DENSE GRADED RUBBER MIXTURES AND CHEMKRETE at SEILING, OKLAHOMA INCLUDING FIRST YEAR EVALUATION

by

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16. ABSTRACT

This report discusses the application of three ground rubber additives and a chemical additive as ingredients in dense graded asphalt concrete (AC) overlays. A two inch layer of Type C dense graded AC with fabric reinforcement is being used as a comparison.

The goal of this project is to find better methods of controlling distress cracking and to slow the deterioration of the AC overlay.

The construction methods for each product mixture are discussed. The Chemkrete method closely resembles conventional mixing and laying methods. A chemical agent was added to the asphalt holding tank and thoroughly mixed. Ground tire rubber crumbs of the Arm-R-Shield and Overflex processes were added and mixed with 85-100 penetration asphalt. The Plusride product is also ground tire rubber but is added as an aggregate. Fabric reinforcement was not used with the asphalt rubber mixes.

In this experimental application, one and one-half inches of Chemkrete costs about the same as two inches of AC. Two inches of Plusride coat about twice the standard AC. Arm-R-Shield and Overflex cost about 3½ times the standard AC for their respective 2 inch layers.

Evaluations of the performance of these products will continue for three years. Initial performance evaluations indicate some stress conditions are beginning to come into view.

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EXECUTIVE SUMMARY

This report discusses the July, 1982, application of three ground rubber additives and a chemical additive as ingredients in dense graded asphalt concrete (AC) overlays. A 2 inch layer of Type C dense graded AC with fabric reinforcement is being used as a comparison.

The goal of this project is to find better methods of controlling distress cracking and to slow the deterioration of the AC overlay.

The construction methods for each product mixture are discussed. The Chemkrete method closely resembles conventional mixing and laying methods. A chemical agent was added to the asphalt holding tank and thoroughly mixed. Ground tire rubber crumbs of the Arm-R-Shield and Overflex processes were added and mixed with 85-100 penetration asphalt. The Plusride product is also ground tire rubber but was added as an aggregate. Fabric reinforcement was not used with the asphalt rubber mixes.

In this experimental application, 1.5 inches of Chemkrete costs about the same as 2 inches of AC. Two inches of Plusride cost about twice the standard AC. Arm-R-Shield and Overflex cost about 3 1/2 times the standard AC for their respective 2 inch layers.

Evaluations of the performance of these products will continue for three years. Initial performance evaluations indicate some stress conditions are beginning to come into view.

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INTRODUCTION

State Highway 3, US 270, from Oklahoma City to the Colorado state line was designated by Governor George Nigh as the "Northwest Passage". Plans were completed for improving this roadway that crosses the State of Oklahoma. The improvements included such items as a 2 in (50 mm) overlay, stress absorbing fabric interlayers, truck passing lanes, and 10 ft (3.0 m) wide shoulders. The culverts were extended to accommodate the widening of the roadway, plus a variety of other items were installed to upgrade the facility.

A roadway section of SH 3, northwest of Seiling, Oklahoma, approximately 8 mi (12.9 km) long, displayed transverse cracking. These cracks were spaced 5 ft to 15 ft (1.5 to 4.6 m) apart (8). The Oklahoma Department of Transportation (ODOT) Research and Development Division worked with Field Division VI to develop an experimental program to test four different types of new product systems in four 1 mi (1.6 km) full width sections. These four systems were developed to resist reflective transverse cracks, and/or increase roadway durability. They were laid in July, 1982.

Although nothing has been totally successful in stopping reflective transverse cracking, the fabric stress absorbing membrane interlayer (SAMI) system with a standard dense graded asphalt concrete (AC) overlay has proven to be a useful tool in retarding cracks and sealing old pavements.

Three asphalt-rubber products, Arm-R-Shield, Plusride, and Overflex in a dense graded AC mix will be compared to the standard SAMI system. Two inches (50mm) of Type C AC applied over a Petromat layer will be used as a control section. This will be considered the standard treatment for purposes of comparison of the overlay construction on SH-3 in this area.

A fourth product, Chemkrete, will be laid over the fabric (Petromat) SAMI system. The Chemkrete section has a 25 percent reduction in the lift thickness from 2 in (50mm) to 1.5 in (38mm) in accordance with the product manufacturer's recommendation (10).

The 4.0 mi (6.4 km) experimental test section contains no truck passing lanes. See Figure 1 for location. Therefore, the full effect of the traffic stress will be applied to the experimental treatments on the 2-lane roadway.

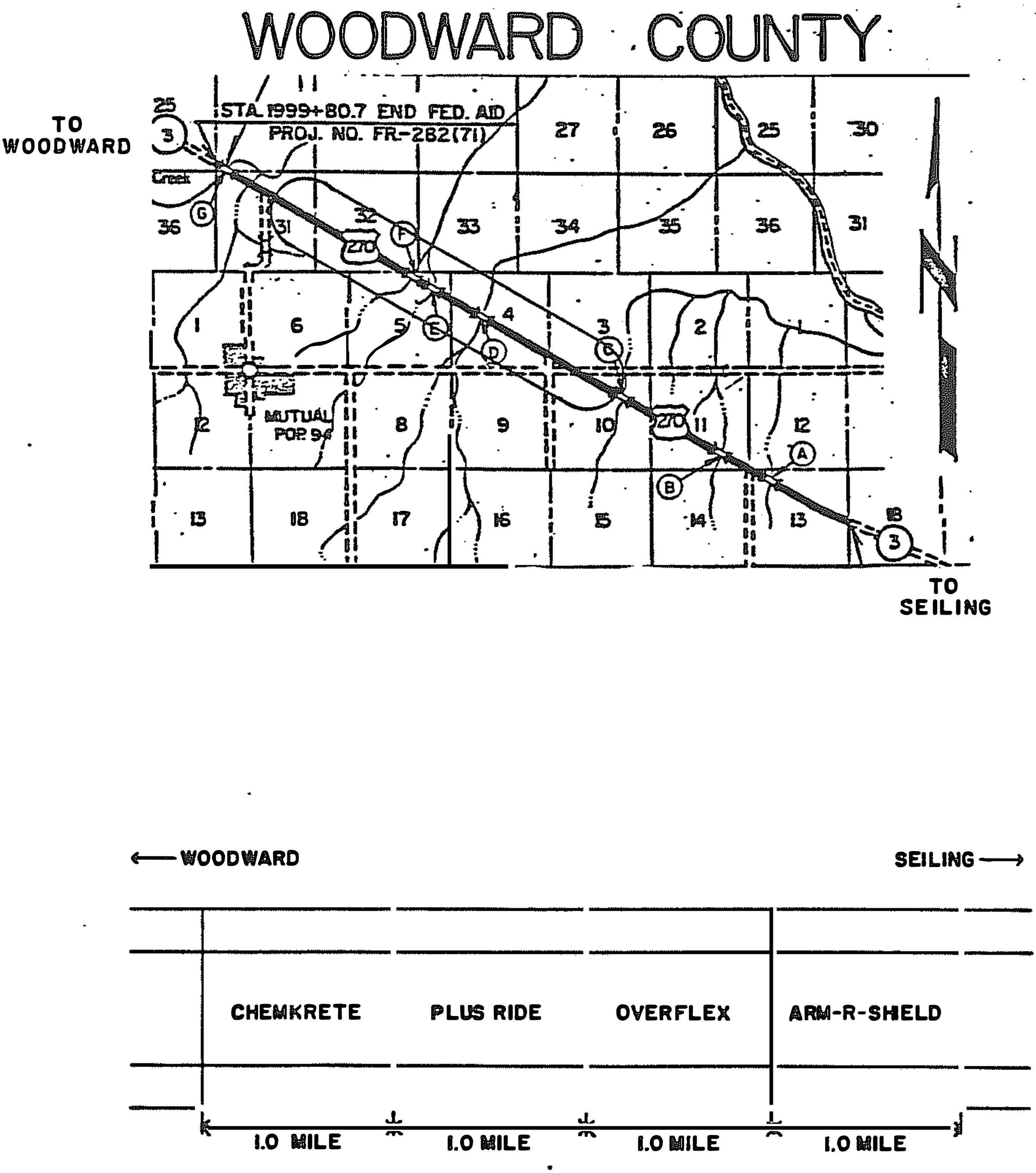


Figure 1. Project Location

HISTORY

Presented below is a detailed account of the roadway history for 7.3 mi (11.7 km) of SH 3, which includes the current project, FR282(71).

1934	Grading and drainage were completed on a 36 ft (11 m) roadway width for 7.3 mi (11.7 km) from a point 4.8 mi (7.7 km) southeast of the junction of SH 50 to a point 6.5 mi (10.5 km) northwest of the Major County line.
1936	Gravel was spread to a thickness of 5 in (127 mm) on a 20 ft (6.1 m) roadway width for 7.3 mi (11.7 km) from a point 4.8 mi (7.7 km) southeast of the junction of SH 50 to a point 6.5 mi (10.5 km) northwest of the Major County line.
1937	Paving was completed on a 20 ft (6.1 m) roadway width, using a thickness of 1.5 in (38 mm) of rock asphalt over a 5 in (127 mm) thick gravel base, for 1.7 mi (2.7 km) from a point 4.8 mi (7.7 km) southeast of the junction of SH 50 to a point 12.1 mi (19.5 km) northwest of the Major County line.
1937	Paving was completed on a 20 ft (6.1 m) roadway width, using a thickness of 1.5 in (38 mm) of rock asphalt over a 5 in (127 mm) thick gravel base, for 5.5 mi (8.9 km) from a point 6.6 mi (10.6 km) southeast of the junction of SH 50 to a point 6.5 mi (10.5 km) northwest of the Major County line.
1971	Paving was completed on a 24 ft (7.3 m) roadway width, using a 1 in (25 mm) thickness of asphalt concrete over 6.5 in (165 mm) previous base, for 7.3 mi (11.7 km) from a point 4.8 mi (7.7 km) southeast of the junction of SH 50 to a point 6.5 mi (10.5 km) northeast of the Major County line.
1978	Paving was completed on a 24 ft (7.3 m) roadway width, using a thickness of 3 in (75 mm) of asphalt concrete over a 9 in (230 mm) thick existing base, for 7.3 mi (11.7 km) from a point 4.8 mi (7.7 km) southeast of the junction of SH 50 to a point 6.5 mi (10.5 km) northwest of the Major County line.

1982 Paving was completed on 24 ft (7.3 m) roadway width, using 2 in (52 mm) asphalt-rubber; 1.5 in (38 mm) Chemkrete and 2 in (52 mm) asphalt concrete with a Petromat membrane over a 12 in (300 mm) thick base, for 7.3 mi (11.7 km) from a point 4.8 mi (7.7 km) southeast of the junction of SH 50 to a point 6.5 mi (10.5 km) northwest of the Major County line.

SOILS

The soils that underlie the roadway along the project, generally have a granular particle size with moderate or rapid permeability characteristics. The predominant American Association of State Highway and Transportation Officials (AASHTO) classification is A-4, with lesser extents of A-3. These soils have provided an adequate support for the roadway. For more detailed soils information see Appendix A.

PRE-EXISTING-ROADWAY

The Research and Development Division Engineers observed the old roadway pavement on August 6, 1981 and, after that, pre-construction testing procedures were established. By November 5, 1981 the work plan had been developed and approved. See Appendix B for test data.

The rideability of the surface was measured in inches of roughness per mile with a Mays ride meter. The inches of roughness per mile is translated into a Serviceability Index (SI) with 5.0 being a perfect ride surface and 0.0 being an unbearably rough riding surface. The lowest serviceability level that will be tolerated before resurfacing or reconstruction becomes desirable is generally accepted to be a value of 2.5 for major highways. The criterion for resurfacing corresponds to a mid-range or "fair" user rating according to the AASHTO system and is the point where roughly half of users consider a pavement unacceptable in its present condition (2). The average reading of the SH 3, 7 mi (11.2 km) experimental section was 195 inches of roughness per mile which translated into a 2.9 SI.

A detailed crack survey was made in ten randomly selected 200 ft (61 m) sections within the treated areas. Four control sections were established outside of the treated areas for comparison. Each section will be inspected annually for three consecutive years to observe cracking, if any, that may occur. The typical pattern on the pre-existing surface was transverse cracking, spaced 10 ft to 15 ft (2.5 to 3.3 m) apart.

The pavement thickness measurement and subgrade soil testing was done by the ODOT Materials Division. The pavement thickness averaged 9 in (230 mm).

Deflection tests using a Benkelman beam and rut depth measurements were the final preliminary observations. The deflection measurements indicated that the roadway had adequate strength for a 9,000 lb (4,086 kg) wheel load. This is the design requirement necessary for Federal-Aid Primary, Trunk System-Road Number 7 (4). The ruts averaged 0.2 in (5 mm) depth in the outside wheel path.

TRAFFIC

There was an average daily traffic (ADT) volume in 1979 of 2,600 vehicles, for the section of SH-3 starting from a point 6.5 mi (10.5 km) northwest of the Major County line for 1.9 mi (3.1 km) northwest along SH-3. Starting from a point 8.4 mi (13.5 km) northwest of the Major County line for 5.4 mi (8.7 km) northwest along SH-3, the ADT volume is 2,700 vehicles (4).

The general contractor, Broce Construction Company, supplied the traffic control for the project. Traffic control consisted of two flaggers approximately 0.3 mi (0.4 km) apart. The vehicles were directed on the opposite side of the tacked roadway lane and shoulder. As the working day wore on, the flaggers would move farther apart, because the new mat was kept from traffic until the surface indicated stability had been obtained. A pilot car was used after the flaggers exceeded 0.5 mi (0.7 km) apart.

CHEMKRETE

Construction

Chemkrete modified asphalt was the first experimental mixture applied to the "Northwest Passage" project between Seiling and Woodward, Oklahoma. The Chemkrete section is located approximately 0.5 mi (0.8 km) northwest of Persimmon Creek in Woodward County. The section measures one roadway mile (1.6 km) in length with two 10 ft (3.0 m) shoulders and a 24 ft (7.3 m) traveled path width.

On Tuesday, July 13, 1982 a transport truck holding 7 tons (6.4 metric tons) of the chemical additive, Chemkrete, was delivered to the Broce Construction Company drum-mix plant, located on the north bank of Persimmon Creek, east of SH-3. The plant was equipped with two asphalt holding tanks, four aggregate bins, a storage silo, and a dryer.

