DEVELOPMENT OF IMPROVED MIX DESIGN AND CONSTRUCTION PROCEDURES FOR COLD IN-PLACE RECYCLED PAVEMENTS

1984-86 Construction Projects

Volume II

by

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16. Abstract

This is the second of a three-volume report prepared to document the results of the cold in-place recycling (CIR) effort in Oregon. The overall objectives of the project are to develop improved design and construction procedures for cold recycled pavements. Volume I of this report describes the efforts to accomplish this objective over the period 1984-86. Specific guidelines are given for design, construction, and field control.

Volume II contains the supporting data for the research effort. In particular, it contains a review of selected mix and thickness design procedures, mix design, and field data for the 1986 projects, and the proposed construction specifications for 1987 projects.

Volume III will be developed later and will include data documenting the performance of the 1986 projects over a three-year period (1986-89).

17. Key Words	18. Distribution Statement
Recycling, Cold Recycling, Asphalt Emulsion, Mix Design Construction	

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified		

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This is an interim report concerned with the Development of Improved Design and Construction Procedures for Cold In-Place Recycled (CIR) Pavements. The authors are grateful for the cooperation of the Oregon Highway Division field staff in Regions 4 and 5 and to personnel in the State Materials Laboratory in Salem, Oregon. Special appreciation is also extended to Dan Olson, Projects Manager, for collecting and summarizing much of the 1986 information contained in this report, and to Dick Nelson, District Maintenance Supervisor, for providing much of the 1984-85 information on CIR with the single unit mills.

DISCLAIMER

The contents of this report reflect the views of the authors who are responsible for the facts and the accuracy presented herein. The contents do not necessarily reflect the official views or policies of the Oregon Department of Transportation. This report does not constitute a standard, specification, or regulation.

TABLE OF CONTENTS

APPENDIX A

SUMMARY OF EXISTING MIX AND THICKNESS DESIGN PROCEDURES

MIX AND THICKNESS DESIGN PROCEDURES

1.0 Introduction

In the spring of 1986, a survey was made of selected agencies, suppliers, and associations to identify:

1) mix design procedures for cold in-place recycled asphalt mixtures, and
2) thickness design procedures used for cold in-place recycled mixtures.

The results of that survey are presented in this appendix.

2.0 Mix Design Procedures

Table A.1 summarizes selected mix design from industry/suppliers including:

1) Witco Chemical
2) NCHRP
3) Chevron USA
4) The Asphalt Institute

As noted, the RAP evaluation procedures are generally similar, as is the method of selecting the type of recycling agent. However, there are considerable differences in the sample preparation, test methods, and mix design criteria.

Table A.2 summarizes similar data for selected agencies currently using CIR. Again, the methods used in the mix design process vary considerably. Despite these variations, the use of cold recycling is continually increasing.

Table A.1. Summary of Selected Industry Mix Design Procedures for Cold In-Place Recycling--Spring 1986

Agency/DOT	RAP Evaluation	Recycling/Reclaiming Agent	Sample Preparation	Testing Procedures	Mix Design Criteria
Witco Chemical Corp. (1979)	Extract & recover asphalt & aggregate. Determine asphalt penetration @ 77°F, viscosity @ 140°F. From sieve analysis data, calculate asphalt demand & determine minimum amount of reclaiming agent.	Select type and current reclaiming agent to achieve desired viscosity using nomograph.	Samples are not prepared for mix tests.	None used.	Based entirely on obtaining acceptable penetration and/or viscosity.
NCHRP Report 224 (1980)	Extract & recover asphalt & aggregate. Determine (1) asphalt content %, penetration @ 77°F and viscosity @ 140°F, and (2) aggregate gradation and durability value. Determine asphalt demand using variation of a surface area approach.	Determine type & amount of modifier to achieve desired viscosity @ 140°F or penetration @ 77°F.	Mix & fabricate 3 samples at 5 selected modifer contents. Standard mixing and molding operations are recommended.	Recommended mix tests include void content, Hveem or Marshall stability, water susceptibility, resilient modulus, and/or indirect tension.	Optimum mix design based on mix tests. No specific criteria are given.
Chevron USA (1982)	Extract & recover asphalt & aggregate. Determine asphalt content, penetration @ 77°F, viscosity @ 140°F, and aggregate gradation. Estimate asphalt demand using CKE or surface area of aggregate.	Select emulsified recycling agent to produce desired viscosity.	Prepare trial mixes @ 1% below, 0, 1, & 2% above estimated emulsified recycling agent. Note coating thickness. Compact using kneading compact (10-50 blows @ 250 psi & 40,000 lb. double plunger).	1) Initial cure for 24 hrs @ 73±5°F. Determine resistance value (R_1) and cohesiometer value (C_1), @ 73±3°F. 2) Final cure for 72 hrs @ 73±5°F + 4 days vacuum desiccation @ 10-20 mm mercury. Determine resilient modulus (MR) @ 73±3°F, stabilometer (S), & cohesiometer (C_2) @ 140±5°F. 3) Final cure for 72 hrs @ 73±5°F + vacuum saturation @ 100 mm of mercury. Determine resistance (R_2) & cohesiometer (C_3) @ 73±3°F.	Coating % = 75 min R_1 = 70 min C_1 = 50 min M_R = 150,000-600,000 psi S = 30 min C_2 = 100 min R_2 = 78 min C_3 = 100 min
The Asphalt Institute (1983)	Extract & recover asphalt & aggregate. Determine asphalt content & properties and aggregate gradation.	Select type and grade of new asphalt. Use nearest grade that can be worked. Determine asphalt demand based on surface area concepts.	Prepare trial mixes and make necessary field adjustments.	None recommended.	None given.

Table A.2. Summary of Selected Agency Mix Design Procedures for Cold In-Place Recycling--Spring 1986.

Agency/DOT	RAP Evaluation	Recycling/Reclaiming Agent	Sample Preparation	Testing Procedures	Mix Design Criteria
California (Doty, 1986)	Extract & recover asphalt using Abson recovery method. Determine asphalt content %, viscosity @ 140°F, and aggregate gradation. Calculate approximate bitumen requirement using aggregate surface area method.	Emulsified recycling agent (ERA) providing a theoretical viscosity of 8000 poises at 140°F is normally selected.	Add the emulsion, then mix at room temp. (75±5°F). Cure @ 140°F for 16±1 hrs & compact @ 140° F with approximately 20 blows @ 250 psi, followed by 150 blows @ 500 psi. Apply leveling load of 12,500 lbs. Place in 140°F oven for 90 minutes ± 30 minutes.	Test for S-value @ 140°F. Determine specific gravity & voids. Note degree of flushing/bleeding.	Use highest emulsion content that provides the desired S value (S = 30 min [travelled lane], and 25 min [shoulder]), Voids (4% min.), and slight or no flushing.
Minnesota (Inberg, 1986)	Size RAP to 1 inch minus. Determine moisture content. Extract and recover asphalt, determine asphalt viscosity and penetration, and aggregate gradation.	Determine type of emulsion based on road type, traffic, & class of treatment.	Target emulsion usually ranges from 2-4% and varies with RAP asphalt content. Four samples are prepared @ each emulsion level. After mixing @ 77°F, cure for 2 hrs, remix and compact using Marshall Method--75 blows/side. Remove from mold and cure @ 140°F for 3 days.	Determine Bulk S.G. and run Marshall stability on 2 cores @ each emulsion level. The other 2 cores are soaked for 3 days @ 77°F. After soaking the stabilities are determined.	1) Marshall stability 2) Retained stability 3) Moisture gain No specific values are given.
Nevada DOT (Pradere 1986)	Extract & recover asphalt using Abson recovery method. Determine asphalt content, viscosity @ 140°F, and aggregate gradation. Calculate approximate bitumen requirement using aggregate surface area method	Emulsified recycling agent (ERA) providing a theoretical viscosity of 8000 poises at 140°F is normally selected.	Mix emulsion at room temp. (75±5°F), cure @ 140°F for 16±1 hrs. Compact using Hveem compactor with 25 tamps @ 250 psi and 150 tamps @ 500 psi. Apply leveling load of 12,500 lbs.	Test for S-value @ 140°F. Determine specific gravity & voids.	Use highest emulsion content that provides a minimum S = 35 and minimum voids = 6-10%.

