

MLR-85-6

EVALUATION OF ADDITIVES
FOR
EXTRUDED ASPHALT CURBS

Final Report
Project No. MLR-85-6

by

Douglas Heins
Asphalt Mix Design Engineer
Office of Materials
Iowa Department of Transportation

May 1985

ABSTRACT

This study investigates the properties imparted to extruded asphalt curb mixes by five different additives. The AC used in these mixes was also tested with various amounts of the additives. All of the additives stiffened the AC as indicated by a reduction of penetration and increased viscosity. Only the powdered asphalts, gilsonite and Witcurb improved the Marshall stability and the indirect tensil strength enough to justify their use in curb mixes.

INTRODUCTION

Current Iowa Department of Transportation specifications require the addition of 15 pounds of powdered asphalt for each 100 pounds of AC incorporated into a 3/8" or 1/2" mixture. Routinely we have been using gilsonite in extruded asphalt curb mixes.

Witco Chemical Corporation produces a powdered asphalt from petroleum sources for asphalt curb mixes. They recommend the addition of 25 pounds of "Witcurb" for each 100 pounds of AC.

The Iowa Department of Transportation has had good results with Asphadur (Polyethylene) added to mixes to reduce shoving and rutting in severe service on hills and intersections.

Cabot Corporation produces carbon black under the trade name "Microfil" to increase the stability of asphalt paving mixes.

Kapejo Inc. produces polyester fibers under the trade name of BoniFibers as a reinforcement for curb mixes.

Information is needed to properly assess the potentials and application rates of various additives in producing asphalt curb mixes.

SCOPE:

This study examines the Marshall stability and indirect tensile strength of a control mix and that mix with five different additives. The AC used in this mix was also tested for penetration and viscosity with various percentages of the different additives.

PROCEDURES:

A. Materials

The following materials were used in this study:

Cr. Limestone and 3/8" Limestone - Midwest Limestone, Gilmore City -

AAT4 - 823, AAT4 - 824

Sand - Hoffert S & G, Emmetsburg - AAT4 - 825, AC10 - AB4 - 173

Gilsonite, Witcurb, Carbon Black, Bonifiber, Asphadur

B. Mixes

The following trail mixes were prepared:

| <u>Mix No.</u> | <u>Description</u> |
|----------------|--|
| 1 | Control 30% AAT4 - 823 35% AAT4 - 824 35% AAT4 - 825 6.15% AB4 - 173 |
| 2 | Mix No. 1 with 15% (by wt. AC) gilsonite |
| 3 | Mix No. 1 with 25% (by wt. AC) Witcurb |
| 4 | Mix No. 1 with 5 lb (per ton of mix) Bonifiber and an extra 0.25% AC |
| 5 | Mix No. 1 with 15% (by wt. AC) carbon black |
| 6 | Mix No. 1 with 6% (by wt. AC) Asphadur |

The following liquid asphalts were prepared

1. AB4-173
2. AB4-173 with 15% Witcurb added
3. AB4-173 with 25% Witcurb added
4. AB4-173 with 40% Witcurb added
5. AB4-173 with 15% gilsonite added
6. AB4-173 with 25% gilsonite added
7. AB4-173 with 15% carbon black added
8. AB4-173 with 6% Asphadur added

C. Aggregate Gradation

Aggregates and mix gradation were as submitted for Project BRF-F-18-3(41)--2P-55 Kossuth Co.

| | | | | | | | | | |
|-----------|-----|-----|----|----|----|----|----|-----|-----|
| Sieve No. | 1/2 | 3/8 | 4 | 8 | 16 | 30 | 50 | 100 | 200 |
| % Passing | 100 | 91 | 67 | 53 | 39 | 25 | 13 | 8.1 | 6.0 |

D. Mix Tests

Six specimen were molded from each combination with 3 tested for Marshall stability and 3 tested for indirect strength.

E. AC Tests

The liquid asphalts were mixed and tested for penetration at 77°F and where possible for viscosity at 140°F.

RESULTS

Table No. 1 shows the Marshall density, Marshall stability and indirect tensile strength for each of the mixes. Table No. 2 shows the penetration at 77°F and the viscosity at 140°F. Each additive decreased the penetration (hardened the asphalt) and increased amounts of additive further decreased the penetration with the gilsonite and Asphadur showing the greatest effect. Correspondently the viscosity, where they could be tested, was increased.

Figure No. 1 is a graphical plot of Table No. 2.