The two tanks stored 124 tons (112 metric tons) of 120-150 penetration grade asphalt to be used for this process. Chemkrete was added to the tanks, and circulated through the night for 12 hours to achieve a stable blend. The Chemkrete liquid blend was 5.7 percent by weight of the asphalt content. See Appendix C for Special Provisions.

A distributor truck applied 0.35 gal/yd^2 (1.58 l/m^2) of 85-100 penetration bituminous tack coat. A Petromat fabric membrane was applied over the tack coat.

During the next two days of construction, the asphalt concrete mixing and laying operation took place. First, the drier was heated to 275°F (135°C) and the bins were filled with ODOT Type C gradation aggregate. (Oklahoma Standard Specifications 708.04) Finally, the mat was laid at a nominal 1.5 in (38 mm) thick. This mat thickness was 0.5 in (13 mm) less than the standard 2 in (50 mm) design thickness due to the claimed added strength given to the mix with the addition of Chemkrete. A total of 2,313 tons (2,099 metric tons) of Chemkrete modified asphalt concrete was produced and laid over the Petromat.

The compaction procedure was done with a static steel wheeled roller followed by two rubber tire rollers and finished with a steel wheeled roller. The rolling patterns were established on the experimental mix in the same manner as a standard mix.

Field Investigation

On October 15, 1982 a distress condition on the surface of Chemkrete was noticed. As a result, a series of tests and evaluation procedures were performed.

It was noted that a number of large and small holes or "pop-outs" were occurring in the roadway surface. A map was drafted to plot and to note the number and location of these holes. The pop-outs ranged in size from 0.5 in (13 mm) to 3 in (76 mm) in diameter.

The source of the holes could not be determined from the visual observations, nor from any laboratory test. The only evidence available is a report from the ODOT Materials Division relating to a problem with clay balls in the fine aggregate stockpile. This problem occurred on a previously completed project done by the same contractor. The holes present in the Chemkrete section appear to be caused by clay balls. However, no trace of the clay ball was evident in or around the holes at the time of the evaluation.

Cores were taken of the Chemkrete overlay in late November, 1982 and sent to the Materials Laboratory for analysis. The set of cores taken in the southeast bound lane, from the mat laid on the first day of construction, had penetration readings of 112, 115, 121 and 94. The set of cores taken from the northwest bound lane, on the mat laid on the final day of construction, had penetration readings of 34, 85, 35, and 50. See Appendix D.

The variation in penetration values of the extracted asphalt indicate a difficulty in getting properly blended Chemkrete material. Eight or more hours of circulation in an asphalt plant holding tank located at the project site was suggested by the manufacturer. On the first day of construction, the mixture had twelve hours of circulation. This type of mixing may not be adequate.

In November, 1982, hairline size transverse cracks were observed. These were reflective cracks and they were evident throughout the one mile (1.6 km) experimental section. Within four months after application 100 percent of the original cracks had reflected.

Both Chemkrete and the standard asphalt pavements have a fabric reinforcement layer. The Chemkrete treatment has been the only section to crack within four months after laydown.

Conclusion

Chemkrete has the potential for benefiting asphalt concrete mixes. In the ODOT overlay project it appeared that proper mixing was difficult. Special mixing devices or procedures need to be developed to mix Chemkrete with asphalt cement.

No problems were encountered in the finishing or compaction of the Chemkrete mix.

Reflective cracks formed within four months of laydown because the mat apparently becomes brittle in a very short time. This is an undesirable property that should be corrected before the mix is accepted for general use.

ARM-R-SHIELD

Construction

The Arizona Refining Company crew set up on the Persimmon Creek plant site on July 19, 1982 and began the mixing of asphalt, granulated-crumb rubber, and asphalt extender oil. The rubber particles formed 20 percent of the asphalt binder. See Appendix C.

The necessary rubber blending equipment was furnished by the Arizona Refining Company. The 75,000 lb (34,020 kg) heat tank was loaded with 85-100 penetration asphalt. The blending machine was connected between the modified distributor truck and the heat tank. The close-by rubber extender oil tank was connected to the modified distributor truck.

As rubber particles were dumped into the blending machine, the recommended amounts of asphalt would flow to the lower tank. The combination would mix for 15 seconds at $400 \pm 25^{\circ}F$ ($205 \pm 14^{\circ}C$), then was pumped to the modified distributor truck that was partially loaded with asphalt extender oil.

Approximately 30 percent of the drum-mix plant holding tank was filled with Arm-R-Shield asphalt-rubber binder on the morning of July 20, 1982.

ODOT Type C gradation aggregate was heated to a temperature of $400 \pm 25^{\circ}F$ ($205 \pm 14^{\circ}C$), which on an average was $125^{\circ}F$ ($52^{\circ}C$) higher than standard mixes. The asphalt-rubber binder was added at 8.2 percent by weight of total mix. See Figure 2 for percentage content of constituents.

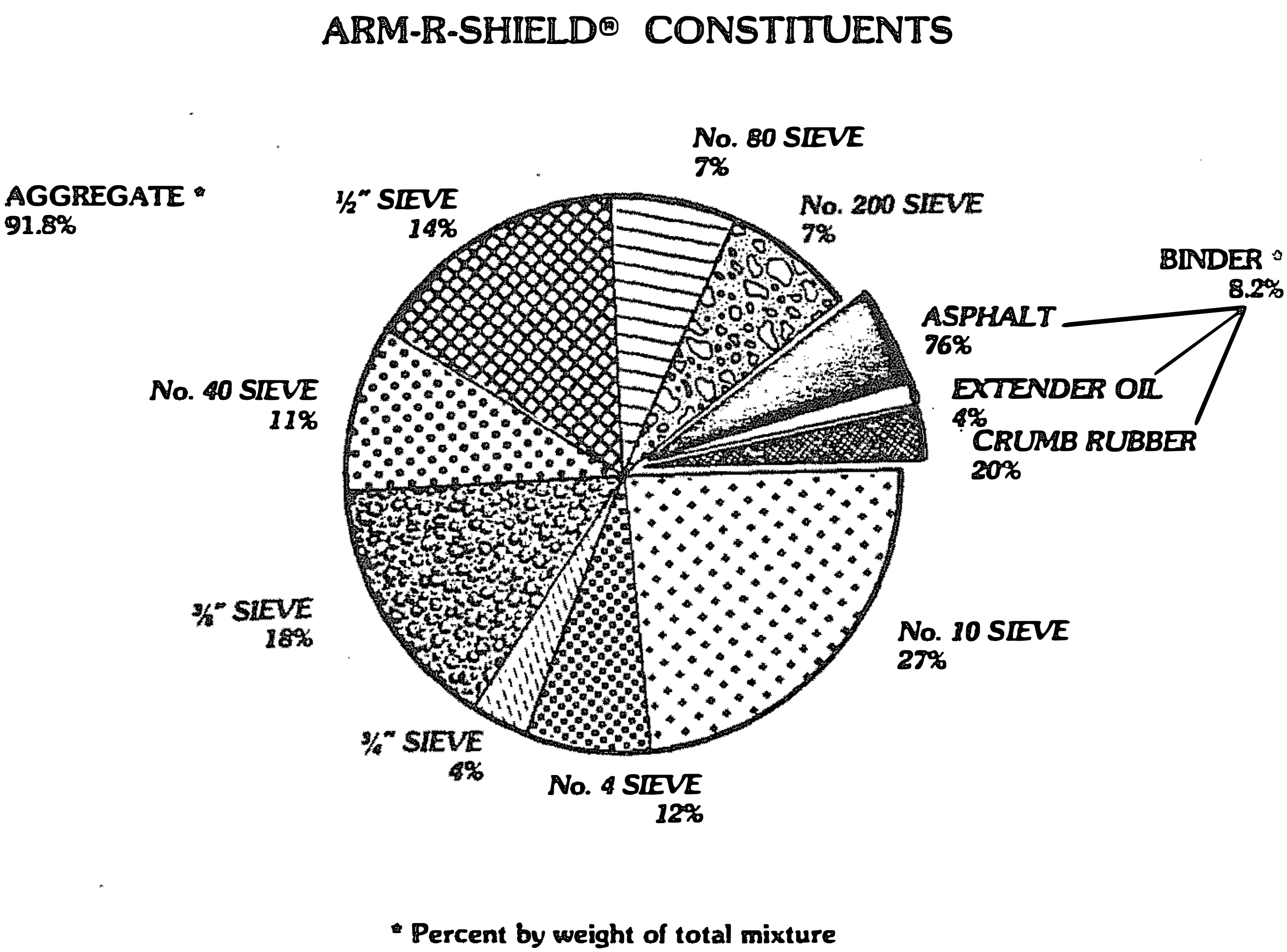


Figure 2. Arm-R-Shield Constituents

During the laydown and compaction operation, a few small blobs of asphalt-rubber binder would accumulate on the back of the metal screed and fall onto the mat. The irregular shaped blobs covered less than two percent of surface area and they were about 1/8 in (3.2 mm) thick.

A fine spray of water was used in front of the steel wheel roller on the first pass, then the 8-12 tons (7-11 metric ton) roller would complete the compaction procedure in three passes.

The blobs of asphalt-rubber binder that formed on the back of the heated screeds did not cause any compaction or finishing problems. Still, the combination of extreme high temperature and the sticky blobs on the mat, caused the roller operator to exercise caution.

After two days of work, the 2 in (50 mm) thick mat, one mile (1.6 km) long section was constructed. The mat contained 2,755 tons (2,500 metric tons) of Arm-R-Shield asphalt-rubber mix.

Conclusion

In comparison, it took four hours to mix a 1,500 gal (5,700 l) load of asphalt-rubber binder. But, the standard asphalt cement binder is shipped ready to use. The amount of asphalt-rubber binder used had to be planned carefully so all of it would be used that day and not left in the holding tank. This careful planning is necessary to keep the material flowable. The tackiness of the asphalt-rubber binder required special paddles in a holding tank, like those in the modified distributor truck.

PLUSRIDE

Construction

The Plusride process is very well suited for a batch plant. The construction company began to make the necessary adjustments to the plant a week before the August 17, 1982 construction began. See Figure 3 for a cut away view of the batch plant.

An opening was made at the top of the gradation control unit. Normally, this area would contain vibrating screens, but the screens were removed to accommodate an additional conveyor system installed on top of a 10 ft (3.0 m) platform (1). This conveyor belt system led to the opening in the gradation control unit. The granulated tire rubber particles were then introduced to the hot dried, heated 325°F(163°C) aggregate through the opening. The rubber material falls into the weigh-hopper where the proper amount would be sent to the pugmill. Then, the liquid asphalt would enter the pugmill at a temperature of 275°F (135°C) and mix to form Plusride rubber modified asphaltic concrete. See Appendix C.

The aggregate gradation system required four cold feed bins. The bins were filled with coarse aggregate, limestone screenings, sand, and volcanic ash. See Figure 4 for Plusride special aggregate gradation. A portion of the volcanic ash was lost in the atmosphere due to high winds during the drying cycle of the aggregates. The aggregate drying temperature was 325°F (163°C). See Appendix C.