Table A.2. Summary of Selected Agency Mix Design Procedures for Cold In-Place Recycling--Spring 1986 (continued)

Agency/DOT	RAP Evaluation	Recycling/Reclaiming Agent	Sample Preparation	Testing Procedures	Mix Design Criteria
New Mexico (Hanson 1986)	Extract & recover aggregate. Determine asphalt properties and aggregate gradation	HFE-150 or 150S normally used.	Prepare 3 specimens for each test. Warm individual mixed specimen in 140°F oven for 2 hrs. Mold briqettes using Marshall procedure - 50 blows applied to each face. Cure specimens in mold for 24 hrs before extrusion. Air cure for a minimum of 72 hrs or until moisture loss is stabilized.	During curing period, weigh specimen at intervals and determine moisture loss. Determine compressive strength at 05 in/min.	Add emulsion content based on optimum density & compressive strength. (No specific criteria are given.) Field emulsion rate adjustments are made due to differences in gradation in the milling/crushing process.
Pennsylvania (Kandhal 1986)	Extract & recover asphalt using Abson recovery of aged asphalt. Determine asphalt content, viscosity @ 140°F, penetration @ 77°F, and aggregate gradation.	Both CMS-2 & CSS-1h are used. At least 4 emulsion contents - normally 2, 2.5, 3 & 3.5% are used for trial batches.	Mix emulsion at optimum moisture content @ 140°F. Cure loose mix @ 105°F for 45 min; remix for 30 sec & cool to room temperature. Compact in Marshall mold with 75 blows each side. Extrude specimen the next day & cure in forced-air oven @ 104°F for 3 days.	Determine bulk specific gravity & resilient modulus M_R @ 77°F. After vacuum saturation determine % water absorption, resilient M_R, Marshall stability & flow @ 77°F. Calculate % retained M_R.	Optimum emulsion content selected considering: 1) bulk specific gravity of compacted specimen 2) initial M_R 3) M_R after vacuum saturation 4) % retained M_R.

**Specific project studies - not agency design procedure.

3.0 Thickness Design Procedures

At present, only a limited amount of work has been accomplished with respect to developing design procedures for cold recycled mixes. This is in part because most prior work dealt with preservation and/or upgrading of existing low volume road facilities. In these applications, thickness design was not a major consideration.

In the future, however, with widespread use of recycling for reconstruction, development of a national thickness design method is essential. Table A.3 summarizes selected thickness design procedures which can be used now. Table A.4 summarizes for the AASHTO methods, typical structural layer coefficients developed in NCHRP Report 224 (1980).

4.0 Evaluation of Findings

At present, there are a number of mix and thickness design procedures available for use with cold recycled pavements. Unfortunately, there are considerable variations in the methods used. A concentrated effort is needed to develop standard methods for both mix and thickness design.

Table A.3. Thickness Design Procedures

Agency	Materials Characterization	Traffic Analysis	Other Inputs	Design Philosophy
Asphalt Institute (MS-1)	Subgrade resilient modulus, & mix resilient modulus @ 73±3°F	Total 18,000 lb EAL	•Fatigue Criteria •Rutting Criteria	Combined thickness of cold-mix base & asphalt surface course determined from design charts developed for emulsified asphalts using 3 categories of aggregates. Minimum surface course required & defined based on traffic level.
AASHTO 1972	Soil support S determined from CBR, R, or triaxial tests; appropriate layer coefficients a_1, a_2, a_3 for surface, base & subbase materials.	Total 18,000 lb EAL	•Terminal serviceability P_t = 2.0 for low volume roads P_t = 2.5 for major highway facilities •Regional factor R for climatic environment correction.	Nomograph solution to the pavement design equation resulting from the AASHTO road test. $SN = a_1D_1+a_2D_2+a_3D_3$ where D_i are values of respective layer thicknesses.
AASHTO 1986	Effective roadbed soil resilient modulus, appropriate layer coefficients a_1, a_2, a_3 for surface, base & subbase material	Total 18,000 lb EAL	•Reliability and overall standard deviation •Serviceability loss $\Delta_p SI$, Drainage coefficients m_2, m_3	Nomograph solution to the pavement design equation resulting from the AASHTO road test. $SN = a_1D_1+a_2D_2m_2+a_3D_3m_3$ where D_i are values of respective layer thicknesses.
Chevron USA (1982)	Subgrade resilient modulus, M_R, of mix resilient modulus	Total 18,000 lb EAL	•Fatigue criteria •Rutting criteria	Based on elastic layered theory, final thickness is determined from analysis of tensile strain at bottom of treated layer & vertical subgrade strain. Initial thickness requires correction for asphalt volume & air voids.

Table A.4. Typical AASHTO Structural Layer Coefficients (after Epps et al. 1980)

Type of Recycled Material	Layer Used as	Range of a_i Computed	Average a_i	Number of Test Sections	a_i for Corresponding Layer and Material at AASHTO Road Test
Central plant recycled asphalt concrete surface	Surface	0.37-0.59	0.48	14	0.44
Central plant recycled asphalt concrete base	Base	0.37-0.49	0.42	3	0.35
In-place recycled asphalt concrete stabilized with asphalt and/or an asphalt modifier	Base	0.22-0.49	0.36	6	0.35
In-place recycled asphalt concrete and existing base material stabilized with cement	Base	0.23-0.42	0.31	4	0.15-0.23
In-place recycled asphalt concrete and existing base stabilized with lime	Base	0.40	0.40	1	0.15-0.30
In-place recycled asphalt road mix stabilized with asphalt	Surface	0.42	0.42	1	---

APPENDIX B

ODOT'S PAVEMENT CONDITION

RATING METHOD

INTRODUCTION

Roadway conditions throughout the state system are rated using five categories ranging from very poor to very good (Figs. B.1-B.5). Trained field engineering teams (5 teams statewide) perform this rating on a biennial basis. These data are used in the state's preservation studies as well as its pavement management system.

