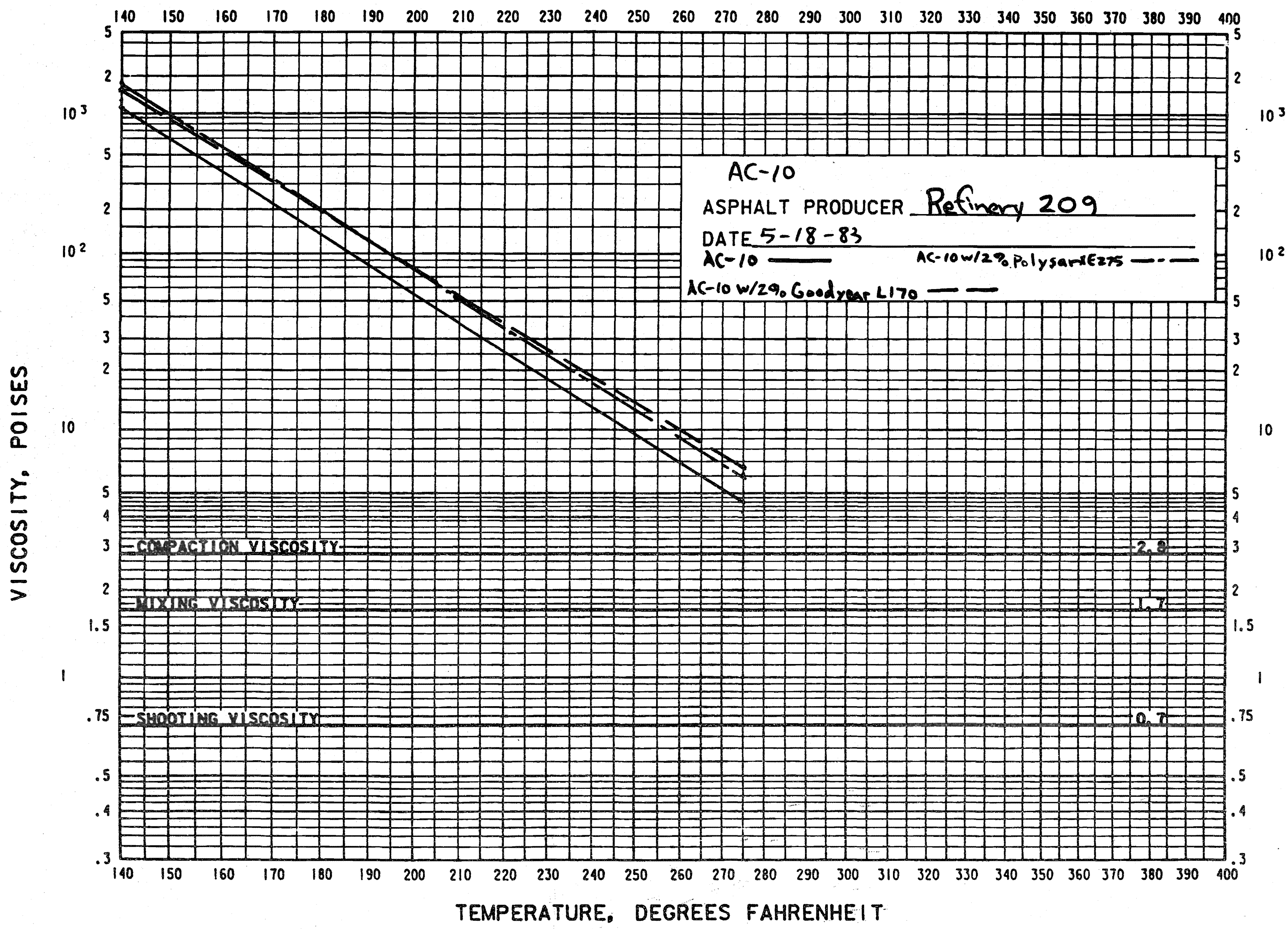


Figure 4