USE OF REAGENT GRADE

VERSUS

INDUSTRIAL GRADE TRICHLORETHYLENE IN ASPHALT RECOVERIES

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by

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Objective

This is a continuation of a project initiated a year ago to determine any differences in test results on recovered asphalt cements caused by the use of industrial grade of solvent as compared with the reagent grade. AASHTO specifies the use of reagent grade of trichlorethylene, but the Laboratory uses industrial grade which costs much less.

Last year this objective of the project was aborted when it was found that a larger difference in test results was obtained between the two distillation apparatuses than between the two solvents. Then all efforts were directed toward obtaining uniformity in test results between the apparatuses under the east hood as compared with that under the west hood. Considerable progress was made toward this end. (See report under this same title dated April 1982).

The objective this year was to again evaluate the results when using both variables (apparatuses and solvents). Another objective developed later in this investigation; this was to determine any differences in test results on recovered asphalt cements caused by the use of reclaimed trichlorethylene (from the distillation process) as compared with the use of industrial grade of solvent. At the present time the reclaimed trichlorethylene is discarded. If the reclaimed solvent could be used for further recoveries, a considerable savings in solvent costs would result.

Materials

Industrial grade trichlorethylene was obtained from Barton Solvent Co. in Des Moines which is our normal supply source.

Reagent grade trichlorethylene was obtained from Iowa State University Chemistry Store.

The reclaimed trichlorethylene was obtained from the laboratory distillation of extraction solvent in the recovery of asphalt cement.

The mixes used were surplus of field samples that had been submitted to the Laboratory for testing during the previous construction season. The numbering (1 through 14) indicates the different mixes used, and the lettering indicates the different test samples from each mix.

Procedure

Standard sampling, reflux extraction, asphalt recovery, penetration, and viscosity procedures and apparatuses were used throughout this investigation. Only one operator performed all the extraction and recovery procedures.

After the field mixes were brought to temperature, they were thoroughly mixed and then sampled to provide approximately equal portions for the subsequent extractions and asphalt recoveries.

Four samples were taken from each of mixes 1 through 6. Two samples were extracted using industrial grade solvent. The asphalt was recovered one one by using the east apparatus and on the other by using the west equipment. The other two samples were extracted using reagent grade solvent (again using the east recovery apparatus for one and the west for the other). The penetrations and viscosities of the recovered asphalts were determinined and tabulated for each sample. (See results). This permitted a comparison of the effects on the test results when using the two solvents, as well as when using the two sets of apparatus.

Eight samples were obtained from each of the mixes numbered 7 through 11.

Four samples were extracted using industrial grade solvent and four were extracted using reclaimed solvent. Two of each were recovered by using the east, and two by using the west apparatus. The penetrations and viscosities of the recovered asphalts were determined and tabulated for each sample (See results). This procedure permitted a duplicate comparison of results obtained when using the two sets of apparatuses as well as the two solvents (industrial grade versus reclaimed).

The balance of this investigation (mixes numbered 12 through 14) was directed toward eliminating the variation still present in results when the asphalt was recovered under the two hoods. Mixes 12 and 13 were extracted using only industrial grade solvent, but the delivery tubes on the two distillation apparatuses were switched. Four asphalt samples were recovered from each mix, with two recovered under each hood.

Sample numbers 14-3-A to 14-3-F were extracted using only reclaimed solvent, but a new delivery tube was used in the distillation apparatus under the east hood. Six asphalt samples were recovered (3 under each hood).

Sample numbers 14-3-G to 14-3-L were extracted using only reclaimed solvent, but a new transformer (identical to the one used with the east apparatus) was put into use under the west hood. Six asphalt samples were recovered (3 under each hood).

Results

The penetration and viscosity of each sample of recovered asphalt cement was determined and tabulated showing the type of solvent used in the extraction and also which recovery apparatus was used.

The penetrations and viscosities of mixes 1 through 6, which correlate the results obtained by using the industrial grade with those when using the reagent grade of solvent, as well as those obtained by using the east

versus the west apparatuses (hoods), are shown in Table I.

When comparing the test results obtained with the industrial grade with those obtained when using the reagent grade of Trichlorethylene, on the same apparatus, it was found that the average difference in penetration was 1.4 units (tenths of a millimeter); with the higher penetration coming from use of the industrial grade. This is within the AASHTO T 49 repeatability requirements for the penetration test itself. (No precision standards have been established for the Abson recovered asphalt properties).

The small differences in test results obtained by using industrial grade of solvent rather than the reagent grade, coupled with essentially the same results from the investigation performed last year, led to the termination of this phase of the investigation.

However, every sample tested showed that the asphalt cement had as high or higher penetration (softer) when recovered under the west hood when compared to the results obtained under the east hood. This was true regardless of whether industrial or reagent grade of solvent was used. The tabulation of test results (Table I) shows an average penetration difference of 2.6 units between the two sets of apparatus. The viscosity test results verified this trend. The balance of this investigation was then directed toward eliminating this difference, and at the same time to correlate test results obtained with reclaimed solvent with those obtained by using the industrial grade.

The same procedures were used on mixes 7 through 11 as were used on mixes 1 through 7, except the reclaimed trichlorethylene was used in place of the reagent grade, and eight samples were tested from each mix. Four were tested with each solvent and 4 were tested on each set of apparatus. The results are shown in Table II.