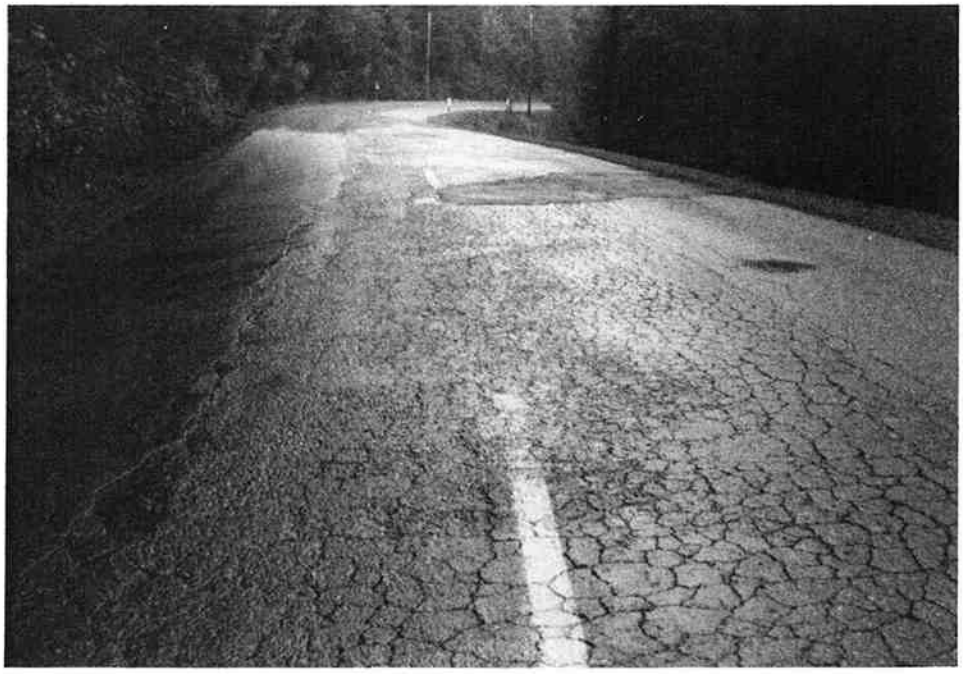


Fig. B.1. Very Poor--Extensive pavement distress and possible base failure

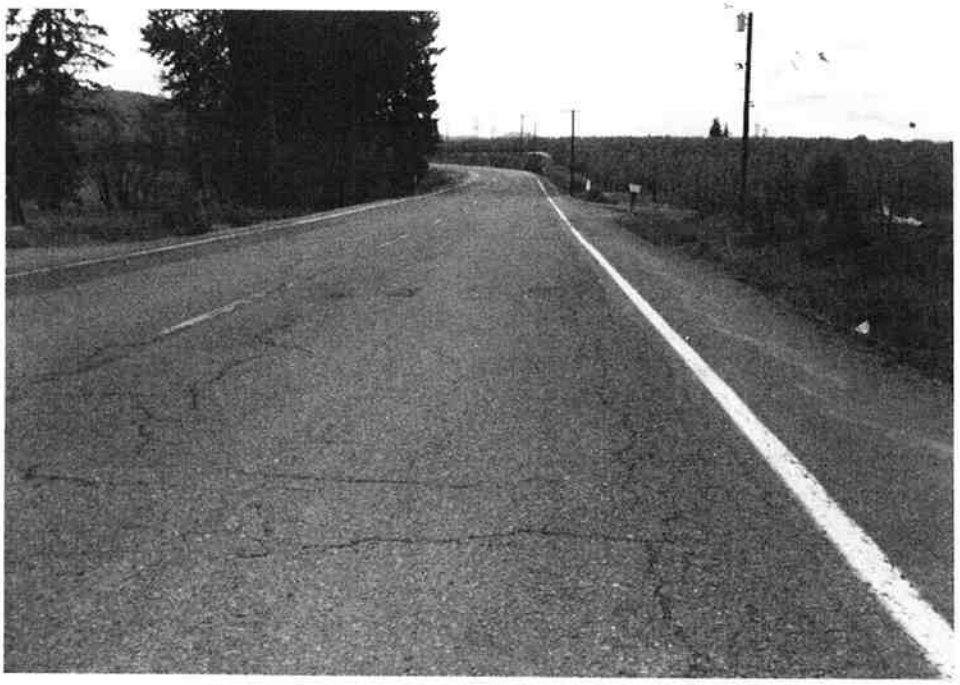


Fig. B.2. Poor--marked evidence of structural deficiencies.

Fig. B.3. Fair--generally stable structure with minor areas of structural distress evident.

Fig. B.4. Good--pavement structure is stable. May have minor surface erosion or cracking.

Fig. B.5. Very good--pavement structure is stable with no cracking, patching, or deformation.

APPENDIX C

MIX DESIGNS--1986 PROJECTS

MIX DESIGNS--1986 PROJECTS

1.0 Introduction

This appendix summarizes the mix design data for the projects constructed in 1986. All mix designs were performed in Salem labs using the modified Hveem method described in Chapter 3.

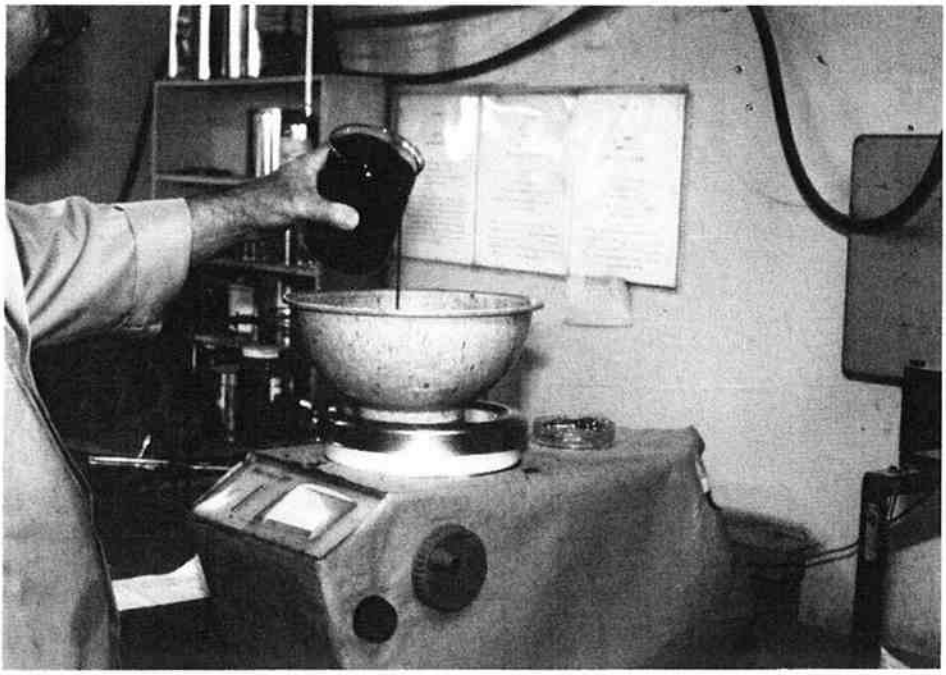
2.0 Procedure

The basic procedure consisted of mixing the emulsion with the RAP (Fig. C.1), compacting the mix (Fig. C.2), and testing the mix for stability and modulus (Fig. C.3).

3.0 Results

The results of the mix designs are summarized in Table C.1. Note all of the mix design data are included in this table together with the recommended emulsion and water contents.

It should be noted these values were generally higher than those used in the construction process. This was due to problems in laydown and compaction.



