HIGHWAY RESEARCH REPORT

BITUMINOUS MIX OVERLAY FOR PCC PAVEMENTS SUBJECTED TO TIRE CHAINS

FINAL REPORT

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STATE OF CALIFO

TRANSPORTATION AG

DEPARTMENT OF PUBLIC WORKS

DIVISION OF HIGHWAYS

ND RESEARCH DEPARTMEN

RESEARCH REPORT

NO. M & R 643392

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STATE OF CALIFORNIA—TRANSPORTATION AGENCY

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DIVISION OF HIGHWAYS
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June 1968
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Mr. J. A. Legarra
State Highway Engineer

Dear Sir:

Submitted herewith is a research report titled:

BITUMINOUS MIX

OVERLAY FOR PCC

PAVEMENTS SUBJECTED TO

TIRE CHAINS

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REFERENCE: Zube, E., Skog, J. and Scrimsher, T., "Bituminous Mix Overlay for PCC Pavements Subjected to Tire Chains," State of California, Department of Public Works, Division of Highways, Materials and Research Department, Research Report 643392, June 1968.

ABSTRACT: This preliminary study was made to determine in the laboratory how surface abrasion could be minimized in certain bituminous mixes.

Mixtures with identical gradings, but with different grades of asphalt and various sources of coarse aggregate were tested with and without asbestos and a rubber product known as Ramflex.

This project indicated that the addition of either asbestos or rubber would reduce the surface abrasion of a bituminous mix with any asphalt used. It also indicated that at 32°F the surface abrasion increased with the 60-70 penetration asphalt over and above that of the 120-150 or 85-100 penetration asphalt.

KEY WORDS: Bituminous mixes, asphaltic mixes, asphalt concrete, surface abrasion, asbestos, Ramflex, rubber, asphalt hardness, synthetic aggregate Synopal.

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INTRODUCTION

Portland cement concrete bridge decks and pavements may become pitted and scoured in the wheel tracks in areas where tire chains are frequently required during the winter months. Further, bridge decks may show signs of serious distress from applications of de-icing salts.

The purpose of this preliminary study is to consider the possibilities of designing a thin tough bituminous surface which might act as a protective layer over a special epoxy membrane for sealing existing PCC decks, and to act as a chain resistant wearing surface over existing PCC pavements.

Previous studies on this subject are shown in the references. Two materials, asbestos and rubber compounds, were found to increase the ability of the surfacing to resist wear and abrasion from tire chains and snow-plow blades.(1)(2) Therefore, our preliminary studies have been concerned with determining the ability of asphalt concrete mixtures containing asbestos and a rubber compound to resist abrasion at 32°F.

CONCLUSIONS

For any specific grade of asphalt and at the design asphalt content, the abrasion resistance at 32°F is increased by the addition of 1% or 2% asbestos by weight of the aggregate or by addition of 5% by weight of the asphalt of a rubber compound known as "Ramflex". However, for example, a 60-70 grade asphalt mix with 5% Ramflex had only slightly better resistance to abrasion than the control with 120-150 grade from the same source of manufacture. This indicates the importance of using a soft grade of asphalt when adding an additive.

Two material sources of coarse aggregate and one synthetic coarse aggregate when combined with one fine aggregate source, did not provide any material differences in abrasion loss.

RECOMMENDATIONS

It is clearly important to lay small test sections with different mix designs and additives on bridge decks and pavements where chain and snow-plow action together with the use of de-icing agents are encountered during winter operations. This will provide a possible correlation between the 32°F abrasion test and the resistance of the surface to chain and

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snow-plow action. Further, if a correlation is attained, then laboratory work may be expedited on mix design without the necessity of field evaluation of each potential paving mixture. On the basis of this study and the experiences of other reports (1) and (2) we recommend that thin blankets containing various additives be placed in short test sections on bridges and on pavements during the coming summer.