When comparing the results obtained with the reclaimed solvent with those obtained using the industrial grade, (on the same apparatus) only a slight difference in average penetrations was found (less than one penetration unit). However, when using the same solvent with the two sets of apparatus, an average penetration difference of nearly four penetration units was found. Again the west hood produced the higher penetration figures.

In an attempt to resolve the differences in test results between the two sets of apparatus, mixes 12 and 13 were tested with the distillation delivery tubes from the east and west hoods switched. Only industrial grade solvent was used and four samples were tested from each mix. An equal number was tested under each hood. The average penetration test results were almost identical. This prompted a new delivery tube to be installed under the east hood. Samples A through F of mix 14 were then made to check on the results, using only reclaimed solvent and testing three samples under each hood. The average penetration results of these tests showed that the west apparatus was still giving penetrations nearly four units higher than the east apparatus.

Samples G through L of mix 14 were made after replacing the transformer under the west hood with a new one which was identical with the one under the east hood. Again only reclaimed solvent was used and three samples were tested under each hood. The average penetration results of these tests were nearly identical.

Thus concluded the investigation for this year, but a follow-up will be made next winter using reclaimed solvent versus industrial grade, and checking results obtained from both sets of apparatus. During the past summer construction season, several opportunities to check the results on

the same mix under each hood have been utilized, and the uniformity of the test results have been encouraging.

Conclusions

1. Based on the results of this and last years investigations, there appears to be no reason to switch to the more expensive reagent trichlorethylene for use in the Abson recovery test.
2. Another considerable savings can be made if the reclaimed solvent from the recoveries can be recycled. If the results obtained next winter in this regard are as promising as those obtained this year, steps will be taken in that direction.
3. It is truly amazing how identical every component of the apparatus must be under the two hoods to obtain the same test results on the same mix. Frequent correlation of the two sets of apparatus is a ncecessity.
4. It is not difficult to see why the coefficient of variation on nationwide test results on recovered asphalts from AMRL test samples are so high.

TABLE I

Mix No.	Solvent		Apparatus		Recovered Asphalt	
	Industrial	Reagent	East	West	Pen.	Viscosity
1 - 3-A	X		X		56	2560
B		X		X	57	2820
C		X	X		52	3190
D	X			X	57	2800
2 - 3-A	X		X		55	2940
B		X		X	62	2465
C		X	X		50	3340
D	X			X	57	2690
3 - 3-A	X		X		43	2410
B		X		X	43	2430
C		X	X		38	2560
D	X			X	43	2290
4- 3-A	X		X		54	3270
B		X		X	53	3460
C		X	X		52	3650
D	X			X	54	3340
5 - 3-A	X		X		53	3210
B		X		X	52	3440
C		X	X		51	3340
D	X			X	52	3190
6 - 3-A	X		X		51	3220
B		X		X	52	3110
C		X	X		49	3430
D	X			X	53	3200
Avg. Penetration	52.3	50.9	50.3	52.9		

TABLE II

Mix No.	Solvent		Apparatus		Recovered Asphalt	
	Industrial	Reclaimed	East	West	Pen.	Viscosity
7 - 3A	X		X		57	2750
B	X			X	61	2550
C		X	X		60	2610
D		X		X	61	2520
E		X	X		58	2640
F		X		X	60	2550
G	X		X		58	2760
H	X			X	56	2760
8 - 3A	X		X		64	2440
B	X			X	68	2260
C		X	X		60	2550
D		X		X	69	2120
E		X	X		58	2550
F		X		X	63	2340
G	X		X		61	2180
H	X			X	67	2390
9 - 3A	X		X		71	2040
B	X			X	68	2130
C		X	X		68	2240
D		X		X	73	2030
E		X	X		66	2260
F		X		X	72	1970
G	X		X		70	2100
H	X			X	72	2040
10 - 3A	X		X		57	3060
B	X			X	61	2810
C		X	X		55	3440
D		X		X	61	2860
E		X	X		57	3630
F		X		X	59	3380
G	X		X		51	3750
H	X			X	56	3360
11 - 3A	X			X	75	1950
B	X		X		68	2240
C		X	X		72	2066
D		X		X	75	2018
E		X	X		68	2277
F		X		X	78	1897
G	X			X	70	2265
H	X		X		67	2343
Avg. Penetration	63.90	64.65	62.30	66.25		

TABLE III

Delivery Tubes From E & W Hoods Switched

Mix No.	Solvent		Apparatus		Recovered Asphalt	
	Industrial	Reclaimed	East	West	Pen.	Viscosity
12 - 3A	X		X		73	2130
B	X			X	72	2129
C	X		X		76	2137
D	X			X	76	2145
13 - 3A	X		X		62	3239
B	X			X	60	3112
C	X		X		60	2968
D	X			X	64	2737
Avg. Penetration			67.75	68.00		
		New Delivery Tube Under East Hood				
14 - 3A		X	X		80	1568
B		X		X	85	1514
C		X	X		81	1650
D		X		X	86	1470
E		X	X		81	1600
F		X		X	82	1570
Avg. Penetration			80.67	84.33		
		New Transformer Under West Hood				
14 - 3G		X	X		76	1840
H		X		X	79	1760
I		X	X		83	1670
J		X		X	82	1660
K		X	X		82	1779
L		X		X	81	1791
Avg. Penetration			80.33	80.67		