a) Adding CMS-2S

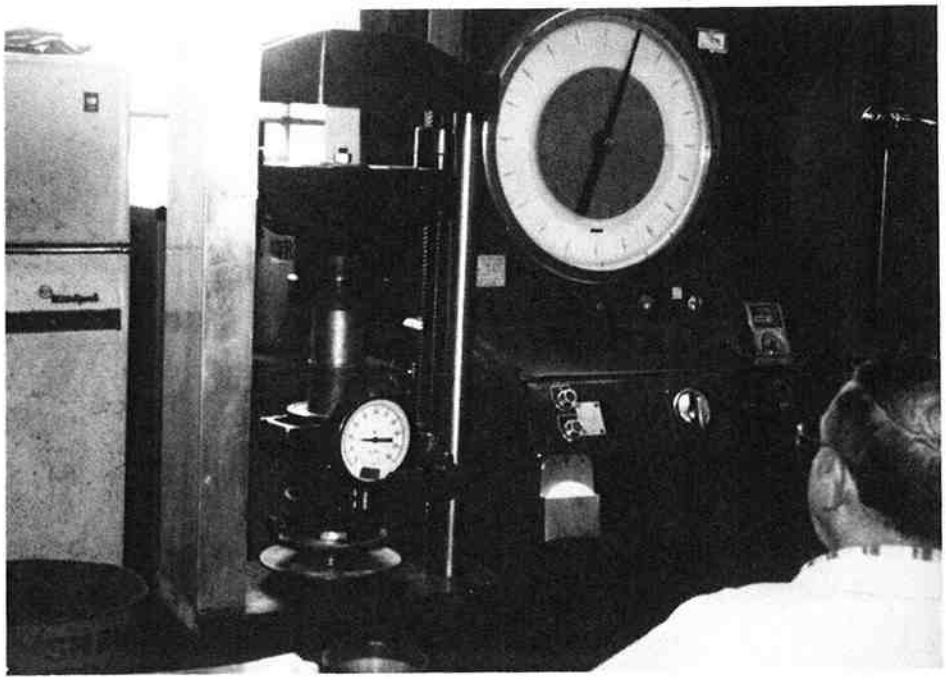
b) Mixing CMS-2S with RAP

Fig. C.1. Mixing Phase for Cold Recycling Mixes

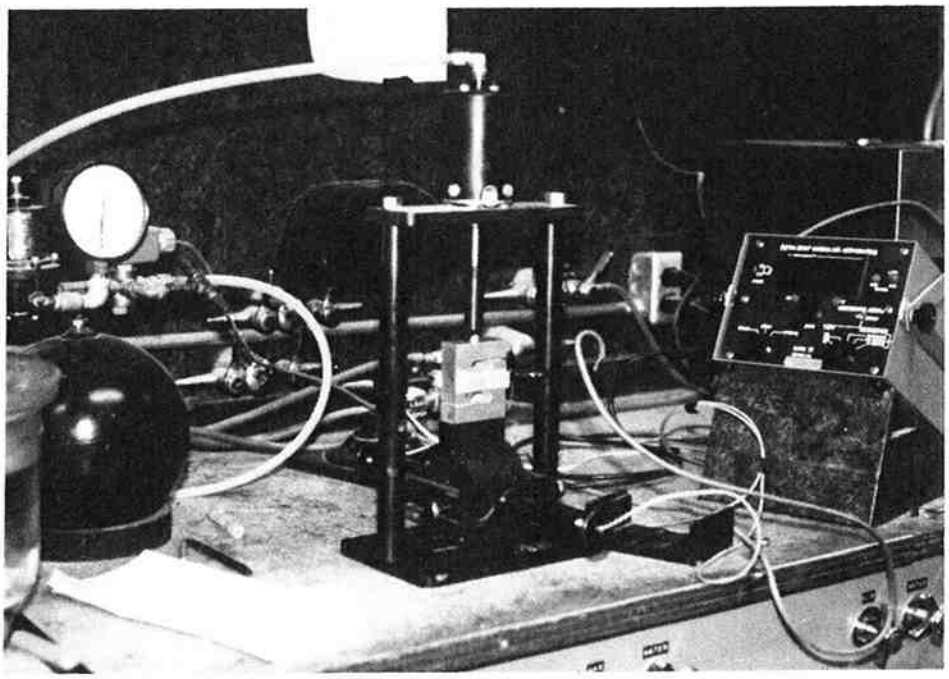
a) Placing mix in mold

b) Compacting mix

Figure C.2 Compaction Phase for Cold Recycled Mixes.



a) Hveem Stability



b) Resilient Modulus

Fig. C.3. Tests Run on Cold Recycled Mixes

Table C.1. Preliminary Mix Design Results—Salem Lab

(a) Region 4 Projects

Unit	A						B		C		D			E			
Mix Design Area	1	2	3	4	1**	2**	1	2	1	2	1	2	3	1	2	3	4
Emulsion Content*	1.5	1.5	2.0	2.5	1.0	1.0	1.0	1.5	1.0	1.0	1.0	1.0	2.0	2.0	2.5	1.5	1.5
Water Content*	4.0	4.0	4.0	4.0	2.0	2.0	3.0	4.0	3.0	5.0	4.0	5.0	5.0	3.0	3.0	5.0	5.0
1st Stability @ 77°F	62	48	52	38	36	58	47	61	42	27	62	40	49	44	31	38.5	43.5
2nd Stability @ 140°F	21	10	13	16	12	16	8	20	20	11	16	18	15	26	17	16	20.5
3rd Stability @ 140°F	19	1.5	1	4	2	6	2	12	23	2	2	4	4	15	11	15.5	11
% Voids 2nd Compaction	8.4	5.42	6.8	7.79			4.5	7.75	8.7	5.6	4.3	6.7	9.9	5.5	9.38	6.23	9.22
% Voids 3rd Compaction	3.3	4.85	4.4	3.85	0.4	0.4	0.9	1.0	1.6	1.1	3.5	0.2	3.0	1.0	0.9	0.85	1.05
Rice Gravity	2.419	2.585	2.447	2.485	2.589	2.560	2.451	2.494	2.379	2.375	2.435	2.434	2.442	2.403	2.406	2.395	2.512
Asphalt Film Thickness	Dry-Suff	Dry-Suff	Dry-Suff	Dry-Suff	Dry-Suff	Dry-Suff	Suff	Dry-Suff	Dry-Suff	Dry-Suff	Dry+	Dry-Suff	Dry-Suff	Suff	Dry-Suff	Dry-Suff	Dry-suff
Unconditional M_R ($x10^3$)	55.495	504.15	468.9	489.1	411.9	555.4	430.8	660.25	637.9	447.8	502.4	583.6	428.2	338.2	167.55	248.6	358.7
Vacuum Sat. M_R	346.6	480.75	354.8	408.95	338.2	511.3	430.4	625.9	480.8	436.6	407.5	523.6	287.5	338.1	84.25	198.3	259.3
Freeze-Thaw M_R	147.3	220.1	77.6	205.3	331.3	222.6	131.0	261.6	259.2	286.5	165.0	239.2	162.1	104.1	Too soft	147.95	139.7
M_R Ratio 1	.62	.95	.76	.83	.82	.92	1.00	.95	.75	.98	.81	.90	.67	1.00	.51	.79	.72
M_R Ratio 2	.27	.44	.17	.42	.76	.40	.30	.40	.41	.64	.33	.41	.38	.31	–	.59	.39

(a) Region 4 Projects (Cont'd)

(b) Districts 10 & 11 Projects

Unit	F		G	A		B				C	D		E	F
Design Area #	1	2	1	1	1**	1	1**	2**	3**	1	1	2	1	
Emulsion Content %	3.0	2.0	3.0	2.5	2.0	3.0	3.5	2.5	2.5	3.5	3.0	2.0	3.0	
Water Content %	2.5	2.5	2.5	3.0	3.0	4.0	4.0	4.0	4.0	5.0	3.0	3.0	4.0	Emergency
1st Stability @ 77°F	39	27	59	55	52	51	27	76	74	72	16	45	58	Repair.
2nd Stability @ 140°F	10	10	16	22	31	13	15	32	26	18	5	18	16	No mix
3rd Stability @ 140°F	1	2	1	6	8	1	15	25	42	11	3	52	1	design
% Voids 2nd Compaction	6.7	5.95	6.0	7.17	7.55	7.46	11.3	7.1	8.0	8.24	2.7	9.5	6.6	performed.
% Voids 3rd Compaction	1.8	0.8	0.5	1.45	2.1	2.2	0.8	2.3	3.3	2.2	1.40	3.4	2.5	
Rice Gravity	2.455	2.52	2.512	2.165	2.196	2.464	2.481	2.508	2.522	2.387	2.364	2.443	2.441	
Asphalt Film Thickness	Suff	Suff-Thick	Suff	Dry-Suff	Dry-Suff	Dry-Suff	Dry-Suff	Suff	Suff	Suff	Suff	Suff	Suff	
Unconditional M_R ($x10^3$)	154.9	157.4	354.6	–	–	821.4	158.2	966.2	848.4	669.35	450.4	1082.9	491.9	
Vacuum Sat. M_R	133.6	163.9	249.9	–	–	651.9	118.9	808.3	817.7	546.5	564.0	769	440.6	
Freeze-Thaw M_R	127.7	103.5	87.2	–	–	376.7	36.2	381.9	526	231.85	324.3	187.5	–	
M_R Ratio 1	.86	1.04	.72	–	–	.79	.75	.83	.96	.82	1.25	.71	0.90	
M_R Ratio 2	.82	.66	.025	0	0	.46	.23	.38	.62	.35	.72	.17	–	