FIGURE 1

Liquid Asphalt Tests
Penetration at various percentages

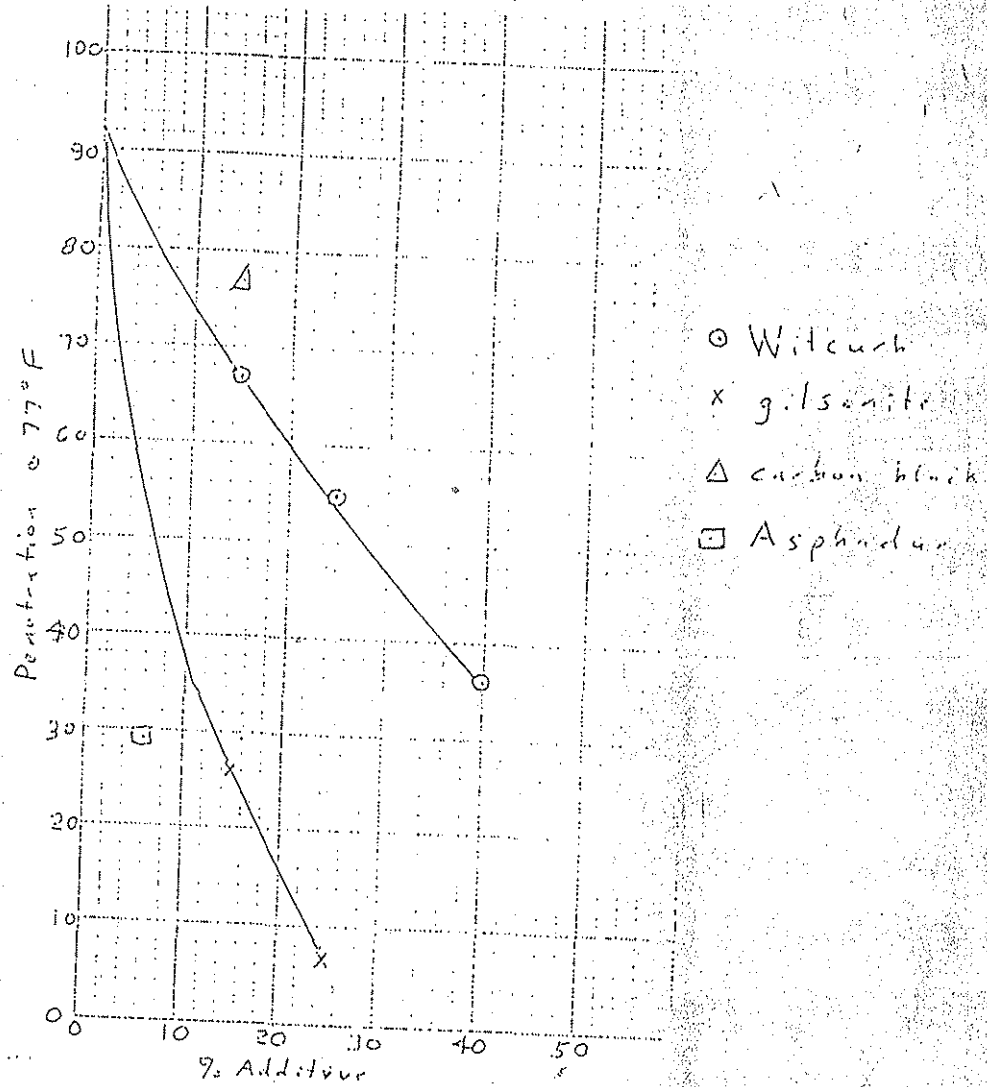


Table No. 1
Asphalt Mix Tests

| Mix No. | Additive | % by Wt AC | Density | Stability Pounds | Indirect Tensile p.s.i. |
|---------|--------------|------------|---------|------------------|-------------------------|
| 1 | None | -- | 2.351 | 3143 | 161.7 |
| 2 | gilsonite | 15 | 2.348 | 4073 | 264.7 |
| 3 | Witcurb | 25 | 2.336 | 3805 | 219.8 |
| 4 | BoniFiber | 5 lb* | 2.307 | 2617 | 118.9 |
| 5 | carbon black | 15 | 2.346 | 3613 | 159.5 |
| 6 | Asphadur | 6 | 2.316 | 3137 | 146.8 |

* Per ton of mix

Table No. 2
Liquid Asphalt Tests

| No. | Additive | % Add | Penetration @ 77°F | Viscosity @ 140°F |
|-----|--------------|-------|--------------------|-------------------|
| 1 | None | -- | 92 | 1,190 |
| 2 | Witcurb | 15 | 67 | 3,050 |
| 3 | Witcurb | 25 | 55 | 6,120 |
| 4 | Witcurb | 40 | 36 | 18,690 |
| 5 | gilsonite | 15 | 26 | 8,690 |
| 6 | gilsonite | 25 | 7 | * |
| 7 | carbon black | 15** | 77 | 2,650 |
| 8 | Asphadur | 6 | 29 | *** |

*Too high to test; ** Difficult to keep in suspension; *** Can't be tested

DISCUSSION AND CONCLUSIONS

Asphalt mixes used in extruded asphalt curbs need to be tougher and more resistant to deformation under static loads than normal paving mixes. Because the quantity of mix required for each project is small it is impractical to design and produce a separate mix for this purpose.

Our standard specifications address this in article 2303.26 with the addition of 15% powdered asphalt by weight of AC. Present practice involved the use of gilsonite, a natural asphalt. Another powdered asphalt is "Witcurb" which is produced from petroleum by Witco Chemical Corporation.

Our tests, both on mixes and liquid asphalts, support the use of powdered asphalt as an additive to modify the properties of regular paving mixes for

extruded asphalt curbs. Witco recommends an admixture rate of 25%. Our tests support this as nearly equivalent to the specified 15% rate for gilsonite.

According to G. W. Maupin, Jr. of the Virginia Highway and Transportation Research Council some areas in the east have been using BoniFibers in extruded asphalt curbs. He predicted that our tests for Marshall stability in indirect tensile strength would not show an improvement with BoniFibers, indeed both tests showed a negative effect.

The Iowa DOT uses Asphadur modified mixes in selected areas on hills and intersections to reduce shoving and rutting. Carbon black has also been suggested as an additive for these problem areas. If these additives improve pavement performance in severe service areas, they might also improve curb performance. Our test on the liquid asphalt shows an increase in stiffness as a result of these additives but no real improvement in stability or tensile strength.

We feel Witcurb should be considered for asphalt curbs but at the manufacturers recommended rate of 25% of the AC. This is more than the present 15% rate for gilsonite but might be economically feasible as an alternate on some projects.

Asphadur, BoniFibers and carbon black do not appear to offer much advantage for asphalt curbs. Carbon black and BoniFibers could be investigated as a replacement for Asphadur if it becomes unavailable or for economic reasons.