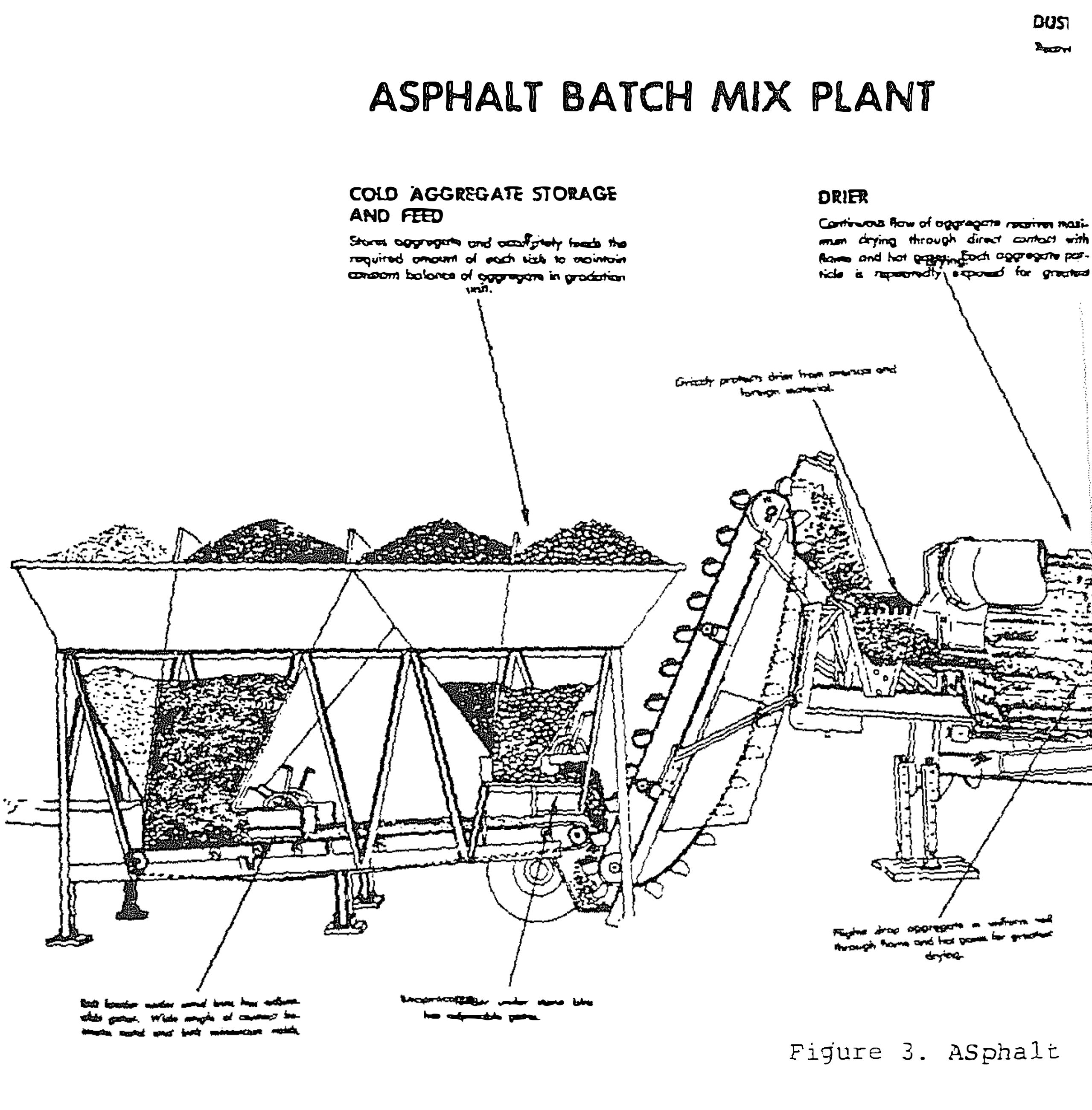
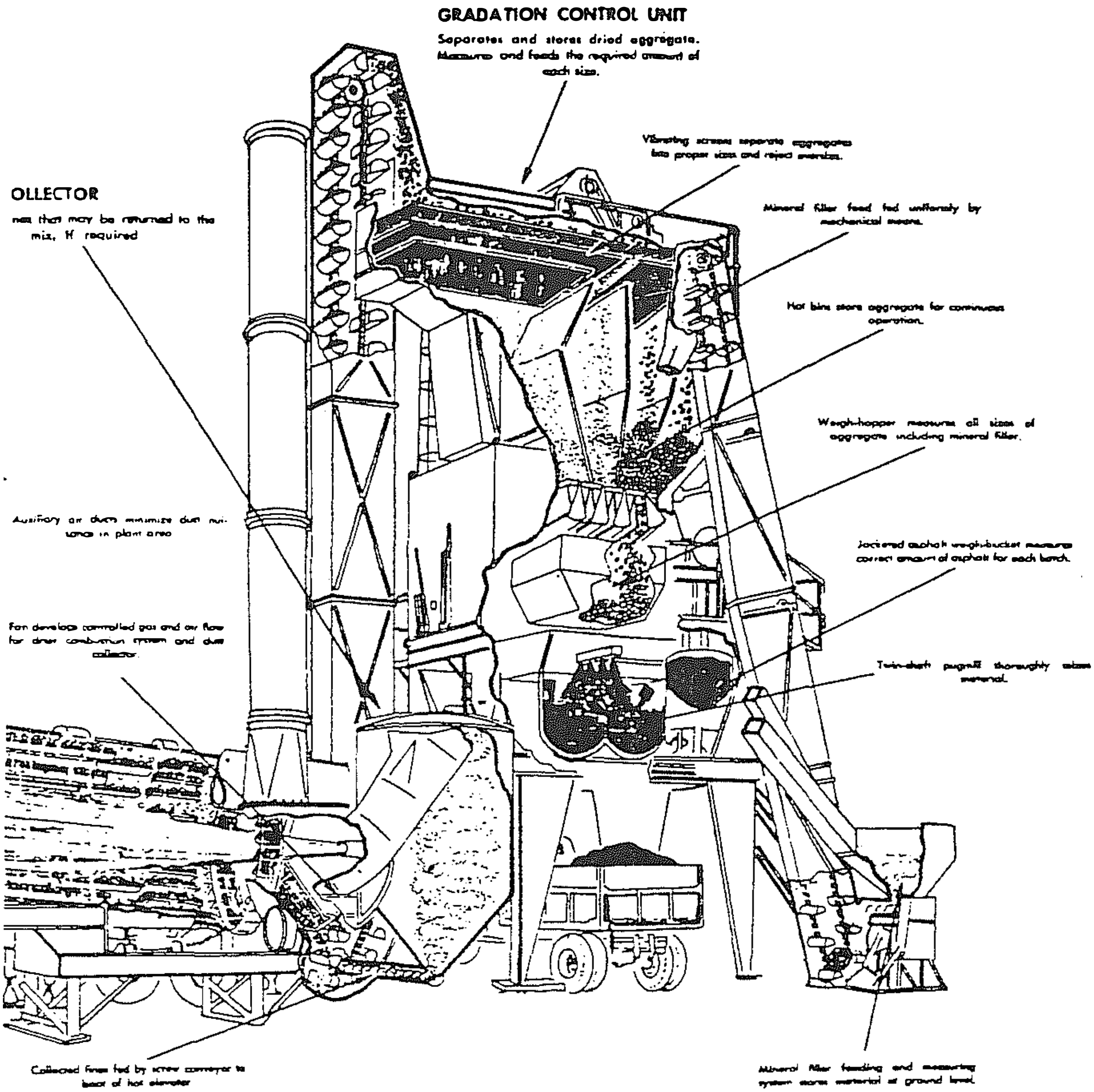


Figure 3. ASphalt



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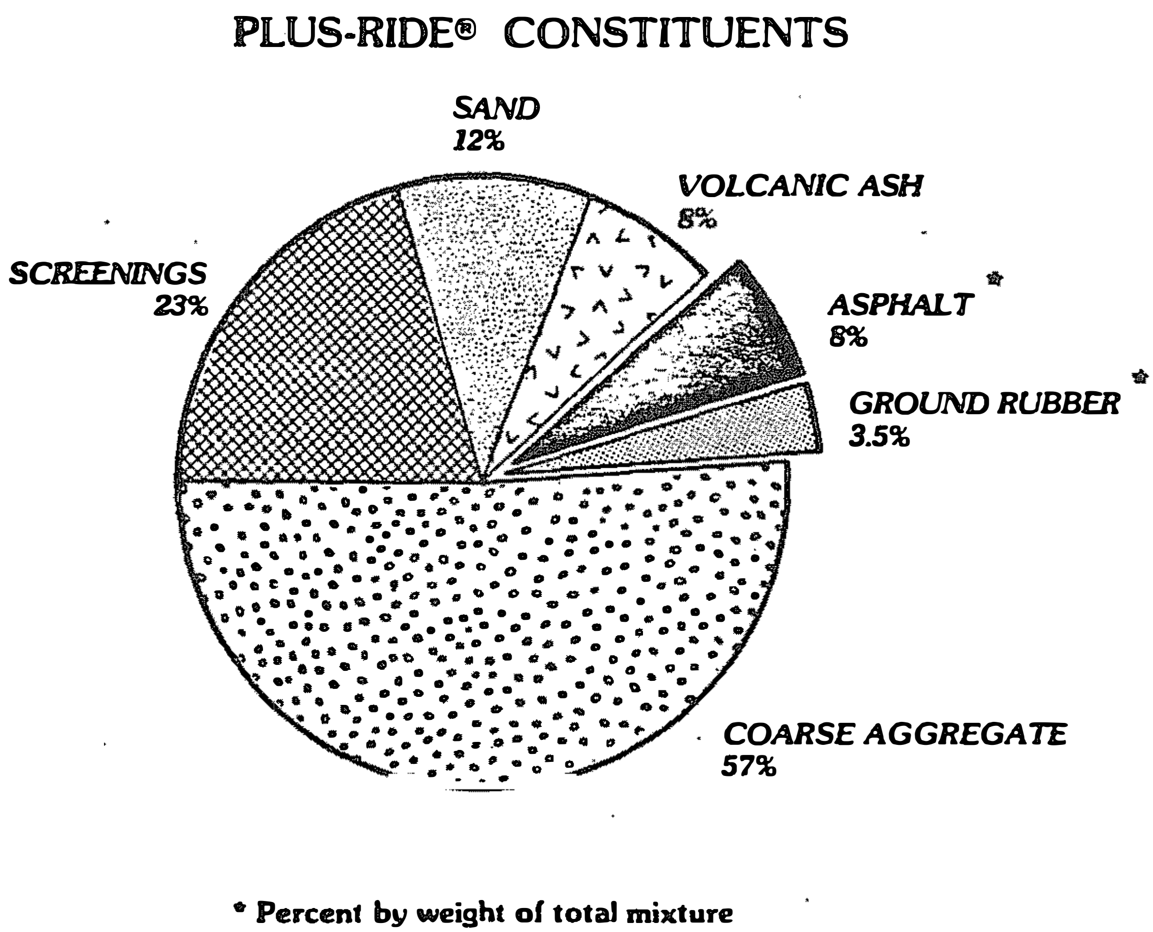

Figure 4. Plusride Constituents

The batch plant produced 2,570 tons (2,332 metric tons) of Plusride rubber modified asphalt concrete in two days. The mix averaged about 199 lbs/yd^2 (82 kg/m^2) laid, per 2 in (50 mm) of mat thickness.

The rolling procedure consisted of four passes by the 8-12 ton (7-11 metric ton) steel wheel roller to obtain proper compaction. The operation was closely monitored by the Plusride field representative.

Conclusion

The large amount of mineral filler needed for the gap graded Plusride caused a problem. A cloud of volcanic ash filled the air in the vicinity of the plant. This caused an approximate two to 10 percent loss of mineral filler material. The manufacturer should have a better method of introduction of this material into the mix.

A final check using the nuclear density machine to determine proper compaction was difficult due to the rubber particles in the mixture, and the lack of accurate mix design data.

OVERFLEX

Construction

Sahuaro Petroleum and Asphalt Company moved their equipment onto the drum-mix plant site as the last experimental section to be applied. Sahuaro supplied the crew and equipment for blending Overflex asphalt-rubber binder.

The crew connected the asphalt heat tank, blending machine, and modified distributor truck. Then, the 60 lb (27 kg) sacks of granulated crumb rubber were dumped into the blending machine hopper and the mixing began on August 20, 1982. See Appendix C. The rubber particles merged at a 425°F (210°C) temperature with a 85-100 penetration asphalt in the lower drum of the machine and mixed for 15 seconds. The compound was then pumped into the modified distributor truck and continued to blend until the necessary consistency was achieved. No extender oil or other additive was required in the Sahuaro asphalt-rubber mix.

A specially developed flow meter was the final piece of equipment installed. The flow meter was attached to the asphalt intake line, which was a direct connection to the dryer. The binder was able to flow from the modified distributor truck, through the flow meter, and into the dryer. The metering apparatus enabled the Overflex binder to by-pass the plant holding tank and mix with the hot aggregate. The meter determined the quantity of binder being used. The meter on the liquid asphalt holding tank normally gives that reading. The hot aggregate is combined with 10 percent binder by weight of mix in the drum dryer at a mixing temperature of 320°F (160°C). This formed the Overflex asphalt-rubber dense graded mix. See Figure 5 for percentage content of constituents.

After approximately 800 tons of mix had been produced, the manufacturer requested a slight change in gradation. This change produced a slight increase in voids. A five percent reduction in sand and a five percent reduction in limestone screening material was accomplished by adjusting the cold feed bins.

In the laydown operation, small blobs of asphalt-rubber binder separated from the metal screed and were deposited on the roadway surface. The blobs texture was rough and they measured 1/8 in (3.2 mm) in thickness.

After two days of construction, the 2 in (50 mm) thick, one mile (1.6 km) long and 44 ft (13.4 m) wide section of Overflex asphalt-rubber surface was completed. It took 2,809 tons (2,549 metric tons) of mix to apply the overlay.

Conclusion

The Sahuaro flow meter had several advantages in helping the plant to operate in a normal fashion. First, the liquid asphalt holding tank was by-passed, therefore, the asphalt in it could be used any time for a standard asphalt operation. Second, the tank and pump did not have to be drained at the end of the day. The asphalt-rubber binder can cause a problem because it is more viscous than the standard asphalt grade used by ODOT in dense graded mixes.

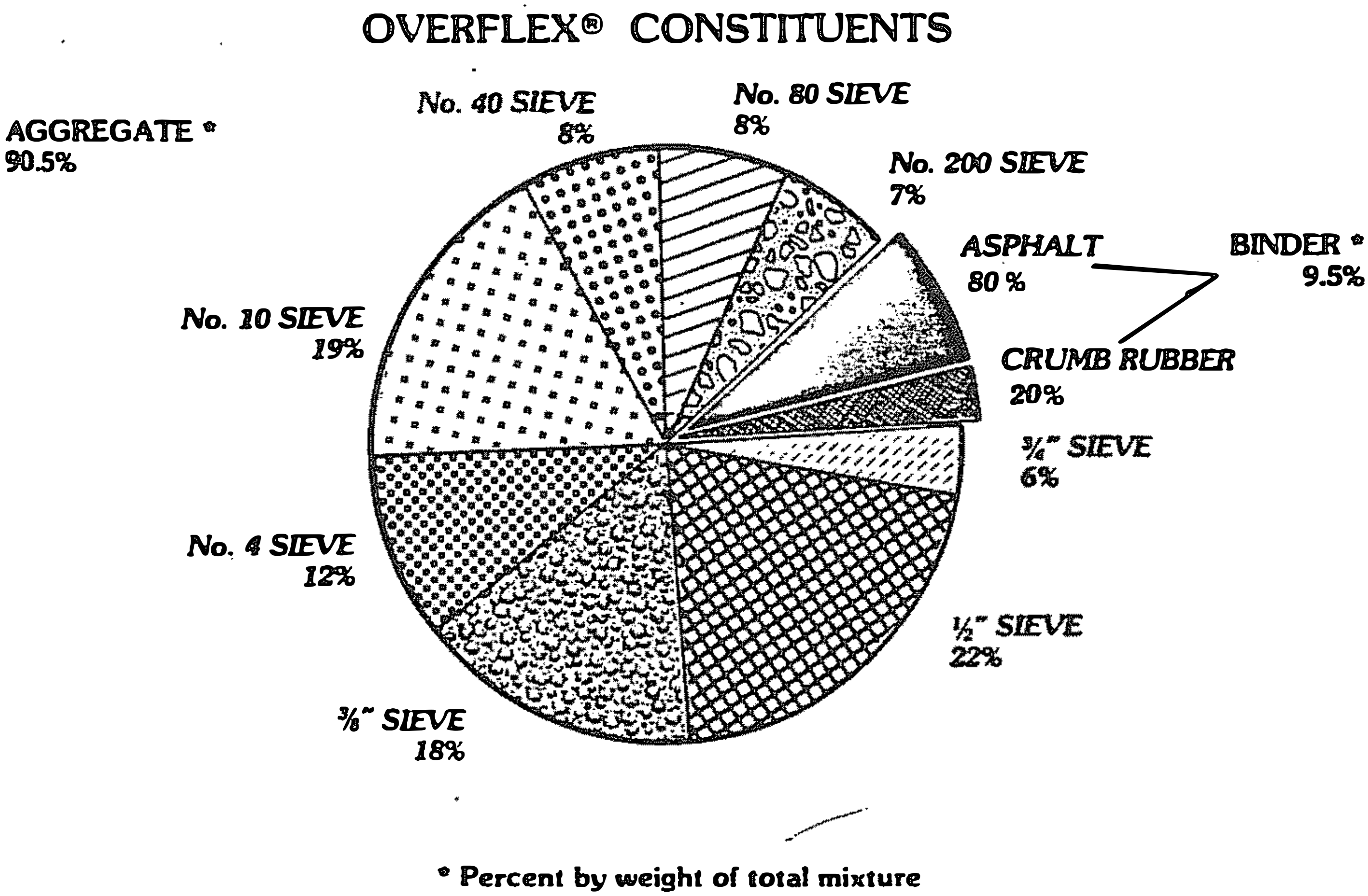

Figure 5. Overflex Constituents

The only construction problem occurred when blobs of asphalt-rubber binder formed on the back of the heated screeds of the laydown machine. These were similar to the Arm-R-Shield blobs. The steel wheel roller operation was delayed while waiting for the material to cool down. Yet, the contractor did not use any additional lubrication on the steel wheel roller.