*Recommended values

**Special test sections

LABORATORY RECORD

HIGHWAY DIVISION — MATERIALS SECTION

Laboratory No. 861190 9

Data Sheet No. A-34401

E. A. C10218

Laboratory charge $510.00

PRELIMINARY COLD RECYCLE MIX DESIGN

Project Region 4 Recycle-MP79.2-Wasco Co. Line

Highway Warm Springs Unit A Design #1

Contractor J. C. Compton

Date received 4/10/86

Submitted by Dan Olson Unit Code # 8041 Date reported 8.7.86

Source of Material MP 83.2, MP 83.4, MP 83.6 Date sampled 4/8/86

Sampled or inspected at Roadway To be used In Place Cold Recycle A/C

Sampled or inspected by R&R Team Quantity represented

* Test Gradation: of Pavement grindings calculated to 100% Passing 1"

P. 1" - 100 P. 3/8 - 74 P. #40 - 6

P. 3/4" - 96 P. 1/4 - 53 P. #200 - 1.6

P. 1/2" - 85 P. #10 - 20 * Milling report 86-4646

Resistance to Deformation and Cohesion: AASHTO - T-246 & 247 (A/C - 5.5; Pen - 14)

% Water / % Emulsion CMS-2S @ 67% Residual	4.0 / 1.0	4.0 / 2.0	4.0 / 3.0	4.0 / 4.0
1st Compaction @ 140°F (After 15-24 hrs. Cure in Bread Pan @ 140°F)				
Hveem stability @ 77°F (Cured @ 140°F 15-24 hrs.)	62	62	56	49
Hveem stability @ 140°F (Cured @ 140°F 15-24 hrs.)	23	18	12	7
Hveem stability @ 140°F after 2nd Comp. (Compacted after 3-4 hrs. @ 240°F)	33	4	2	1
Bulk Specific Gravity - 1st Comp.	2.18	2.22	2.24	2.26
Bulk Specific Gravity - 2nd Comp.	2.19	2.24	2.25	2.28
Bulk Specific Gravity - 3rd Comp.	2.33	2.35	2.37	2.35
Percent Voids @ 3rd Comp.	4.2	2.4	1.0	1.1
Rice Method Real Gravity	2.431	2.407	2.394	2.376
Asphalt Film Thickness	Dry-Suff.	Suff	Suff	Thick
Unconditioned Resilient Modulus (x 10^3) -	536.6	573.3	589.5	585.2
Vac. Sat. Resilient Modulus (x 10^3) -	312.9	380.3	384.1	479.0
Freeze-Thaw Resilient Modulus (x 10^3) -	107.7	186.8	275.5	311.9
M_R Ratio 1 (Vac. Sat./Uncond.) -	58%	66%	65%	82%
M_R Ratio 2 (Freeze-Thaw/Uncond.) -	20%	33%	47%	53%

Recommended water addition (Based on milling dry weight) - 4.0%

" Emulsion content " " " " " " - 1.5%

REPORT TO:

- x Reg. 4 RAS
- F.H.W.A.
- x Construction Engineer
- x RJ VanCleave
- Bridge Engineer
- Region Engineer
- x Project Manager Dan Olson
- Dist. Maintenance Supervisor
- x JC Compton Contr.
- Materials, Eugene
- x Files

RECOMMENDATION:

Material as represented by this sample does, does not comply with specifications.

Based on 7-29-86 Revised Design criteria - 1.0% CMS-2S

W. J. Zuniga

LABORATORY RECORD
HIGHWAY DIVISION — MATERIALS SECTION

Laboratory No. 8611910
Data Sheet No. A34402
E. A. C10218
Laboratory charge $ 510.00
Date received 4/10/86
Date reported 8.7.86
Date sampled 4/8/86

PRELIMINARY COLD RECYCLE MIX DESIGN

Project Region 4 Recycle - MP 79.2 - Wasco Co. Line
Highway Warm Springs Unit A Design #2
Contractor J.C. Compton
Submitted by Dan Olson Unit Code # 8041
Source of Material Mix design area #2
Sampled or inspected at Roadway To be used In place cold recycle AC
Sampled or inspected by R & R Team Quantity represented

*Test Gradation: of Pavement grindings calculated to 100% Passing 1"

P. 1" – 100	P. ⅜" – 74	P. #40 – 5
P. ¾" – 97	P. ¼" – 54	P. #200 – 1.6
P. ½" – 86	P. #10 – 18	* Milling report #86-4647

Resistance to Deformation and Cohesion: AASHTO – T-246 & 247 (A/C – 5.8; Pen – 2.5)

% Water / % Emulsion CMS-2S @67% Residual	4.0 / 1.0	4.0 / 2.0	4.0 / 3.0	4.0 / 4.0
1st Compaction @ 140°F (After 15-24 hrs. Cure in Bread Pan @ 140°F)				
Hveem stability @ 77°F (Cured @ 140°F 15-24 hrs.)	60	36	21	16
Hveem stability @ 140°F (Cured @ 140°F 15-24 hrs.)	15	4	1	1
Hveem stability @ 140°F after 2nd Comp. (Compacted after 3-4 hrs. @ 240°F)	2	1	0.7	0.5
Bulk Specific Gravity – 1st Comp.	2.41	2.45	2.47	2.49
Bulk Specific Gravity – 2nd Comp.	2.43	2.46	2.48	2.49
Bulk Specific Gravity – 3rd Comp.	2.45	2.47	2.49	2.51
Percent Voids @ 3rd Comp.	6.0	3.7	2.3	0.3
Rice Method Real Gravity	2.606	2.565	2.548	2.518
Asphalt Film Thickness	Dry	Suff	Suff	Suff-Thick
Unconditioned Resilient Modulus (x 10^3) –	527.7	480.6	391.9	321.8
Vac. Sat. Resilient Modulus (x 10^3) –	497.0	464.5	389.7	308.4
Freeze-Thaw Resilient Modulus (x 10^3) –	195.5	244.7	261.2	201.1
M_R Ratio 1 (Vac. Sat./Uncond.) –	94%	97%	99%	96%
M_R Ratio 2 (Freeze-Thaw/Uncond.) –	37%	51%	67%	62%

Recommended water addition (Based on milling dry weight) – 4.0%
" Emulsion content " " " " " – 1.5%

REPORT TO:
- x Reg. 4 RAS
- ☐ F.H.W.A.
- x ☐ Construction Engineer
- x ☐ RJ VanCleave
- ☐ Bridge Engineer
- ☐ Region Engineer
- x ☐ Project Manager Dan Olson
- ☐ Dist. Maintenance Supervisor
- x ☐ JC Compton Cont.
- ☐ Materials, Eugene
- x ☐ Files

RECOMMENDATION:

Material as represented by this sample does, does not comply with specifications.

Based on 7-29-86 Revised Design criteria – 1.5% CMS-2S

W. J. Lucius

RECEIVED OCT 1 1986

CORRECTED REPORT 9-30-86 (TEST GRADATION)

LABORATORY RECORD

HIGHWAY DIVISION — MATERIALS SECTION

Laboratory No. 8611911

Data Sheet No. A34403

E. A. C10218

Laboratory charge $ 510 00

PRELIMINARY COLD RECYCLE MIX DESIGN

Project Region 4 Recycle - MP 79.2 - Wasco Co. Line

Highway Warm Springs Unit A Design #3

Contractor J.C. Compton — Date received 4/10/86

Submitted by Dan Olson — Unit Code # 8041 — Date reported 8.7.86

Source of Material MP 88.1, MP89.2 — Date sampled 4/8/86

Sampled or inspected at Roadway — To be used In Place Cold Recycle A/C

Sampled or inspected by R & R Team — Quantity represented

* Test Gradation: of Pavement grindings calculated to 100% Passing 1"

P. 1" - 100	P. 3/8" - 84	P. #40 8
P. 3/4" - 98	P. 1/4" - 72	P# 200 0.3
P. 1/2" - 91	P#10 - 35	*Milling report #86-4648

Resistance to Deformation and Cohesion: AASHTO - T-246 & 247 (A/c -6.3%; Pen -26)