MATERIALS AND TEST METHODS

In order to design a thin surfacing, a 3/8" maximum grading as specified in Section 39 of the California Standards was used. Three different sources of coarse aggregate were used in order to study the abrasion resistance of this portion of the aggregate gradation. The optimum asphalt content was determined by standard methods. Different grades of asphalt were used from a single production source.

As previously mentioned, asbestos and certain forms of rubber appear to definitely aid in providing a mixture of desired properties. Therefore, asbestos from a local source was selected. This material was Grade F as designated by the company and was rather like a filler with no visible fibers. The rubber compound was known as "Ramflex" and is a rubber powder manufactured by U. S. Rubber Reclaiming Co., Inc., of Buffalo, New York. This material has been used in overlays. However, other rubber compounds have also been used with apparent success for bridge deck surfacing (2). We wish to stress that the additives used in these experiments were available, and have been used in experiments in other areas (1)(2). Further studies with other additives will be required if a larger scale project is proposed. The materials list is shown below.

Coarse Aggregates

Teichert's Coarse from Perkins
Bear River Coarse from Chevreau Pit
Synopal (a synthetic white aggregate)

Fine Aggregate

Teichert's Fine from Perkins

Paving Asphalt

60-70 Grade from Standard Oil, Oakland
85-100 " " " " "
120-150 " " " " "

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Additives

Asbestos, Grade F, Asbestos Bonding Co., Napa, California

"Ramflex" Rubber Compound, U. S. Rubber Reclaiming Co., Inc., Buffalo, New York

The test method used to determine resistance to chain action was that described in reference (3). Briefly, the water covering the swell specimens was drained and the mold and sample placed in a freezer compartment at 32°F for a minimum of 15 hours. After this, a mold and specimen was removed, 250 ml of cold tap water together with eight steel balls, 0.4 inch in diameter, was added and the mold placed in the special shaker. After shaking for 15 minutes at 1200 cpm, the assembly is removed, the free fines are washed into a pan, dried and weighed. In all cases, the final result is the average of two specimens.

In studying the effect of de-icing salts on the abrasion resistance, specimens of compacted mixture were subjected to soak-dry cycles in water and 2% calcium chloride solution. One cycle consisted of two days soaking and two days drying at 100°F. A total of ten cycles was used. At the end of each cycle, the specimens were inspected to detect any noticeable effects of the water or salt solution. After the tenth cycle, the samples were resoaked for 24 hours. The molds and specimens were then removed, the solutions drained and the molds placed in the freezer unit for 15 hours. They were then abraided as previously described.

TEST RESULTS AND DISCUSSION

Abrasion results are shown in Table A together with other mix properties. The results are shown as bar charts in Figures 1, 2 and 3. The addition of either asbestos or the rubber compound known as "Ramflex" will increase the abrasion resistance of the mix at 32°F. Also as the asphalt hardness increases, the abrasion resistance decreases. On the basis of these results the best combination would appear to be a soft asphalt, say 120-150, with additions of one or both additives.

The void content did not appear to influence the abrasion resistance between two mixes having different sources of coarse aggregate. Table B shows the abrasion results for specimens soaked in a calcium chloride solution compared with specimens soaked in water. There is no indication that salt solutions used for de-icing operations reduce the abrasion resistance of a pavement.

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The importance of the abrasion test and the maximum abrasion value permissible to insure minimum damage from chain action must still be determined. We recommend that paving mixtures with asbestos and/or rubber compounds be laid in short test sections in areas of severe chain action in order to determine if a correlation exists between the abrasion test and chain action.

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REFERENCES

1. "Asbestos Modified Bituminous Surface Courses". F. C. Brownridge, Michigan Contractor and Builder, April 16, 1966.

2. "Three-Step Bridge Deck Surfacing". Orrin Riley, Public Works, June 1966.

3. "Factors Affecting Durability of Concrete Surfaces". D. L. Spellman and W. H. Ames, 46th Annual Meeting of the Highway Research Board, January 1967.