SUMMARY AND CONCLUSION

Mixing Procedures

Each rubber product has some differences in mixing, handling procedures, and equipment. Arm-R-Shield and Overflex compare closely with each other in all three categories. Plusride uses an aggregate approach in incorporating the tire particles in a dense graded asphalt concrete mix.

Both Arm-R-Shield and Overflex start out with a fine rubber gradation. The particle size ranges of both products are similar, with the Arm-R-Shield rubber no larger than a No.10 sieve and Overflex rubber all passing a No. 8 sieve. Plusride uses a much larger size rubber particle with all passing a 1/4 in (6.4 mm) sieve.

Arm-R-Shield and Overflex have their rubber particles mixed directly into the asphalt. The vulcanized rubber particles readily disperse in the hot asphalt and substantial amounts can be added before the increased viscosity begins to impede the mixing and paving stages (6). Arm-R-Shield uses 20 to 40 percent devulcanized rubber particles which are more soluble in asphalt (3).

The asphalt-rubber is transported in a modified distributor truck in both the Arm-R-Shield and the Overflex process. Arm-R-Shield binder goes into the holding tank, while Overflex binder is fed directly into the mixing chamber with a special pump/metering machine.

The Plusride large rubber particles act partly like an aggregate and partly like a binder. Plusride has a special gap graded mineral aggregate that is combined with the liquid asphalt and rubber in the mixing chamber.

When comparing Chemkrete to the standard asphalt mixes, a few items must be considered. First, an extra day at the start of a project is necessary to circulate the chemical additive, Chemkrete, into the asphalt. Second, for each additional storage tank fill-up of asphalt, eight hours have to be added to the project schedule for mixing, while there is no delay with the standard asphalt operation.

Construction Procedures

The four experimental sections used two standard laydown machines, in staggered position side by side, so as to cover both a roadway lane and a shoulder. These operations all started on the northwest end of the respective one mile sections and paved in a southeasterly direction. The first several dump truck loads of mix would service the laydown machine on the roadway lane. After approximately 500 ft (152 m) of mat was laid, the dump trucks would service the second laydown machine on the shoulder.

The laydown temperature of Arm-R-Shield ranged between 280^{o}F (138^{o}C) and 225^{o}F (108^{o}C). The Plusride and Overflex laydown temperature averaged 285^{o}F (141^{o}C).

The rolling patterns were established on each of the rubber experimental mixes in the same manner as a standard mix. The mat had to cool to a rolling temperature. This temperature was established by the roller operator by trial and error (5).

The temperatures at which rolling started for Plusride were slightly different when compared to Overflex and Arm-R-Shield. Plusride needed the breakdown roller close behind the laydown machine. Overflex and Arm-R-Shield needed a cooler surface, therefore the breakdown rolling was approximately 300 ft (91 m) behind the laydown machine. All three rubber processes required the use of steel wheeled rollers. They can be used for breakdown, intermediate, and finish rolling.

The Chemkrete operation was patterned after the standard asphalt mix procedure. It required a steel roller for the breakdown and intermediate rolling. A pneumatic roller was required for the finish rolling. The Chemkrete laydown temperature was the same as the standard asphalt mix.

Surface Texture

All of the finished roadway treatments had different surface textures. The three discarded tire rubber products, Arm-R-Shield, Overflex, and Plusride, made slightly different surfaces.

The Arm-R-Shield surface appeared to be fine textured and somewhat gritty (9). The surface appeared tighter than the control section surface.

The Overflex surface texture appeared coarse and gritty (9). This was almost identical to the ODOT Type C surface texture of the control sections.

The Plusride surface appeared coarse and gritty. The Plusride texture appeared to be the most desirable of all the rubber systems because the large amounts of coarse aggregate used produced an open appearance. The Plusride skid test results show the highest readings of all the systems, including the control sections. See Appendix E for skid data.

The Chemkrete surface texture appeared the same as the standard Type C mix.

COSTS

The roadway cost for each experimental mile was estimated according to the materials used on the project and put into two charts. The first chart gives a total dollar figure for each material. The second chart gives a dollar figure per square yard for each material used. See Figure 6 and 7 for treatment costs.

Chemkrete, the chemical additive, was blended with liquid asphalt to make the binder. Chemkrete binder cost $31,400/mi while the standard binder (85-100 penetration grade asphalt) cost $25,100/mi. There was a saving in aggregate cost because a 1.5 in (38 mm) mat of Chemkrete was laid instead of the 2.0 in (50 mm) mat of the standard asphalt mix.

The Plusride special gradation mineral aggregate cost was higher by $39,500/mi than the standard aggregate. The Plusride binder cost was $58,700/mi including the cost of the rubber, which made it cost twice that of the standard binder.

Arm-R-Shield and Overflex are asphalt-rubber binder products. Their costs were similar on this project. The asphalt-rubber binders were more than 3 1/2 times the cost of the standard asphalt binder, thus elevating the cost to $88,000 each mile. See Figure 8 for total costs.