% Water / % Emulsion CMS-2S @67% Residue	4.0 / 1.0	4.0 / 2.0	4.0 / 3.0	4.0 / 4.0
1st Compaction @ 140°F (After 15-24 hrs. Cure in Bread Pan @ 140°F)				
Hveem stability @ 77°F (Cured @ 140°F 15-24 hrs.)	53	52	26	17
Hveem stability @ 140°F (Cured @ 140°F 15-24 hrs.)	18	13	6	2
Hveem stability @ 140°F after 2nd Comp. (Compacted after 3-4 hrs. @ 240°F)	4	1	0.5	0.5
Bulk Specific Gravity - 1st Comp.	2.18	2.25	2.27	2.29
Bulk Specific Gravity - 2nd Comp.	2.22	2.28	2.30	2.32
Bulk Specific Gravity - 3rd Comp.	2.32	2.34	2.36	2.38
Percent Voids @ 3rd Comp.	6.1	4.4	2.4	1.1
Rice Method Real Gravity	2.471	2.447	2.417	2.407
Asphalt Film Thickness	Dry	Dry Suff	Dry-Suff	Dry-Suff
Unconditioned Resilient Modulus (x 10^3) -	427.5	468.9	457.7	440.8
Vac. Sat. Resilient Modulus (x 10^3) -	220.5	354.8	378.8	371.8
Freeze-Thaw Resilient Modulus (x 10^3) -	42.8	77.6	108.9	111.2
M_R Ratio 1 (Vac. Sat./Uncond.) -	52%	76%	83%	84%
M_R Ratio 2 (Freeze-Thaw/Uncond.) -	10%	17%	24%	25%

Recommended water addition (Based on milling dry weight) - 4.0%

" Emulsion content " " " " " - 2.0%

REPORT TO:

- x ☐ Reg. 4 RAS
- x ☐ F.H.W.A.
- x ☐ Construction Engineer
- x ☐ RJ VanCleave
- ☐ Bridge Engineer
- ☐ Region Engineer
- x ☐ Project Manager Dan Olson
- ☐ Dist. Maintenance Supervisor
- x ☐ JC Compton Const.
- ☐ Materials, Eugene
- x ☐ Files

RECOMMENDATION:

Material as represented by this sample does, does not comply with specifications.

Based on 7-29-86 Revised Design Criteria - 1.5% CMS-2S

W. J. Jennings

LABORATORY RECORD
HIGHWAY DIVISION — MATERIALS SECTION

Laboratory No. 86 11912
Data Sheet No. A-34404
E. A. C10218
Laboratory charge # 510.00

PRELIMINARY COLD RECYCLE MIX DESIGN

Project Region 4 Recycle - MP 79.2 - Wasco Co. Line
Highway Warm Springs Unit A Design #4
Contractor JC Compton
Submitted by Dan Olson Unit Code # 8041
Source of Material MP 95.2, MP 96.1,
Sampled or inspected at Roadway
Sampled or inspected by R & R Team

Date received 4/10/86
Date reported 8.7.86
Date sampled 4/8/86
To be used In Place Cold Recycle A/C
Quantity represented

* Test Gradation: of Pavement grindings calculated to 100% Passing 1"
- P. 1" - 100 P. 3/8" - 73 P. #40 - 6
P. 3/4" - 96 P. 1/4" - 58 P. #200 - 2.10
P. 1/2" - 83 P. #10 - 24 * Milling report 86-4649

Resistance to Deformation and Cohesion: AASHTO - T-246 & 247 (A/C - 5.3; Pen - 7)

% Water / % Emulsion CMS-2S @67% Residual	4.0 / 1.0	4.0 / 2.0	4.0 / 3.0	4.0 / 4.0
1st Compaction @ 140°F (After 15-24 hrs. Cure in Bread Pan @ 140°F)				
Hveem stability @ 77°F (Cured @ 140°F 15-24 hrs.)	50	43	32	14
Hveem stability @ 140°F (Cured @ 140°F 15-24 hrs.)	20	19	13	5
Hveem stability @ 140°F after 2nd Comp. (Compacted after 3-4 hrs. @ 240°F)	16	7	1	0.5
Bulk Specific Gravity - 1st Comp.	2.19	2.25	2.27	2.31
Bulk Specific Gravity - 2nd Comp.	2.22	2.28	2.30	2.34
Bulk Specific Gravity - 3rd Comp.	2.36	2.38	2.40	2.42
Percent Voids @ 3rd Comp.	6.6	4.7	3.0	1.1
Rice Method Real Gravity	2.526	2.496	2.473	2.447
Asphalt Film Thickness	Dry	Dry Suff	Suff	Suff
Unconditioned Resilient Modulus (x 10^3) -	362.0	433.4	544.8	423.4
Vac. Sat. Resilient Modulus (x 10^3) -	177.0	352.4	465.5	362.7
Freeze-Thaw Resilient Modulus (x 10^3) -	58.6	145.9	264.8	209.6
M_R Ratio 1 (Vac. Sat./Uncond.) -	49%	81%	85%	86%
M_R Ratio 2 (Freeze-Thaw/Uncond.) -	16%	34%	49%	49%

Recommended water addition (Based on milling dry weight) - 4.0%
" Emulsion content " " " " " -2.5%

REPORT TO:
- x Reg. 4 RAS
- ☐ F.H.W.A.
- x ☐ Construction Engineer
- x ☐ RJ VanCleave
- ☐ Bridge Engineer
- ☐ Region Engineer
- x ☐ Project Manager Dan Olson
- ☐ Dist. Maintenance Supervisor
- x ☐ JC Compton Corp.
- ☐ Materials, Eugene
- x ☐ Files

RECOMMENDATION:
Material as represented by this sample does, does not comply with specifications.
Based on 7-29-86 Revised Criteria - 2.0% CMS-2S

W. J. Zuzin

LABORATORY RECORD

HIGHWAY DIVISION — MATERIALS SECTION

Laboratory No. 8616331

Data Sheet No. AB40575

PRELIMINARY COLD RECYCLE MIX DESIGN

E. A. C10218

Project Region 4 Recycle - Warm Springs Jct. - Wasco Co. Line — Laboratory charge $510.00

Highway Warm Springs Unit A

Contractor J. C. Compton — Date received 8-14-86

Submitted by R.J. Van Cleave — Unit Code # 4061 — Date reported 10-6-86

Source of Material MP 88.0 - 88.26 Rt Lane 2" depth — Sampled during construction — Date sampled 8-12-86

Sampled or inspected at Roadway — To be used In Place Cold Recycle A/C

Sampled or inspected by R J Van Cleave — Quantity represented

* Test Gradation: of Pavement grindings, sampled during construction, calculated to 100% passing 1"

P 1" - 100	P 3/8 - 64	P #40 - 2
P 3/4" - 92	P 1/4 - 46	P #200 - 0.4
P 1/2" - 78	P #10 - 12	*Milling report 86-12699

Resistance to Deformation and Cohesion: AASHTO - T-246 & 247 (A/C - 5.4%; Pen-15)