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TABLE A

TEST DATA SUMMARY

Series	Aggregate	Synopal Coarse Teichert Fine					Teichert Coarse Teichert Fine					Bear River Coarse Teichert Fine				
		% Asph	Sp.Gr.	Voids	SA*	Stab. Value	% Asph	Sp.Gr.	Voids	SA*	Stab. Value	% Asph	Sp.Gr.	Voids	SA*	Stab. Value
I 120-150 Pen. Asph.	Control	5.8	2.20	4.0	42.5	36	5.8	2.21	11.2	44.0	37	5.8	2.24	9.6	41.0	34
	Ramflex	5.8	2.17	5.2	31.3	36	6.2	2.19	11.6	33.2	36	6.2	2.25	9.0	28.9	33
	(1%) Asbestos	5.8	2.19	4.4	31.9	37	6.0	2.20	11.6	37.4	38	6.0	2.23	9.8	32.8	35
	(2%) Asbestos	5.8	2.19	4.4	32.2	37	6.0	2.20	11.6	33.7	35	6.0	2.24	9.2	31.4	35
II 85-100 Pen. Asph.	Control	5.8	2.19	4.5	42.4	37	5.8	2.23	10.4	41.5	36	5.8	2.24	9.6	42.5	40
	Ramflex	5.8	2.15	6.2	24.8	36	6.2	2.22	10.0	30.4	36	6.2	2.22	10.2	32.3	35
	(1%) Asbestos	5.8	2.17	5.2	33.0	37	6.0	2.24	10.0	30.5	38	6.0	2.21	10.5	32.8	37
	(2%) Asbestos	5.8	2.19	4.5	28.8	37	6.0	2.27	8.8	33.7	39	6.0	2.25	8.9	31.5	34
III 60-70 Pen. Asph.	Control	5.8	2.19	4.5	50.2	36	5.8	2.24	10.0	44.7	38	5.8	2.26	8.8	47.6	34
	Ramflex	6.2	2.18	4.8	39.5	36	6.2	2.30	7.7	39.0	36	6.2	2.24	9.4	38.0	30
	(1%) Asbestos	6.0	2.21	3.6	38.7	40	6.0	2.26	9.2	38.9	35	6.0	2.24	9.2	38.4	35
	(2%) Asbestos	6.0	2.22	3.1	41.6	39	6.0	2.22	11.0	38.5	37	6.0	2.26	8.5	36.5	33

*S.A. = Surface Abrasion (Grams Loss) at 32°F

TABLE B

Surface Abrasion at 32°F after Ten

Wetting and Drying Cycles

Additive	Aggregate Source	Asphalt Grade	Asphalt %	Soaking Medium	Surf. Abra. Ave. Gms.
Control	Teichert	85-100	5.3	Water	42.0
				$CaCl_2$	37.6
1% Asbestos	Teichert	85-100	5.8	Water	36.2
				$CaCl_2$	36.2
5% "Ramflex"	Teichert	85-100	5.8	Water	29.7
				$CaCl_2$	31.3