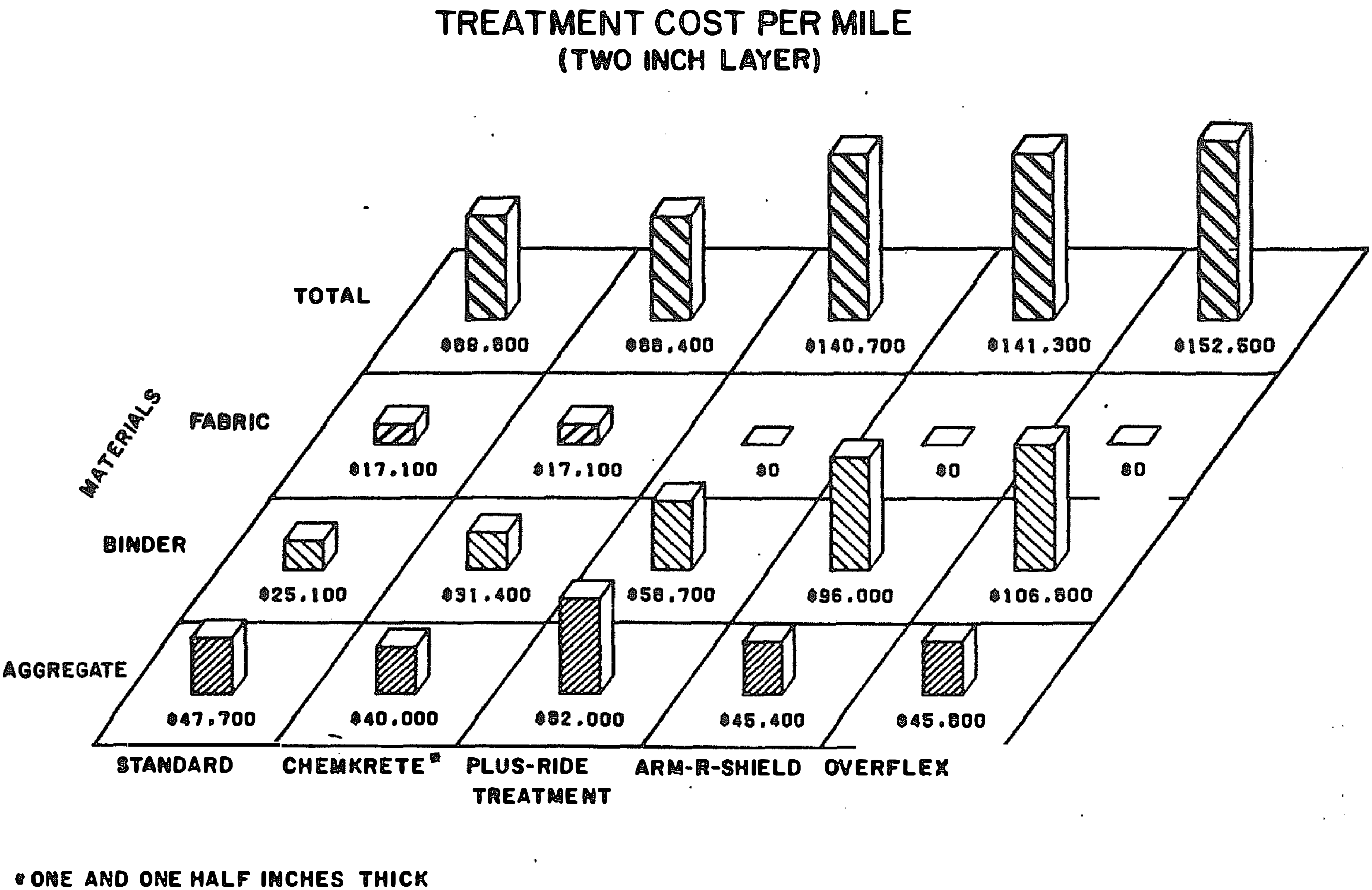

Figure 6. Material Cost Per Mile

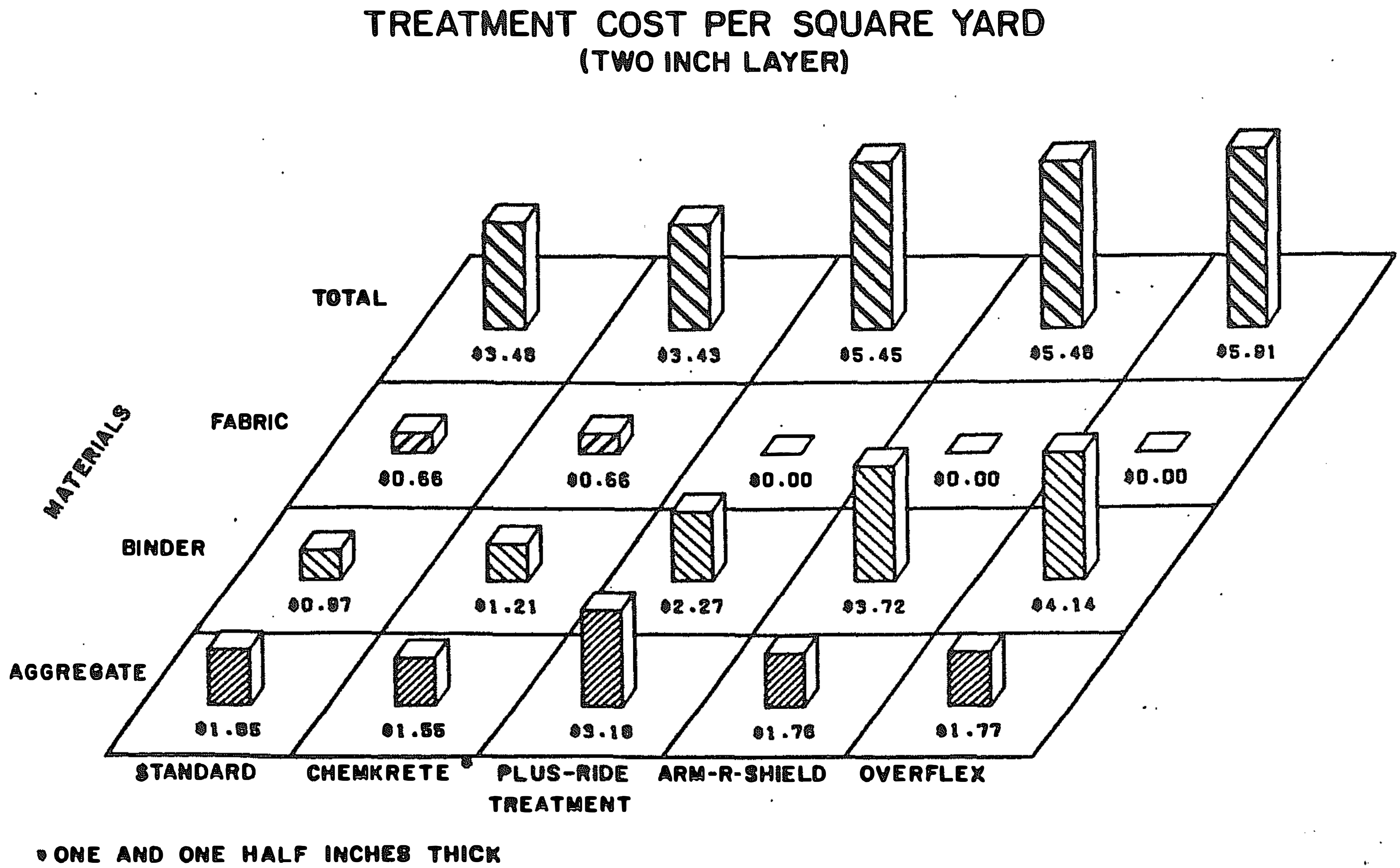

Figure 7. Material Cost Per Square Yard

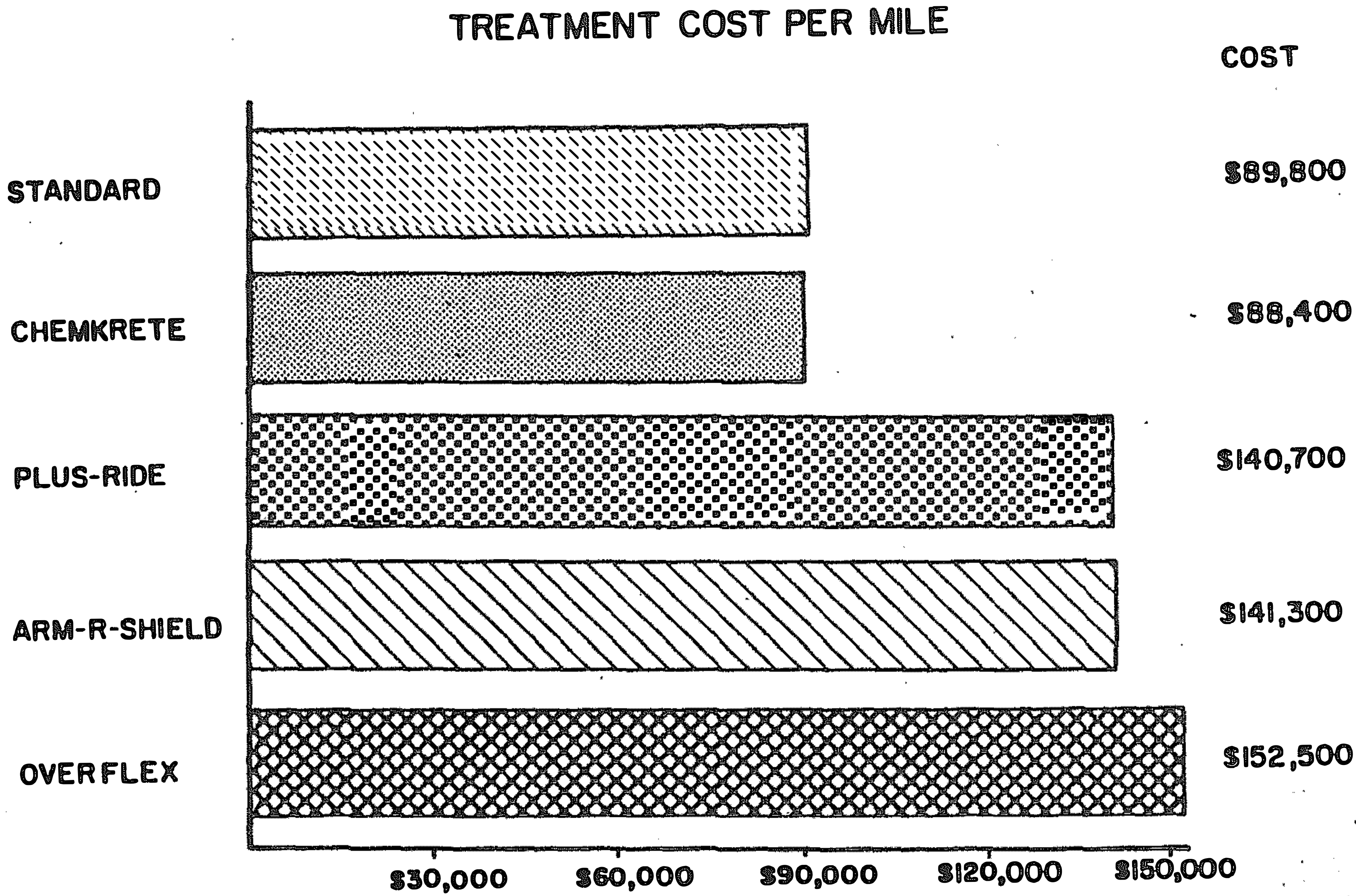

Figure 8. Total Treatment Cost Per Mile

EVALUATION

All these products were applied in a conventional manner with only a few differences. The costs were considerably higher for the rubber mixtures but if reflective cracking is retarded and the higher performance levels are met, then the asphalt-rubber mixtures may be useful.

Evaluations of the performance of the overlays will be made annually for the next three years. These evaluations will include deflection tests, ride quality, skid, and condition surveys.

REFERENCES

1. "The Asphalt Handbook", Manual Series No. 4, The Asphalt Institute, (1965) p. 124.

2. Croteau, Jack, "Pavement Roughness Evaluation Using a Mays Ride Meter", New Jersey Department of Transportation Division Research with U.S. Department of Transportation, FHWA, June, 1981, p. 15.

3. Huff, B.J. and Vallerga B.A., "Characteristics and Performance of Asphalt-Rubber Material Containing a Blend of Reclaimed and Crumb Rubber, Transportation Research Record 821, (1981) p. 30.

4. "Highway Needs Study and Sufficiency Rating Report", Vol. II, Oklahoma Department of Transportation (1981), p. 7a and 403.

5. Marker, Vaughn, "Factors Affecting Compaction: Asphalt Compaction Conference", Oklahoma Department of Transportation, (1981) p. 31-57.

6. Piggott, M.R., Woodhams, R.T., "Recycling of Rubber Tires in Asphalt Paving", Department of Chemical Engineering and Applied Chemistry, University of Toronto, Canada, (March, 1979), p. 6.

7. "Soil Survey", Woodward County, Oklahoma, United States Department of Agriculture, No. 6 (1960).

8. "Standard Nomenclature and Definition for Pavement Components and Deficiencies", Highway Research Board, Special Report 113, (March, 1969) p.13.

9. "Tentative Skid-Resistance Requirements for Main Rural Highways, NCHRP-Report No. 37, (1967) p. 24.

10. White, Thomas D., Memo: "Asphalt Technology and High Strength Modified Asphalt Products", Chem-Crete Corp., (1982).

APPENDIX A

SOILS

The soil series comprising the major areas along the project include the Carey, Woodward, Pratt, and St. Paul, while the minor soil series along the roadway include the Quinlan, Elsmere, and Tivoli (7). See Figure A-1 for Soils map.

The Carey soil is a deep, well-drained, reddish-brown or brown loamy soil accounting for 37 percent of the project length. The silt loam surface layer is about 14 in (360 mm) thick and has a granular structure. The subsoil is about 30 in (760 mm) thick and has a coarse, prismatic structure that breaks easily. The subsoil is generally noncalcareous with moderate permeability and no accumulation of lime.

The Woodward soil is a moderately deep, well-drained, reddish-brown loamy soil comprising 20 percent of the project length. The surface layer is about 10 in (250 mm) thick and the subsoil is about 16 in (400 mm) thick. Both the surface layer and subsoil are generally calcareous and have a granular structure with moderate permeability. There are generally accumulations of lime in a few places within the subsoil.

The Pratt soil is a somewhat excessively drained, brown sandy soil making up 16 percent of the project length. The surface layer of brown loamy fine sand is about 12 in (300 mm) thick while the subsoil of yellowish-brown loamy fine sand is about 30 in (760 mm) thick. Both the surface layer and subsoil have a weak, granular structure with rapid permeability. The subsoil is generally noncalcareous and neutral in reaction.

The St. Paul soil is a deep, moderately well-drained, brown loamy soil comprising 12 percent of the project length. The brown silt loam surface layer is about 17 in (430 mm) thick with a granular structure. The reddish-brown clay loam subsoil is about 30 in (760 mm) thick with a subangular blocky structure having clay films on the block surfaces. This soil has a moderately slow permeability.

The Quinlan soil is a shallow, somewhat excessively drained, red loamy soil making up 10 percent of the project length. The surface layer is a red or reddish-brown loam with a granular structure and is about 9 in (230 mm) thick. The subsoil is a red mixture of loam and weathered sandstone about 4 in (100 mm) thick with moderate permeability. The subsoil is calcareous, but it has only a few lime accumulations.

The Elsmere soil is a deep, grayish-brown loamy fine sand that has a high water table. The grayish-brown surface layer has a loose single-grained structure and is 16 in (410 mm) thick. The pale-brown subsoil is also single-grained and is about 30 in (760 mm) thick. It is stratified and averages a loamy fine sand in texture. The subsoil is indistinctly mottled and generally calcareous. The soil has a rapid permeability down to the high water table and accounts for 4 percent of the project length.

The Tivoli soil is an excessively drained, pale-brown sandy soil that comprises only 1 percent of the project length. Tivoli soil consists of about 7 in (180 mm) of pale-brown very sandy soil over many feet of loose fine sand that takes water very rapidly. The subsoil is generally noncalcareous and neutral.

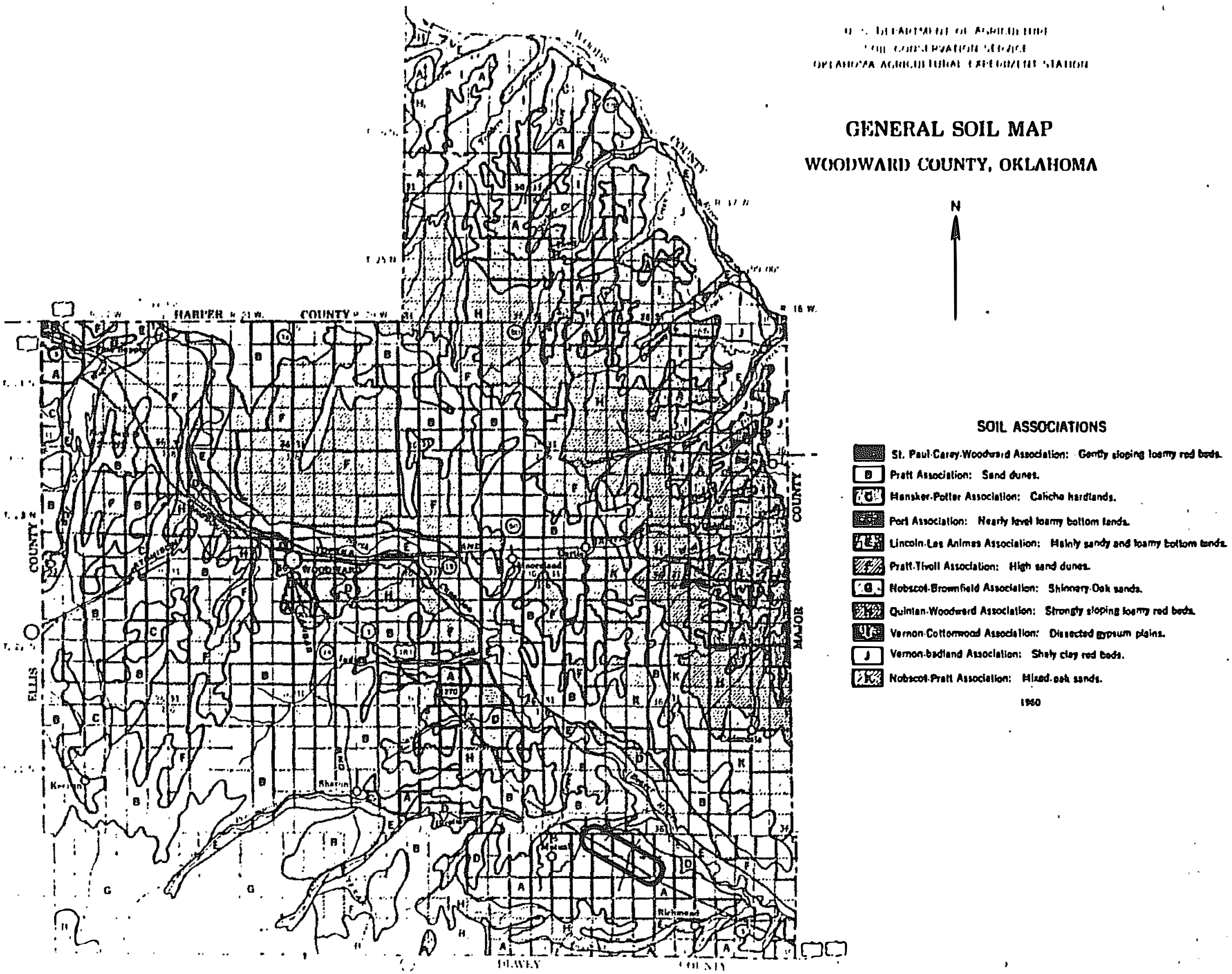

Figure A-1. Soil Profile Map

APPENDIX B

Appendix B

MAYS RIDE METER DATA

N.W. BOUND LANE*

SH 3 WOODWARD COUNTY

Description	Mi (0.2)	Reading	Description	Mi (0.2)	Reading
New Overlay	1	78	New Overlay	21	62
↓	2	56	↓	22	166
↓	3	61	↓	23	170
↓	4	79	Old Pavement	24	226
↓	5	64	↓	25	343
↓	6	74	↓	26	222
↓	7	79	↓	27	522
↓	8	56	↓	28	241
↓	9	108	↓	29	281
↓	10	111	↓	30	217
↓	11	79	↓	31	206
↓	12	79	↓	32	323
↓	13	119	↓	33	169
↓	14	115	↓	34	61
↓	15	108	↓	35	58
↓	16	123	↓	36	46
↓	17	131	↓	37	50
Bridge	18	253	↓	38	226
New Overlay	19	99	↓	39	321
	20	77	↓	40	239

* Beginning at Persimmon creek and traveling Northwest for 7.5 mi (12 km) to end of project.

MAYS RIDE METER DATA

S.E. BOUND LANE*

SH 3   WOODWARD COUNTY

Description	Mi (0.2)	Reading	Description	Mi (0.2)	Reading
Old Pavement	40	302	New Pavement	20	84
↓	39	293	↓	19	86
	38	161	Bridge	18	239
	37	73	New Pavement	17	155
	36	49	↓	16	175
	35	63		15	141
	34	77		14	191
	33	106		13	187
	32	107		12	66
	31	116		11	62
	30	92		10	61
	29	319		9	83
	28	309		8	72
	27	395		7	68
	26	174		6	70
	25	188		5	59
	24	344		4	50
New pavement	23	183		3	66
↓	22	96		2	55
	21	99		1	55

* Beginning at Persimmon Creek and traveling Northwest for 7.5 mi (12 km) to end of project.

APPENDIX C

411-Ex.4(a-b)
12-4-81

OKLAHOMA DEPARTMENT OF TRANSPORTATION
SPECIAL PROVISIONS
FOR
EXPERIMENTAL
MODIFIED ASPHALT CONCRETE
(CHEM-CRETE)*

These Special Provisions revise, amend, and where in conflict, supersede applicable Sections of Standard Specifications for Highway Construction, Edition of 1976.

411.01. DESCRIPTION. (Add as follows). This work shall consist of the addition of the chemical modifier, CHEM-CRETE, to paving grade asphalt. The modified asphalt shall be used in a bituminous paving mixture according to these Special Provisions.

A technical representative of the CHEM-CRETE Corporation shall be present at the pre-bid conference and during construction. They shall also provide information and technical advice to the Contractor and Engineer.

*CHEM-CRETE a trade name for CHEM-CRETE modified asphalt product produced by the CHEM-CRETE Corporation, 2180 Sand Hill Road, Menlo Park, California, 94025; telephone number (415) 854-6206.

708.03. ASPHALT MATERIALS. (Add as follows). The bituminous material to be modified shall have a penetration of 120 - 150. The asphalt shall meet the requirements of AASHTO M-20.

Amend Section 708 to include the following:

(a) CHEM-CRETE MATERIAL. (Add as follows). Shall meet the following requirements:

Asphalt Modifier - Type 125.35.