% Water / % Emulsion CMS-2S @ 67% Residual	2.0 / 0.0	2.0 / 0.5	2.0 / 1.0	2.0 / 1.5	2.0 / 2.0
1st Compaction @ 140°F (After 15-24 hrs. Cure in Bread Pan @ 140°F)					
Hveem stability @ 77°F (Cured @ 140°F 15-24 hrs.)	39	40	36	17	20
Hveem stability @ 140°F (Cured @ 140°F 15-24 hrs.)	19	17	12	3	3
Hveem stability @ 140°F after 2nd Comp. (Compacted after 3-4 hrs. @ 240°F)	5	3	2	0.5	0.5
Bulk Specific Gravity - 1st Comp.	2.42	2.45	2.47	2.50	2.51
Bulk Specific Gravity - 2nd Comp.	2.45	2.48	2.50	2.53	2.53
Bulk Specific Gravity - 3rd Comp.	2.61	2.60	2.58	2.57	2.57
Percent Voids @ 3rd Comp.	0.3	0.1	0.4	0	0
Rice Method Real Gravity	2.619	2.603	2.589	2.563	2.549
Asphalt film thickness	Dry	Dry	Dry-Suff	Suff	Suff
Unconditioned Resilient Modulus (x 10^3) -	548.7	509.8	411.9	409.4	523.9
Vac. Sat. Resilient Modulus (x 10^3) -	400.9	380.9	338.2	372.1	423.5
Freeze-Thaw Resilient Modulus (x 10^3) -	177.6	304.6	313.3	362.0	319.7
M_R Ratio 1 (Vac. Sat./Uncond.) -	73%	75%	82%	91%	81%
M_R Ratio 2 (Freeze-Thaw/Uncond.) -	32%	60%	76%	88%	61%

** Recommended water addition (Based on milling dry weight) - 2.0%

** " Emulsion content " " " " " - 1.0%

** Based on revised criteria.

REPORT TO:

- x R.J. VanCleave
- ☐ F.H.W.A.
- ☐ Construction Engineer
- ☐ Maintenance Engineer
- ☐ Bridge Engineer
- x ☐ Region ~~Engineer~~ 4 RAS
- x ☐ Project Manager Dan Olson
- ☐ Dist. Maintenance Supervisor
- ☐ Materials, Portland
- x ☐ Materials, Eugene
- x ☐ Files

RECOMMENDATION:

Material as represented by this sample does, does not comply with specifications.

D. J. Zumwalt

LABORATORY RECORD

HIGHWAY DIVISION — MATERIALS SECTION

Laboratory No. 86 16332

Data Sheet No. AB40776

E. A. C10218

Laboratory charge $510.00

PRELIMINARY COLD RECYCLE MIX DESIGN

Project Region 4 Recycle - Warm Springs Jct - Wasco Co. Line

Highway Warm Springs Unit A

Contractor J. C. Compton

Date received 8-14-86

Submitted by R J Van Cleave Unit Code # 4061

Date reported 10/6/86

Source of Material MP 88.28 - 88.54 Rt. Lane 3" depth

Sampled during construction

Date sampled 8-12-86

Sampled or inspected at Roadway

To be used In Place Cold Recycle A/C

Sampled or inspected by R J VanCleave

Quantity represented

* Test Gradation: of pavement grindings, sampled during construction, calculated to 100% passing 1"

P 1" - 100	P 3/8" - 66	P #40 - 2
P 3/4" - 96	P 1/4" - 49	P #200 - 0.6
P 1/2" - 82	P #10 - 14	* Milling report 86-12700

Resistance to Deformation and Cohesion: AASHTO - T-246 & 247 (A/C - 5.7%; Pen - 90)

% Water / % Emulsion CMS-2S @ 67% Residue	2.0 / 0.0	2.0 / 0.5	2.0 / 1.0	2.0 / 1.5	2.0 / 2.0
1st Compaction @ 140°F (After 15-24 hrs. Cure in Bread Pan @ 140°F)					
Hveem stability @ 77°F (Cured @ 140°F 15-24 hrs.)	53	58	58	46	48
Hveem stability @ 140°F (Cured @ 140°F 15-24 hrs.)	21	18	16	14	12
Hveem stability @ 140°F after 2nd Comp. (Compacted after 3-4 hrs. @ 240°F)	21	7	6	3	2
Bulk Specific Gravity - 1st Comp.	2.37	2.39	2.40	2.40	2.41
Bulk Specific Gravity - 2nd Comp.	2.38	2.40	2.42	2.42	2.44
Bulk Specific Gravity - 3rd Comp.	2.55	2.55	2.55	2.53	2.51
Percent Voids @ 3rd Comp.	1.1	0.8	0.4	0.6	0.5
Rice Method Real Gravity	2.579	2.570	2.560	2.544	2.523
Asphalt film thickness	Dry	Dry	Dry-Suff	Suff	Suff
Unconditioned Resilient Modulus (x 10^3) -	435.4	452.6	555.4	525.2	363.6
Vac. Sat. Resilient Modulus (x 10^3) -	361.0	428.4	511.3	495.1	376.0
Freeze-Thaw Resilient Modulus (x 10^3) -	132.6	233.9	222.6	243.2	302.0
M_R Ratio 1 (Vac. Sat./Uncond.) -	83%	95%	92%	94%	103%
M_R Ratio 2 (Freeze-Thaw/Uncond.) -	30%	52%	40%	46%	83%

** Recommended water addition (Based on milling dry wt.) -2.0%

** " Emulsion content " " " " " -1.0%

** Based on revised criteria.

REPORT TO:

- [x] R.J. VanCleave
- [ ] F.H.W.A.
- [ ] Construction Engineer
- [ ] Maintenance Engineer
- [ ] Bridge Engineer
- [x] Region ~~Engineer~~ 4 RAS
- [x] Project Manager Dan Olson
- [ ] Dist. Maintenance Supervisor
- [ ] Materials, Portland — OK/GS
- [x] Materials, Eugene
- [x] Files

RECOMMENDATION:

Material as represented by this sample does, does not comply with specifications.

R. J. Gruman

LABORATORY RECORD

HIGHWAY DIVISION — MATERIALS SECTION

Laboratory No. 8611913

Data Sheet No. A34405

E. A. C10218

Laboratory charge # 510 03

PRELIMINARY COLD RECYCLE MIX DESIGN

Project Region 4 Recycle - Sisters - Fryrear Rd

Highway McKenzie - Bend Unit K Design #1

Contractor JC Compton

Date received 4/10/86

Submitted by Dan Olson Unit Code # 8041

Date reported 8.7.86

Source of Material MP2.0, MP3.1

Date sampled 4/8/86

Sampled or inspected at Roadway

To be used In Place Cold Recycle A/C

Sampled or inspected by R&R Team

Quantity represented

* Test Gradation: of Pavement grindings calculated to 100% Passing 1"

P. 1" – 100	P. 3/8 – 84	P #40 – 5.1
P. 3/4" – 99	P. 1/4 – 66	P #200 – 0.9
P. 1/2" – 92	P. #10 – 24	* Milling report 86-4650

Resistance to Deformation and Cohesion: AASHTO - T-246 & 247 (A/C - 6.9%; Pen-34)

% Water / % Emulsion CMS-2S @ 67% Residual	3.0 / 0.0	3.0 / 1.0	3.0 / 2.0	3.0 / 3.0
1st Compaction @ 140°F (After 15-24 hrs. Cure in Bread Pan @ 140°F)				
Hveem stability @ 77°F (Cured @ 140°F 15-24 hrs.)	56	47	28	15
Hveem stability @ 140°F (Cured @ 140°F 15-24 hrs.)	17	8	3	2
Hveem stability @ 140°F after 2nd Comp. (Compacted after 3-4 hrs. @ 240°F)	7	2	1	0.4
Bulk Specific Gravity - 1st Comp.	2.29	2.31	2.33	2.34
Bulk Specific Gravity - 2nd Comp.	2.33	2.34	2.36	2.36
Bulk Specific Gravity - 3rd Comp.	2.45	2.43	2.42	2.39
Percent Voids @ 3rd Comp.	1.1	0.9	0.3	0.2
Rice Method Real Gravity	2.478	2.451	2.426	2.395
Asphalt Film Thickness	Dry	Suff	Suff	Suff-Thick
Unconditioned Resilient Modulus (x 10^3) -	395.7	430.8	293.3	226.2
Vac. Sat. Resilient Modulus (x 10^3) -	328.9	430.4	289.1	223.7
Freeze-Thaw Resilient Modulus (x 10^3) -	87.6	131.0	164.2	135.9
M_R Ratio 1 (Vac. Sat./Uncond.) -	82%	100%	99%	99%
M_R Ratio 2 (Freeze-Thaw/Uncond.) -	22%	30%	56%	60%

Recommended water addition (Based on milling dry weight) - 3.0%

" Emulsion content " " " " " - 1.0%

REPORT TO:

- x Req. 4 RAS
- ☐ F.H.W.A.
- x ☐ Construction Engineer
- x ☐ RJ VanCleave
- ☐ Bridge Engineer
- ☐ Region Engineer
- x ☐ Project Manager Dan Olson
- ☐ Dist. Maintenance Supervisor
- x ☐ JC Compton Contr.
- ☐ Materials, Eugene
- x ☐ Files

RECOMMENDATION:

Material as represented by this sample does, does not comply with specifications.