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Figure I

EFFECT OF THE ADDITION OF ASBESTOS AND RAMFLEX ON LOW TEMPERATURE ABRASION LOSS OF ASPHALT CONCRETE

SERIES I

120 – 150 PENETRATION ASPHALT

TESTED AT 32°F

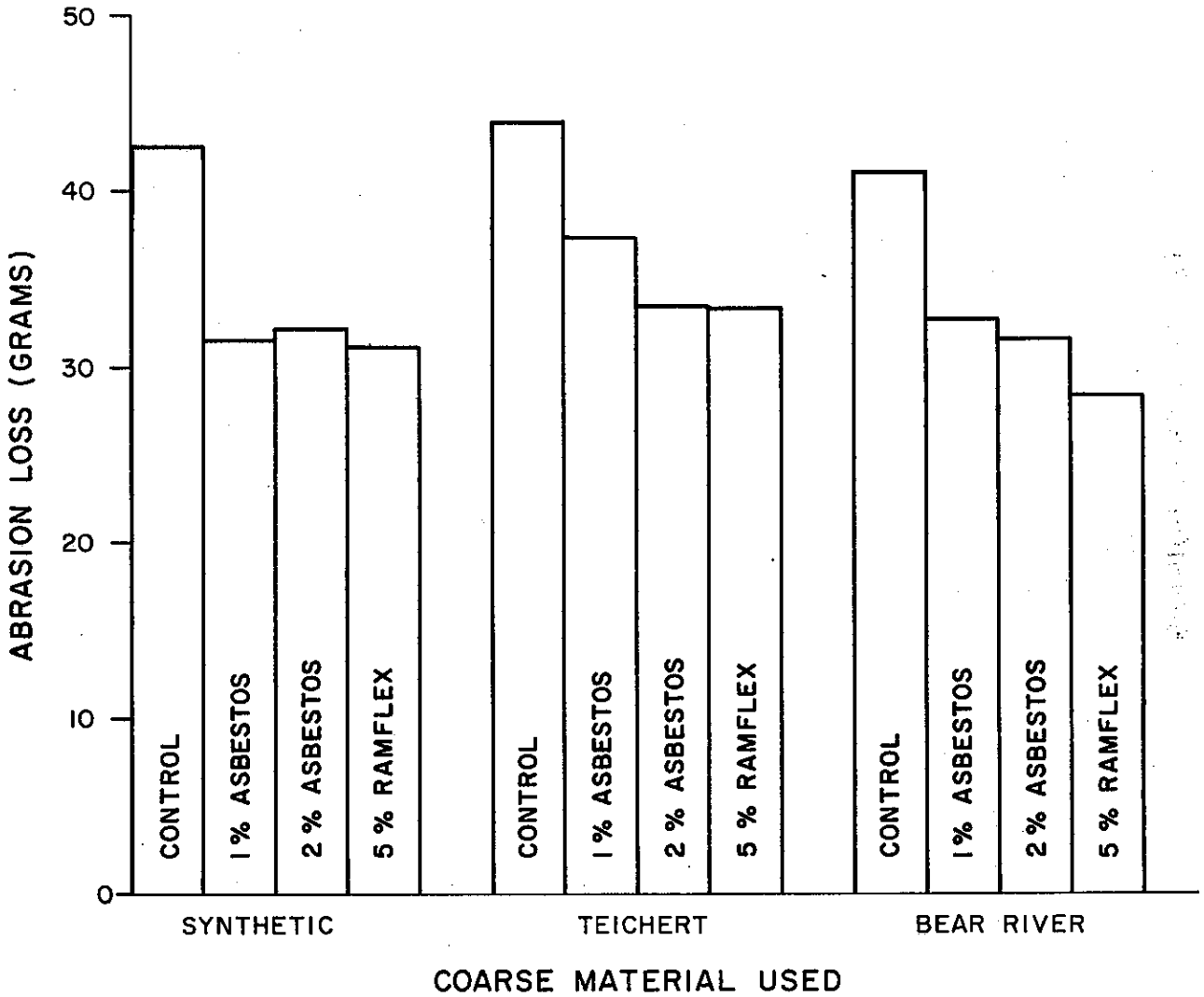