Characteristic	Standard	Temperature	Typical Value
Specific Gravity	ASTM-D 70	75° F	0.926
	ASTM-D 3142	100° F	0.915
	ASTM-D 3142	212° F	0.873
Viscosity, centi-Poises	ASTM-D 2171	68° F	258.0
	ASTM-D 2171	100° F	99.6
	ASTM-D 2171	140° F	40.7
	ASTM-D 2171	275° F	6.82
Flash Point, C.O.C., minimum		410° F	

Color: Amber to Dark Brown.

(b) Binder. The CHEM-CRETE modified asphalt shall contain one (1) part CHEM-CRETE additive and nineteen (19) parts of 120 - 150 penetration asphalt cement.

The uniform mixing of CHEM-CRETE with the specified asphalt shall be performed at the refinery or approved mixing & storage facilities provided for on the job site in strict accordance with the manufacturer's recommendations and instructions. The Contractor is to be responsible for assuring that the CHEM-CRETE modified asphalt is properly mixed, delivered, stored, and utilized according to these specifications.

700.04. COMPOSITION OF MIXTURES. (Amend as follows). The paving mixtures shall consist of a uniform mixture of the combined aggregate and CHEM-CRETE bituminous material and shall conform to the requirements shown in Table III for the type of mixture designated on the Plans or in the Proposal.

708.05. TOLERANCES. (Add the following). The content of the CHEM-CRETE additive shall be tested by the Engineer or Manufacturer with a test kit supplied by the CHEM-CRETE Corporation.

411.06. BASIS OF PAYMENT. (Amend as follows). Accepted quantities for CHEM-CRETE Modified Asphalt Concrete measured as provided above will be paid for at the contract unit price for:

(A-3)	TYPE C AGGREGATE	TON
SP.	CHEM-CRETE ASPHALT	TON

which shall be full compensation for furnishing all materials, equipment, labor and incidentals to complete the work as specified.

OKLAHOMA DEPARTMENT OF TRANSPORTATION
SPECIAL PROVISIONS FOR EXPERIMENTAL ASPHALT RUBBER DENSE GRADED MIXTURE (ARM-R-SHIELD)*

These Special Provisions revise, amend, and where in conflict, supersede applicable Sections of Standard Specifications for Highway Construction, Edition of 1976.

411.01. DESCRIPTION. (Add as follows). This work shall consist of the addition of ARM-R-SHIELD asphalt-rubber as a binder in a bituminous paving mixture in accordance with these Special Provisions.

A technical representative of the Arizona Refining Company shall be present at the pre-bid conference and during construction. They shall also provide information and technical advice to the Contractor and Engineer.

*ARM-R-SHIELD a trade name for the asphalt-rubber binder product produced by the Arizona Refining Company, P.O. Box 1453, Phoenix, Arizona, 85001; telephone number (800) 528-5305.

708.01. APPROVAL OF MATERIALS. (Amend as follows). The Contractor shall submit samples of all materials proposed for use under these specifications to Arizona Refining Company and to the Materials Division, Oklahoma Department of Transportation. These materials will be tested and utilized for the preparation of design mixtures. Arizona Refining Company shall promptly submit the recommended design mixture to the Materials Engineer for his examination and approval.

708.03. ASPHALT MATERIALS. (Add as follows). The bituminous materials used to manufacture the asphalt-rubber shall meet the requirements of AASHTO M-20.

Amend Section 708 to include the following:

(a) RUBBER MATERIAL. (Add as follows). The rubber shall be a dry, free flowing blend of 20 to 40 percent powdered reclaimed (i.e., devulcanized) rubber and 60 to 80 percent ground vulcanized rubber. The exact proportions will be determined by Arizona Refining Company to maximize the end properties of the product with the rubber available in the area.

(1) Purity. The rubber shall be free of wire, excess fabric, or other contaminants.

(2) Size. The rubber shall contain no particles larger than 10 mesh or exceeding 1/4 inch in length.

(3) Mill Test. When 40 to 50 grams of rubber retained on the No. 30 sieve are added to a tight set 6-inch rubber mill, the material shall band on the mill roll in one pass. (Note: This test is to establish that a sufficient quantity of reclaimed, devulcanized rubber is present.

(4) Each lot of the granulated-crumb rubber shall be tested by the manufacturer. The rubber supplier shall furnish a Type A certification as per Section 106.12 with test reports indicating the material meets the manufacturer's current specifications and the gradation requirements herein specified.

(b) Binder. (Add as follows). The rubber and modified asphalt shall be combined in a ratio of 20 (± 2) percent rubber to 80 (± 2) percent asphalt by weight of mixture and reacted for a sufficient time at 400 (± 25)^o F to produce a product with the following properties.

Viscosity at 400^o F................1,000 cps maximum
Softening Point (R & B)............120^o F minimum
Flex Temperature (90^o Bend Test)...20^o F maximum

In the event a delay occurs when the product is ready to be applied, the heat shall be turned off until the job resumes.

The handling, loading, hauling, transfer pumping, or similar operations connected with the movement of the asphalt rubber to and within the plant site, shall be the responsibility of Arizona Refining Co., with the cooperation of the Contractor.

(c) Application Temperature. (Amend as follows). The Aggregate shall be heated from 325° F to 365° F and the asphalt-rubber binder shall be heated from 375° F to 425° F for mixing purposes. The combined material shall be between 325° F and 365° F at mixing.

708.04. COMPOSITION OF MIXTURES. (Add the following). The aggregate asphalt-rubber, and rubber extender oil shall be uniformly mixed and conform to the requirements of asphalt concrete.

The gradation of the aggregates shall be Type C as designated in Table III - Table of Mixtures (Hot Mix-Hot Laid).

708.05. TOLERANCES. (Amend as follows). The percent asphalt-rubber used in the dense graded mix may be determined by the tank strap method of measurement.

411.04. CONSTRUCTION METHODS. (Amend as follows). (g) Spreading and Finishing. The asphalt rubber mixture shall be laid with a paver meeting the requirements of Subsection 411.03(g) at a temperature of 275° F minimum and only upon an approved surface, which shall be dry.

(i) Compaction. (Amend the third paragraph by adding the following). Rolling shall be continous until the specified density has been obtained. Pneumatic rollers shall not be used for compaction of the asphalt mixture unless it has sufficiently cooled to prevent tire pickup of the surface.

411.06. BASIS OF PAYMENT. (Amend as follows). Accepted quantities for Asphalt Rubber Dense Graded Mixture measured as provided above will be paid for at the contract unit price for:

(A-3)	TYPE C AGGREGATE	TON
SP.	ASPHALT RUBBER (ARM-R-SHIELD)	TON

which shall be full compsensation for furnishing all materials, equipment, labor and incidentals to complete the work as specified.

OKLAHOMA DEPARTMENT OF TRANSPORTATION
SPECIAL PROVISIONS
FOR
EXPERIMENTAL
ASPHALT RUBBER DENSE GRADED MIXTURE
(PLUSRIDE)*

These Special Provisions revise, amend, and where in conflict, supersede applicable Sections of Standard Specifications for Highway Construction, Edition of 1976.

411.01. DESCRIPTION. (Add as follows). This work shall consist of the production of PLUSRIDE asphalt, where ground rubber tires are added to a gap graded mineral aggregate in a bituminous paving mixture in accordance with these Special Provisions.

A technical representative of the All Season Surfacing Corporation shall be present at the pre-bid conference and during construction. They shall also provide information and technical advice to the Contractor and Engineer.

*PLUSRIDE a trade name for the dense graded rubber mixture produced by the All Season Surfacing Corporation, 10717 N.E. 4th Street, Suite 1, Bellevue, Washington, 98004; telephone number (206) 454-3830.

708.02. MINERAL AGGREGATE. (Amend as follows). The mineral aggregate shall be composed of coarse aggregate, fine aggregate, and mineral filler. The aggregates shall meet the requirements of the gradation for PLUSRIDE as shown in the table below and as approved by the Materials Engineer.

The aggregate shall meet all the remaining requirements in Section 708.02.

PLUSRIDE Aggregate Gradation

Sieve Size	Percent Passing
5/8 in.	100
3/8 in.	60 - 80
1/4 in.	30 - 42
No. 10	15 - 30
No. 30	10 - 25
No. 200	4 - 12

708.03. ASPHALT MATERIALS. (Add as follows). The bituminous materials used to manufacture the asphalt-rubber shall be 85 - 100 penetration meeting the requirements of AASHTO M-20.

(c) Application Temperature. (Amend as follows). The aggregate shall be heated from 325° F to 350° F for mixing purposes. The liquid asphalt temperature shall be 275° to 325° F.

Amend Section 708 to include the following:

(a) Rubber Material. (Add as follows). The granulated rubber shall be graded as follows.

PLUSRIDE RUBBER

Sieve Size	Percent Passing
1/4 in.	100
No. 4	76 - 92
No. 10	28 - 36
No. 20	10 - 24

Each lot of the granulated rubber shall be tested by the manufacturer. The rubber supplier shall furnish a Type A certification as per Section 106.12, with test reports indicating the material meets the manufacturer's current specifications and the gradation requirements herein specified.

All Seasons Surfacing Corporation will assist the Contractor with arrangements for supply and delivery of granulated rubber to the job site.

708.04. COMPOSITION OF MIXTURES. (Add the following). The aggregate, asphalt and rubber granules shall be uniformly mixed and conform to the requirements of PLUSRIDE shown in the following table:

MATERIAL	PLUSRIDE
Mineral Aggregate (% by weight of total mix)	87.5 - 89.5
Rubber granulate (% by weight of total mix)	2.5 - 3.5
Asphalt (% by weight of total mix)	5.0 - 9.0

The combined mixture will be designed to give a laboratory molded density of 97 percent of the maximum theoretical density. Normally 5 to 10 percent of the aggregate is sand; the remaining part is crushed rock. The aggregate shall be of good quality. Filler from the dust bins can also be used.

The percent asphalt used in the mixture may be determined by the tank strap method of measurement.

411.04. CONSTRUCTION METHODS. (Amend as follows). (g) Spreading and Finishing. The asphalt-rubber mixture shall be laid with a paver meeting the requirements of Subsection 411.03(g) at a minimum temperature of 300° F and only upon an approved surface, which shall be dry.

(i) Compaction. (Amend the third paragraph by adding the following). Rolling shall be continous until the paving mixture temperature reaches approximately 140° F or a temperature approved by the Resident Engineer for proper compaction. Pneumatic rollers shall not be used for compaction of the asphalt mixture unless it has sufficiently cooled to prevent tire pickup of the surface.

411.05. METHOD OF MEASUREMENT. (Amend to include the following). Rubber Granulate shall be measured separately by the ton in accordance with Section 109.

411.06. BASIS OF PAYMENT. (Amend as follows). Accepted quantities for Asphalt Rubber Dense Graded Mixture will be paid for at the contract unit price for:

SP.	PLUSRIDE AGGREGATE	TON
(B)	ASPHALT	TON
SP.	RUBBER GRANULATE (PLUSRIDE)	TON

which shall be full compensation for furnishing all materials, equipment, labor and incidentals to complete the work as specified.

OKLAHOMA DEPARTMENT OF TRANSPORTATION
SPECIAL PROVISIONS
FOR
EXPERIMENTAL
ASPHALT RUBBER DENSE GRADED MIXTURE
(OVERFLEX)*

These Special Provisions revise, amend, and where in conflict, supersede applicable Sections of Standard Specifications for Highway Construction, Edition of 1976.

411.01. DESCRIPTION. (Add as follows). This work shall consist of the addition of OVERFLEX asphalt-rubber as a binder in a bituminous paving mixture in accordance with these Special Provisions.

A technical representative of the Sahuaro Petroleum and Asphalt Company shall be present at the pre-bid conference and during construction. They shall also provide information and technical advice to the Contractor and Engineer.

*OVERFLEX a trade name for the asphalt-rubber binder product produced by the Sahuaro Petroleum and Asphalt Company, 731 North 19th Avenue, Phoenix, Arizona, 85005; telephone number (800) 528-4548.

708.01. APPROVAL OF MATERIALS. (Amend as follows). The Contractor shall submit samples of all materials proposed for use under these specifications to Sahuaro Petroleum and Asphalt Company and to the Materials Division, Oklahoma Department of Transportation. These materials will be tested and utilized for the preparation of design mixtures. Sahuaro shall promptly submit the recommended design mixture to the Materials Engineer for his examination and approval.

708.03. ASPHALT MATERIALS. (Add as follows). The bituminous materials used to manufacture the asphalt-rubber shall meet the requirements of AASHTO M-20.

Amend Section 708 to include the following:

(a) Rubber Material. (Add as follows). The granulated-crumb rubber shall be 100 percent vulcanized.

(1) Granulated-crumb rubber shall meet the gradation requirements for Type II or Type III as follows:

Sieve Size	Percent Passing Type II	Percent Passing Type III
No. 16	100	100
No. 30	60 - 90	95 - 100
No. 50	0 - 20	30 - 60
No. 80	0 - 5	15 - 35
No. 200		0 - 10

(2) Each lot of the granulated-crumb rubber shall be tested by the manufacturer. The rubber supplier shall furnish a Type A certification as per Section 106.12, with test reports indicating the material meets the manufacturer's current specifications and the gradation requirements herein specified.

A blend of the above granulated-crumb rubber types may be used. The actual blend (by weight) shall be determined by Laboratory Mix Design.

(b) Binder. The asphalt rubber binder shall contain 20 ± 2 percent ground vulcanized rubber by weight of the total asphalt rubber binder.

The handling, loading, hauling, transfer pumping, or similar operations connected with the movement of the asphalt rubber to and within the plant site, shall be the responsibility of Sahuaro, with the cooperation of the contractor.

(c) Application Temperature. (Amend as follows). The aggregate shall be heated from 325° F to 350° F and the asphalt-rubber binder shall be heated from 300° F to 350° F for mixing purposes.

708.04. COMPOSITION OF MIXTURES. (Add the following). The aggregate, and asphalt-rubber shall be uniformly mixed and conform to the requirements of asphalt concrete.

The gradation of the aggregates shall be Type C as designated in Table III - Table of Mixtures (Hot Mix - Hot Laid). The Type C gradation and binder content used shall be adjusted to yield a percent maximum theoretical density range from 92 to 96.

708.05. TOLERANCES. (Amend as follows). The percent asphalt-rubber used in the dense graded mix may be determined by the tank strap method of measurement.

411.04. CONSTRUCTION METHODS. (Amend as follows). (g) Spreading and Finishing. The asphalt-rubber mixture shall be laid with a paver meeting the requirements of Subsection 411.03(g) at a temperature of 275° F minimum and only upon an approved surface, which shall be dry.

(i) Compaction. (Amend the third paragraph by adding the following). Rolling shall be continous until the specified density has been obtained. Pneumatic rollers shall not be used for compaction of the asphalt mixture unless it has sufficiently cooled to prevent tire pickup of the surface.

411.06. BASIS OF PAYMENT. (Amend as follows). Accepted quantities for Asphalt Rubber Dense Graded Mixture will be paid for at the contract unit price for:

(A-3)	TYPE C AGGREGATE	TON
SP.	ASPHALT RUBBER (OVERFLEX)	TON

which shall be full compensation for furnishing all materials, equipment, labor and incidentals to complete the work as specified.

APPENDIX D

DT-Form 221
Rev. 4/77

STATE OF OKLAHOMA
DEPARTMENT OF TRANSPORTATION

Materials Division

Calculations Checked By ____________

Proof Read By ____________

8-1130-1179[illegible]
8-3036-1179[illegible]
8-3046-1179[illegible]
Report No. 8-3086-1179[illegible]

Report on Sample of Roadway Cores

Control Section No. ____________ Project No. Research Acct. No. 352910

Sample Received at Laboratory ____________, 19____ County ____________ Div. ____

Received on project ____________ Sampled ____________ 19____ By Research

From ____________ Identification ____________ Quantity ____________

Resident Engr. ____________ Address ____________

Contractor ____________ Tested By ____________

Source of Material Roadway Cores of Chemcrete Modified Asph. Conc.

Examined for Use in ____________ Test for Specification No. ____________

Roadway Core No.	1	2	3	4	5	6	7	8
Specific Gravity	2.344	2.390	2.380	2.401	2.359	2.382	2.387	2.[illegible]
As Percent of Max.Theo.	95.4	96.8	96.0	97.5	95.6	97.2	95.9	[illegible]
Air Voids, %	4.6	3.2	4.0	2.5	4.4	2.8	4.1	3.[illegible]
Voids in Mineral Aggr., %	15.5	14.8	14.8	13.7	15.4	15.0	15.4	[illegible]
Voids Filled with AC, %	70.3	78.4	73.0	81.8	71.4	81.3	73.4	[illegible]
Asphalt Content, %	4.7	4.9	4.6	4.7	4.7	5.2	4.8	[illegible]
Tests on Recovered Asphalt:								
Penetration	112	115	34	85	35	121	50	[illegible]
Ductility	150+	150+	43	150+	21	150+	43	[illegible]
Viscosity, 60 deg.C	1272	1202	9694	2369	17459	1189	8379	[illegible]54
Viscosity, 135 deg.C	408	382	949	536	1144	408	733	[illegible]

cc:Materials
Asph. Design
B.C. Hartronft

Remarks: FOR INFORMATION

FEB 11 1983

Transmitted 2-10-83 19____

J.D. Telford

J.D. Telford, P.E.
Materials Engineer

AC OVERLAY PROGRAM

DATE 03-13-84

DIVISION 6 COUNTY WOODWARD TEST DATE 10-6-81

PROJECT NUMBER FR-282(71)

DESCRIPTION
PRELIMINARY TEST DATA SEILING WEST BOUND

RUT DEPTH	MILAGE EXTENTS	BEAM DEFLECTION	LOAD SUPPORTING ABILITY	INCHES OF A.C. EQUIVALENT REQUIRED — WHEEL LOAD DESIGN 5000.	6000.	7000.	8000.	9000.
3	0.0	0.033	9075.	0.0	0.0	0.0	0.0	0.0
5	0.20	0.020	16427.	0.0	0.0	0.0	0.0	0.0
2	0.40	0.016	******	0.0	0.0	0.0	0.0	0.0
1	0.60	0.021	15504.	0.0	0.0	0.0	0.0	0.0
2	0.80	0.017	19915.	0.0	0.0	0.0	0.0	0.0
2	1.00	0.024	13235.	0.0	0.0	0.0	0.0	0.0
2	1.20	0.029	10576.	0.0	0.0	0.0	0.0	0.0
2	1.40	0.025	12610.	0.0	0.0	0.0	0.0	0.0
3	1.60	0.037	7924.	0.0	0.0	0.0	0.1	1.2
2	1.80	0.017	19915.	0.0	0.0	0.0	0.0	0.0
2	2.00	0.012	******	0.0	0.0	0.0	0.0	0.0
2	2.40	0.019	17456.	0.0	0.0	0.0	0.0	0.0
1	2.60	0.017	19915.	0.0	0.0	0.0	0.0	0.0
4	2.80	0.017	19915.	0.0	0.0	0.0	0.0	0.0
1	3.00	0.015	******	0.0	0.0	0.0	0.0	0.0
1	3.20	0.010	******	0.0	0.0	0.0	0.0	0.0
2	3.40	0.010	******	0.0	0.0	0.0	0.0	0.0
2	3.60	0.016	******	0.0	0.0	0.0	0.0	0.0
2	3.80	0.015	******	0.0	0.0	0.0	0.0	0.0
2	4.00	0.005	******	0.0	0.0	0.0	0.0	0.0
2	4.20	0.012	******	0.0	0.0	0.0	0.0	0.0
1	4.40	0.011	******	0.0	0.0	0.0	0.0	0.0
2	4.60	0.020	16427.	0.0	0.0	0.0	0.0	0.0
1	4.80	0.014	******	0.0	0.0	0.0	0.0	0.0
2	5.00	0.015	******	0.0	0.0	0.0	0.0	0.0
2	5.20	0.020	16427.	0.0	0.0	0.0	0.0	0.0
1	5.40	0.025	12610.	0.0	0.0	0.0	0.0	0.0
2	5.60	0.015	******	0.0	0.0	0.0	0.0	0.0
2	5.80	0.015	******	0.0	0.0	0.0	0.0	0.0

****** - WHEEL LOAD GREATER THAN 20000 LB.

RUT DEPTH	MILAGE EXTENTS	BEAM DEFLECTION	LOAD SUPPORTING ABILITY	INCHES OF A.C. EQUIVALENT REQUIRED — WHEEL LOAD DESIGN 5000.	6000.	7000.	8000.	9000.
2	6.00	0.020	16427.	0.0	0.0	0.0	0.0	0.0
1	6.20	0.016	******	0.0	0.0	0.0	0.0	0.0
1	6.40	0.017	19915.	0.0	0.0	0.0	0.0	0.0
1	6.60	0.024	13235.	0.0	0.0	0.0	0.0	0.0
1	6.80	0.019	17456.	0.0	0.0	0.0	0.0	0.0
0	7.00	0.018	18611.	0.0	0.0	0.0	0.0	0.0
1	7.40	0.019	17456.	0.0	0.0	0.0	0.0	0.0

AC OVERLAY PROGRAM

DATE 03-13-84

DIVISION 6 COUNTY WOODWARD TEST DATE 10-6-81

PROJECT NUMBER FR-282(71)

DESCRIPTION
PRELIMINARY TEST DATA SEILING EAST BOUND

RUT DEPTH	MILAGE EXTENTS	BEAM DEFLECTION	LOAD SUPPORTING ABILITY	INCHES OF A.C. EQUIVALENT REQUIRED — WHEEL LOAD DESIGN 5000.	6000.	7000.	8000.	9000.
1	7.40	0.029	10576.	0.0	0.0	0.0	0.0	0.0
2	7.20	0.031	9773.	0.0	0.0	0.0	0.0	0.0
2	7.00	0.020	16427.	0.0	0.0	0.0	0.0	0.0
2	6.80	0.019	17456.	0.0	0.0	0.0	0.0	0.0
1	6.60	0.012	******	0.0	0.0	0.0	0.0	0.0
2	6.40	0.018	18611.	0.0	0.0	0.0	0.0	0.0
2	6.20	0.015	******	0.0	0.0	0.0	0.0	0.0
2	6.00	0.015	******	0.0	0.0	0.0	0.0	0.0
2	5.80	0.019	17456.	0.0	0.0	0.0	0.0	0.0
1	5.60	0.009	******	0.0	0.0	0.0	0.0	0.0
3	5.40	0.015	******	0.0	0.0	0.0	0.0	0.0
3	5.20	0.025	12610.	0.0	0.0	0.0	0.0	0.0
3	5.00	0.027	11511.	0.0	0.0	0.0	0.0	0.0
1	4.80	0.007	******	0.0	0.0	0.0	0.0	0.0
3	4.40	0.017	19915.	0.0	0.0	0.0	0.0	0.0
3	4.20	0.028	11025.	0.0	0.0	0.0	0.0	0.0
5	4.00	0.020	16427.	0.0	0.0	0.0	0.0	0.0
2	3.80	0.028	11025.	0.0	0.0	0.0	0.0	0.0
3	3.60	0.010	******	0.0	0.0	0.0	0.0	0.0
2	3.40	0.014	******	0.0	0.0	0.0	0.0	0.0
2	3.20	0.015	******	0.0	0.0	0.0	0.0	0.0
3	3.00	0.012	******	0.0	0.0	0.0	0.0	0.0
2	2.80	0.013	******	0.0	0.0	0.0	0.0	0.0
2	2.60	0.020	16427.	0.0	0.0	0.0	0.0	0.0
3	2.40	0.020	16427.	0.0	0.0	0.0	0.0	0.0
3	2.20	0.030	10160.	0.0	0.0	0.0	0.0	0.0
2	2.00	0.010	******	0.0	0.0	0.0	0.0	0.0
1	1.80	0.037	7924.	0.0	0.0	0.0	0.1	1.2
1	1.60	0.015	******	0.0	0.0	0.0	0.0	0.0

****** - WHEEL LOAD GREATER THAN 20000 LB.

PAGE 1 OF 2

RUT DEPTH	MILAGE EXTENTS	BEAM DEFLECTION	LOAD SUPPORTING ABILITY	INCHES OF A.C. EQUIVALENT REQUIRED — WHEEL LOAD DESIGN 5000.	6000.	7000.	8000.	9000.
2	1.40	0.022	14672.	0.0	0.0	0.0	0.0	0.0
3	1.20	0.020	16427.	0.0	0.0	0.0	0.0	0.0
2	0.80	0.017	19915.	0.0	0.0	0.0	0.0	0.0
2	0.60	0.021	15504.	0.0	0.0	0.0	0.0	0.0
2	0.40	0.014	******	0.0	0.0	0.0	0.0	0.0
1	0.20	0.015	******	0.0	0.0	0.0	0.0	0.0
1	0.0	0.019	17456.	0.0	0.0	0.0	0.0	0.0

APPENDIX E

SKID DATA SHEET

County: Woodward; Control Section: 02.
Beginning Mileages: 13.61; Study Length: 5.50 (miles)
Location Description: ON US-183. Begin at the East Side of Persimmon Creek Bridge.

Test:
Date 9-2-82.
Speed 40 (MPH)
Reason for Test:
☐-Wet Listing; ☑-Research;
☐-Other ______

Direction of Travel:		Direction of Travel:	
☐ - Northbound;	☑ - Eastbound	☐ - Northbound;	☑ - Eastbound
☐ - Southbound;	☐ - Westbound	☐ - Southbound;	☐ - Westbound
Lane:		Lane:	
☐ - Inside;	☐ - Outside.	☐ - Inside;	☐ - Outside.
Wheel Path:		Wheel Path:	
☑ - Left;	☐ - Right	☑ - Left;	☐ - Right

0.00 Control

Test No.	Mileage (On C.S.)	Skid No.	Test No.	Mileage (On C.S.)	Skid No.
1	0.03	29	13	3.30	30
2	0.53	CHem-CRETE	14	3.53	ARM-R-SHIELD
3	0.67	26	15	3.65	20
4	0.90	24	16	3.90	20
5	1.17	28	17	4.10	25
6	1.53	Plusride	18	4.45	32
7	1.75	39	19	4.56	Control
8	2.00	41	20	4.70	34
9	2.30	37	21	5.00	38
10	2.53	OVERFLEX	22	5.30	30
11	2.60	36	23	5.50	32
12	3.00	29			

Limits of Variance: 0.03, 0.67-1.17, 3.00

Limits of Variance: 3.30, 3.65-4.45, 4.70, 5.30, 5.50

Comments: 0.00, 0.53, 1.53, 2.53, 3.53, 4.56 are the NAME of THE ASPHALT

SKID TEST DISCLAIMER

These test results represents a product of a mechanical test of the skid trailer tire interface with the roadway surface and is the calculated estimate of the coefficient of friction for the spot tested. This number represents an estimate only for the spot tested and does not imply the sufficiency or deficiency of any other spot tested or untested. It does provide the Department with additional data as input for priority programming of maintenance and construction projects.

November 19, 1973 Oklahoma Department of Highways, Traffic Engineering Division

SKID DATA SHEET

County: Woodward; Control Section: 02.
Beginning Mileages: 19.11; Study Length: 5.50 (miles)
Location Description: ON US-183, Begin at Truck lane AND Extend West to East side of Persimmon Creek Bridge.

Test:
Date 9-2-82.
Speed 40 (MPH)
Reason for Test:
☐-Wet Listing; ☑-Research;
☐-Other

Direction of Travel:
☐ - Northbound; ☐ - Eastbound
☐ - Southbound; ☑ - Westbound

Direction of Travel:
☐ - Northbound; ☐ - Eastbound
☐ - Southbound; ☑ - Westbound

Lane:
☐ - Inside; ☐ - Outside.

Lane:
☐ - Inside; ☐ - Outside.

Wheel Path:
☑ - Left; ☐ - Right

Wheel Path:
☑ - Left; ☐ - Right

Test No.	Mileage (On C.S.)	Skid No.	Test No.	Mileage (On C.S.)	Skid No.
1	0.00	Control	13	2.60	28
2	0.15	30	14	2.85	32
3	0.37	35	15	2.95	PLUSRIDE
4	0.60	31	16	3.10	37
5	0.95	ARM-R-SHIELD	17	3.35	34
6	1.06	26	18	3.60	26
7	1.36	36	19	3.95	CHEM-CRETE
8	1.50	40	20	4.10	37
9	1.72	38	21	4.40	43
10	1.95	OVERFLEX	22	4.75	43
11	2.10	34	23	4.96	Control
12	2.30	29	24	5.00	43
			25	5.30	31
			26		

Limits of Variance: 0.15-0.60, 1.06, 2.10-2.95

Limits of Variance: 3.35, 3.60, 5.30

Comments: 0.00, 0.95, 1.95, 2.95, 3.95, 4.96 are the NAME OF THE ASPHALT.