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Figure 2

EFFECT OF THE ADDITION OF ASBESTOS AND RAMFLEX ON LOW TEMPERATURE ABRASION LOSS OF ASPHALT CONCRETE

SERIES II

85 — 100 PENETRATION ASPHALT

TESTED AT 32°F

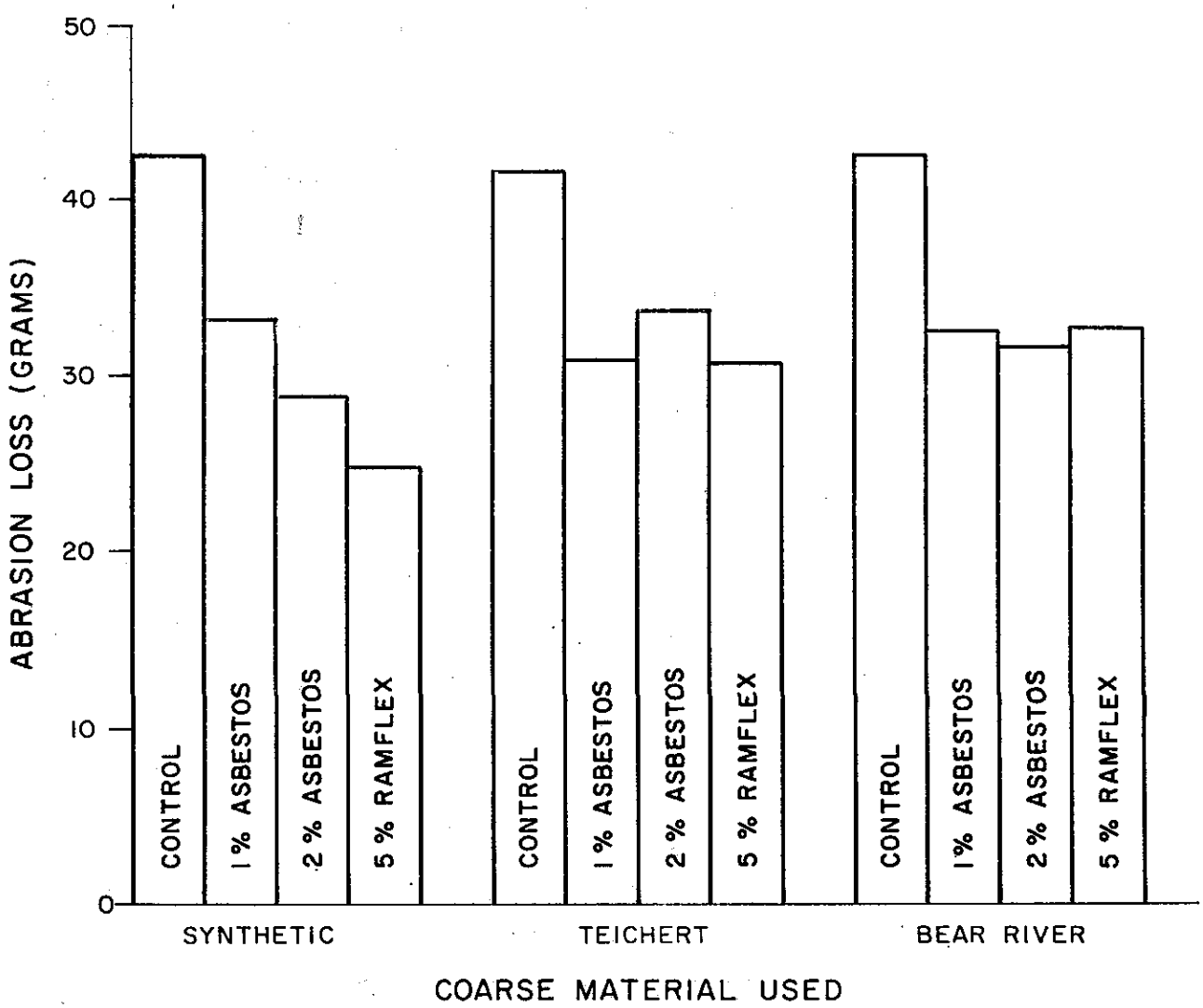