SKID TEST DISCLAIMER

These test results represents a product of a mechanical test of the skid trailer tire interface with the roadway surface and is the calculated estimate of the coefficient of friction for the spot tested. This number represents an estimate only for the spot tested and does not imply the sufficiency or deficiency of any other spot tested or untested. It does provide the Department with additional data as input for priority programming of maintenance and construction projects.

November 19, 1973 | Oklahoma Department of Highways, Traffic Engineering Division

APPENDIX F

FIRST YEAR EVALUATION

SEILING FIRST YEAR EVALUATION

INTRODUCTION

This report will discuss the findings from the first year evaluation, done in September, 1983, of the "Dense Graded Asphalt Rubber Mixtures and Chemkrete" research project on SH 3 at Seiling, Oklahoma. The Oklahoma Department of Transportation (ODOT) project started at a point 6.5 mi (10.5 km) northwest of Major County line and extended west for 7.5 mi (12 km) into Woodward County.

In summer of 1982 four experimental dense graded mix overlays: Chemkrete, Arm-R-Shield, Plusride, and Overflex, plus the standard, were placed on a bituminous pavement that exhibited transverse cracking. The spacing between cracks was from 15 ft to 35 ft (4.5 m to 10.6 m), and the roadway had a 0.2. in (5mm) rut.

The asphalt additive, Chemkrete, will continue to be monitored for general field performance. The asphalt rubber mixes also will be evaluated for their reflective crack retardation capability and general field performance.

Each mile (1.6 km) section in the experimental project, including the standard section, will be discussed separately. A summary of the following will be given: Benkleman Beam deflections, Mays ridemeter reading, and the pavement condition survey.

CHEMKRETE

Chemkrete cracking was first observed in November, 1982, four months after completion. It was reported then, that the original transverse cracks, hairline in width, had reflected.

The September, 1983, annual survey of Chemkrete showed that the reflected cracks had opened up to between 0.125 in to 0.25 in (3.2 mm to 6.4 mm). Twenty percent of the cracks were spalling, however 70 percent of that 20 percent tended to stop in the wheel path area.

ODOT field maintenance crews had patched the clay ball holes which were noted on the original report.

ARM-R-SHIELD

In January, 1983, Arm-R-Shield was investigated because hairline transverse cracks had reflected through the overlay. The two mapped evaluation sections showed that 60 percent of the cracks were reflecting from original cracks.

Several cores were taken, and one was taken in a crack. This split core was bound tightly with the crack imprint visible throughout the asphalt rubber lift.

In September, 1983, the first year evaluation survey was taken. There was no change in the roadway. What was evident, throughout the mile (1.6 km) section, was that the northwest bound lane exhibited 50 percent more cracks than the southeast bound lane.

PLUSRIDE

In September, 1983, a condition survey was begun on the southeast end of the Plusride mile (1.6) and progressed in a northwesterly direction. Bleeding was noted at the beginning of the section. It ranged from minor to intermediate in severity for 0.6 mi (0.9 km) in the eastbound lane. Within that same area on the eastbound lane, three small patches, 2 ft x 5 ft (0.6 m x 1.5 m), were made on the overlay.

On the westbound lane, starting at 0.65 mi (1 km) into the project, ravelling, shoving and potholing occurred on the Plusride for 0.3 mi (0.5 km). This unstable area required a full lane width patch, and was resurfaced, with a seal coat.

OVERFLEX

A condition survey was taken, and the mapped cracked sections were checked on the Overflex mile (1.6 km) section in September, 1983. The investigation revealed no cracks. No distress could be found.

STANDARD

The standard asphalt overlay borders the experimental overlays. Three mapped evaluation sections were chosen from the standard sections that include a non-woven fabric membrane interlayer. Two of the three sections had narrow cracks, but that was all the distress visible.

The first evaluation section had three hairline transverse cracks, and each crack measured less than 3 ft (0.9 m) in length. This section originally had 51 transverse cracks before the overlay.

The second evaluation section had only two hairline transverse cracks, with each crack measuring less than 3 ft (0.9 m) in length. This section originally had 31 transverse cracks before the overlay.

SUMMARY

Included in the Attachments are the results of the physical tests and the condition survey.

The deflection testing was performed using the Benkleman Beam. The design factor on this project was a 9,000 lb wheel load and the 7.3 mi (11.7 km) of roadway deflection tests showed that the roadway met the standard design requirements.

The ride roughness test was performed with a Mays Ridemeter. The ridemeter was driven twice over the experimental project, and an average of the results was taken. All of the sections were consistent and the quality of the ride was good.

The condition survey pointed out problems on three of the five sections discussed. The overall field performance of Plusride has suffered the worst, mainly because ODOT maintenance forces had to patch an unstable area of the roadway. Chemkrete has cracked and the width of those cracks is growing. Arm-R-Shield also has hairline cracks. Finally, Overflex and the standard section compare equally well and their overall field performances are excellent.

AC OVERLAY PROGRAM

DIVISION 6 COUNTY WOODWARD TEST DATE 7-21-83

PROJECT NUMBER 2215

DESCRIPTION
U.S.183 WESTBOUND

	RUT DEPTH (0.1 IN.)	MILEAGE EXTENTS	BEAM DEFLECTION (IN.)	SUPPORTING ABILITY (LBS.)	INCHES OF A.C. EQUIVALENT REQUIRED — WHEEL LOAD DESIGN 8000.	9000.	10000.	11000.	12000.
	2	5.40	0.014	******	0.0	0.0	0.0	0.0	0.0
	2	5.20	0.015	******	0.0	0.0	0.0	0.0	0.0
	2	5.00	0.015	******	0.0	0.0	0.0	0.0	0.0
	1	4.80	0.010	******	0.0	0.0	0.0	0.0	0.0
Control	2	4.60	0.017	19915.	0.0	0.0	0.0	0.0	0.0
	1	4.40	0.023	13919.	0.0	0.0	0.0	0.0	0.0
	1	4.20	0.016	******	0.0	0.0	0.0	0.0	0.0
	0	3.40	0.017	19915.	0.0	0.0	0.0	0.0	0.0
Arm-R-Shield	1	3.20	0.015	******	0.0	0.0	0.0	0.0	0.0
	0	3.00	0.009	******	0.0	0.0	0.0	0.0	0.0
	1	2.60	0.011	******	0.0	0.0	0.0	0.0	0.0
Overflex	1	2.40	0.008	******	0.0	0.0	0.0	0.0	0.0
	1	2.00	0.015	******	0.0	0.0	0.0	0.0	0.0
	1	1.80	0.017	19915.	0.0	0.0	0.0	0.0	0.0
Plusride	1	1.60	0.014	******	0.0	0.0	0.0	0.0	0.0
	0	1.40	0.021	15504.	0.0	0.0	0.0	0.0	0.0
	1	1.00	0.018	18611.	0.0	0.0	0.0	0.0	0.0
	1	0.80	0.019	17456.	0.0	0.0	0.0	0.0	0.0
	1	0.60	0.012	******	0.0	0.0	0.0	0.0	0.0
Chemkrete	1	0.40	0.014	******	0.0	0.0	0.0	0.0	0.0
	1	0.20	0.015	******	0.0	0.0	0.0	0.0	0.0
	1	0.0	0.018	18611.	0.0	0.0	0.0	0.0	0.0

****** - WHEEL LOAD GREATER THAN 20000 LB.

AC OVERLAY PROGRAM

DIVISION 6 COUNTY WOODWARD TEST DATE 7-21-83

PROJECT NUMBER 2215

DESCRIPTION
U.S.183 EASTBOUND

	RUT DEPTH (0.1 IN.)	MILEAGE EXTENTS	BEAM DEFLECTION (IN.)	SUPPORTING ABILITY (LBS.)	INCHES OF A.C. EQUIVALENT REQUIRED — WHEEL LOAD DESIGN 8000.	9000.	10000.	11000.	12000.
	1	0.0	0.018	18611.	0.0	0.0	0.0	0.0	0.0
Chemkrete -	1	0.20	0.013	******	0.0	0.0	0.0	0.0	0.0
	2	0.40	0.022	14672.	0.0	0.0	0.0	0.0	0.0
	1	0.80	0.016	******	0.0	0.0	0.0	0.0	0.0
	2	1.00	0.014	******	0.0	0.0	0.0	0.0	0.0
Plusride -	2	1.20	0.008	******	0.0	0.0	0.0	0.0	0.0
	1	1.40	0.009	******	0.0	0.0	0.0	0.0	0.0
	2	1.80	0.010	******	0.0	0.0	0.0	0.0	0.0
	1	2.00	0.006	******	0.0	0.0	0.0	0.0	0.0
	1	2.20	0.021	15504.	0.0	0.0	0.0	0.0	0.0
Overflex -	1	2.40	0.018	18611.	0.0	0.0	0.0	0.0	0.0
	1	2.60	0.014	******	0.0	0.0	0.0	0.0	0.0
	2	2.80	0.025	12610.	0.0	0.0	0.0	0.0	0.0
	2	3.00	0.014	******	0.0	0.0	0.0	0.0	0.0
Arm-R-Shield -	1	3.60	0.008	******	0.0	0.0	0.0	0.0	0.0
	1	3.80	0.014	******	0.0	0.0	0.0	0.0	0.0
	1	4.00	0.005	******	0.0	0.0	0.0	0.0	0.0
Control -	1	4.40	0.017	19915.	0.0	0.0	0.0	0.0	0.0
	1	4.60	0.003	******	0.0	0.0	0.0	0.0	0.0
	1	4.80	0.022	14672.	0.0	0.0	0.0	0.0	0.0
	1	5.00	0.034	8759.	0.0	0.3	1.4	2.5	3.6
	1	5.20	0.022	14672.	0.0	0.0	0.0	0.0	0.0
	1	5.40	0.027	11511.	0.0	0.0	0.0	0.0	0.5

****** - WHEEL LOAD GREATER THAN 20000 LB.

MAYS RIDEMETER
ASPHALT - RUBBER & CHEMKRETE

SEILING, OK

NOVEMBER 28, 1983

PRODUCT	SOUTHEAST BOUND LANE FIRST RUN	SOUTHEAST BOUND LANE SECOND RUN	NORTHWEST BOUND LANE FIRST RUN	NORTHWEST BOUND LANE SECOND RUN
Control	80	52	51	54
	54	57	52	63
Chemkrete	83	93	83	92
	121	99	81	72
	50	53	50	69
	76	64	82	64
	99	70	96	66
Plusride	87	89	118	154
	56	41	141	128
	55	73	84	147
	79	100	71	81
	95	78	87	98
Overflex	78	77	89	70
	72	82	74	75
	72	71	73	90
	59	70	73	89
	83	80	62	69
Arm-R-Shield	63	54	67	80
	79	84	58	60
	80	81	72	77
	72	90	82	99
	100	96	80	103
Control	99	80	43	48
	58	53	54	57
	44	54	57	50
	58	50	43	36
	62	50	93	82

MAYS RIDEMETER:
ASPHALT - RUBBER & CHEMKRETE

SEILING, OK

NOVEMBER 29, 1983

PRODUCT	SOUTHEAST BOUND LANE FIRST RUN	SOUTHEAST BOUND LANE SECOND RUN	NORTHWEST BOUND LANE FIRST RUN	NORTHWEST BOUND LANE SECOND RUN
Control	65	66	69	79
	66	55	47	51
	55	69	74	72
	62	44	87	95
	62	61	70	65
	59	59	57	55
	46	71	70	82
	77	63	70	59
	67	38	56	40
	40	31	39	37
	40	40	51	56

CONDITION RATING FOR FLEXIBLE PAVEMENTS

DATE: September 27, 1984

LOCATION: 8 mile northwest of Major Co. - Woodward Co.

LENGTH: 5.4 miles MILES SURVEYED BY: Wilson Brewer

Condition Rating	I Cracking	II Surface Roughness	III Distortion	IV Ravelling	V Base Failure
1					
2	1	1			
3	2	2	1	1	
4	3	3	2	2	1
5	4	4	3	3	2-3
6	4	4	4	4	4

1 = less tha
2 = 5% to 15
3 = 15% to 3
4 = more tha

Mileage Location	Condition Rating	I	II	III	IV	V	% Condition Rating	Beam Deflection	S.W.L.	Rut Depth	S. F. Patching
Control 0.0	1	-	-	-	-	-	100				
0.2	1	-	-	-	-	-	100				
0.4	1	-	-	-	-	-	100				
0.6	1	1	-	-	-	-	100				
0.3	1	1	-	-	-	-	100				
Arm-R-Shield 1.0	1	2	-	-	1	-	92				
1.2	1	2	-	-	-	-	95				
1.4	1	2	-	-	-	-	95				
1.6	1	1	-	-	-	-	97				
1.8	1	1	-	-	-	-	97				
Overflex 2.0	1	-	-	-	-	-	100				
2.2	1	-	-	-	-	-	100				
2.4	1	-	-	-	-	-	100				
2.6	1	-	-	-	-	-	100				
2.8	1	-	-	-	-	-	100				3A

CONDITION RATING FOR FLEXIBLE PAVEMENTS

DATE: September 27, 1984

LOCATION: 8 miles northwest of Major Co. Line on SH-3

LENGTH: 5.4 miles   MILES SURVEYED BY: Wilson Brewer

Condition Rating	I Cracking	II Surface Roughness	III Distortion	IV Ravelling	V Base Failure
1					
2	1	1			
3	2	2	1	1	
4	3	3	2	2	1
5	4	4	3	3	2-3
6	4	4	4	4	4

1 = less than [illegible]
2 = 5% to 15%
3 = 15% to 30%
4 = more than [illegible]

Mileage Location	Condition Rating	I	II	III	IV	V	% Condition Rating	Beam Deflection	S.W.L.	Rut Depth	S. F. Patching
lusride											
3.0	1	-	-	1	-	-	97				
3.2	1	-	-	1	-	-	95				2 - 5' x
3.4	1	-	-	1	-	-	95				3' x 5'
3.6	2	-	1	1	-	-	85				12' x 52'
3.8	2	-	1	1	-	-	85				12' x 42'
hemkrete											
4.0	1	2	-	-	-	-	92				
4.2	1	2	-	-	-	-	92				
4.4	1	2	-	-	-	-	92				
4.6	1	2	1	1	-	-	89				
4.8	1	2	1	1	-	-	89				
ontrol											
5.0	1	-	-	-	-	-	100				
5.2	1	-	-	-	-	-	100				
5.4	1	-	-	-	-	-	100				
											3B