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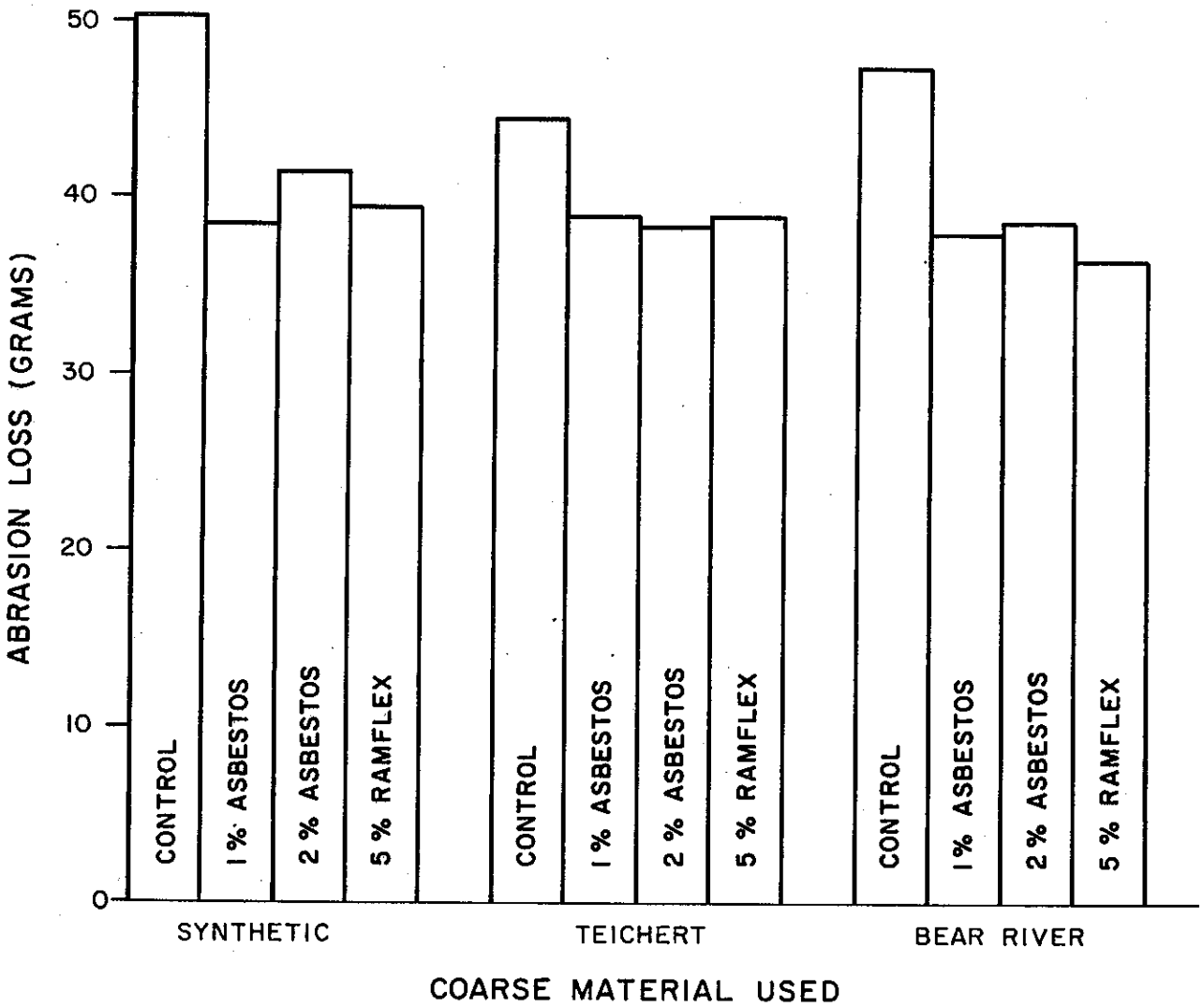
Figure 3

EFFECT OF THE ADDITION OF ASBESTOS AND RAMFLEX ON LOW TEMPERATURE ABRASION LOSS OF ASPHALT CONCRETE

SERIES III

60 – 70 PENETRATION ASPHALT

TESTED AT 32°F



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