Based on 7-29-86 Revised Criteria — 1.0% CMS-2S

W. J. Ferrin

LABORATORY RECORD

HIGHWAY DIVISION — MATERIALS SECTION

Laboratory No. 86 11914

Data Sheet No. A3440.6

E. A. C10218

Laboratory charge $ 510.00

PRELIMINARY COLD RECYCLE MIX DESIGN

Project: Region 4 Recycle Sisters - Fryrear Rd

Highway: McKenzie - Bend Unit B Design #2

Contractor: JC Compton

Date received: 4/10/86

Submitted by: Dan Olson — Unit Code # 8041 — Date reported: 8.7.86

Source of Material: MP 5.2, MP 6.1 — Date sampled: 4/8/86

Sampled or inspected at: Roadway — To be used: In Place Cold Recycle A/C

Sampled or inspected by: R & R Team — Quantity represented:

*Test Gradation: of Pavement grindings calculated to 100% Passing 1"

P. 1" - 100	P. 3/8" - 75	P. #40 - 6
P. 3/4" - 95	P. 1/4" - 57	P. #200 - 1.5
P. 1/2" - 85	P. #10 - 22	* Milling report 86-4651

Resistance to Deformation and Cohesion: AASHTO - T-246 & 247 (A/C - 5.3; Pen - 14)

% Water / % Emulsion CMS-2S @ 67% Residual	4.0 / 0.0	4.0 / 1.0	4.0 / 2.0	4.0 / 3.0
1st Compaction @ 140°F (After 15-24 hrs. Cure in Bread Pan @ 140°F)				
Hveem stability @ 77°F (Cured @ 140°F 15-24 hrs.)	62	62	59	53
Hveem stability @ 140°F (Cured @ 140°F 15-24 hrs.)	24	20	20	12
Hveem stability @ 140°F after 2nd Comp. (Compacted after 3-4 hrs. @ 240°F)	18	20	3	1
Bulk Specific Gravity - 1st Comp.	2.23	2.26	2.30	2.31
Bulk Specific Gravity - 2nd Comp.	2.25	2.27	2.33	2.35
Bulk Specific Gravity - 3rd Comp.	2.46	2.47	2.47	2.45
Percent Voids @ 3rd Comp.	2.7	1.5	0.5	0.4
Rice Method Real Gravity	2.527	2.507	2.482	2.461
Asphalt Film Thickness	Dry	Dry-Suff	Suff	Suff-Thick
Unconditioned Resilient Modulus (x 10^3) -	563.1	717.7	602.8	515.4
Vac. Sat. Resilient Modulus (x 10^3) -	447.1	684.1	567.7	537.7
Freeze-Thaw Resilient Modulus (x 10^3) -	122.0	270.2	253.0	306.7
M_R Ratio 1 (Vac. Sat./Uncond.) -	79%	95%	94%	100+%
M_R Ratio 2 (Freeze-Thaw/Uncond.) -	22%	38%	42%	60%

Recommended water addition (Based on milling dry weight) - 4.0%

" Emulsion content " " " " - 1.5%

REPORT TO:

x Reg. 4 RAS

☐ F.H.W.A.

x ☑ Construction Engineer

x ☐ RJ VanCleave

☐ Bridge Engineer

☑ Region Engineer

x ☑ Project Manager Dan Olson

☐ Dist. Maintenance Supervisor

x ☐ JC Compton Contr.

☐ Materials, Eugene

x ☑ Files

3x Wilson ...

RECOMMENDATION:

Material as represented by this sample does, does not comply with specifications.

Based on 7-29-86 Revised Design Criteria — 1.0% CMS-2S

C-13

W. J. [signature]

LABORATORY RECORD
HIGHWAY DIVISION — MATERIALS SECTION

Laboratory No. 8611915

Data Sheet No. A34407

PRELIMINARY COLD RECYCLE MIX DESIGN

E. A. C10218

Project Region 4 Recycle - Powell Butte - M.P. 15 — Laboratory charge # 510 00

Highway Powell Butte Unit C Design # 1

Contractor JC Compton — Date received 4/10/86

Submitted by Dan Olson — Unit Code # 8041 — Date reported 8.7.86

Source of Material MP 10.8, MP 10.4, MP 3.0, MP 2.6 — Date sampled 4/8/86

Sampled or inspected at Roadway — To be used In Place Cold Recycle A/C

Sampled or inspected by R & R Team — Quantity represented

* Test Gradation: of Pavement grindings calculated to 100% Passing 1"

P. 1" – 100	P. 3/8 – 67	P. #40 – 11
P. 3/4" – 98	P. 1/4 – 54	P. #200 – 1.6
P. 1/2" – 82	P. #10 – 29	* Milling report 86-4652

Resistance to Deformation and Cohesion: AASHTO - T-246 & 247 (A/C - 7.2; Pen - 27)

% Water / % Emulsion CMS-2S @ 67% Residue	3.0 / 0.0	3.0 / 1.0	3.0 / 2.0	3.0 / 3.0
1st Compaction @ 140°F (After 15-24 hrs. Cure in Bread Pan @ 140°F)				
Hveem stability @ 77°F (Cured @ 140°F 15-24 hrs.)	50	42	33	30
Hveem stability @ 140°F (Cured @ 140°F 15-24 hrs.)	47	20	16	11
Hveem stability @ 140°F after 2nd Comp. (Compacted after 3-4 hrs. @ 240°F)	37	23	5	1
Bulk Specific Gravity - 1st Comp.	2.13	2.12	2.16	2.21
Bulk Specific Gravity - 2nd Comp.	2.15	2.17	2.19	2.23
Bulk Specific Gravity - 3rd Comp.	2.33	2.34	2.34	2.34
Percent Voids @ 3rd Comp.	3.0	1.6	0.0	0.0
Rice Method Real Gravity	2.403	2.379	2.341	2.338
Asphalt Film Thickness	Dry	Dry-Suff	Suff	Suff-Thick
Unconditioned Resilient Modulus (x 10^3) -	516.5	637.9	479.2	424.7
Vac. Sat. Resilient Modulus (x 10^3) -	396.9	480.8	412.6	416.6
Freeze-Thaw Resilient Modulus (x 10^3) -	168.0	259.2	285.9	408.1
M_R Ratio 1 (Vac. Sat./Uncond.) -	77	75	86	98
M_R Ratio 2 (Freeze-Thaw/Uncond.) -	33	41	60	96

Recommended water addition (Based on milling dry weight) – 3.0%

" Emulsion content " " " " " – 1.0%

REPORT TO:

- x Reg. 4 RAS
- ☐ F.H.W.A.
- x ☐ Construction Engineer
- ☐ Maintenance Engineer
- ☐ Bridge Engineer
- x ☐ ~~Region Engineer~~ RJ VanCleave
- x ☐ Project Manager Dan Olson
- ☐ Dist. Maintenance Supervisor
- x ☐ ~~Materials, Portland~~ x JC Compton Cont.
- x ☐ Materials, Eugene
- x ☐ Files

RECOMMENDATION:

Material as represented by this sample does, does not comply with specifications.

Based on 7-29-86 Revised criteria – 1.0% CMS-2S

LABORATORY RECORD
HIGHWAY DIVISION — MATERIALS SECTION

Laboratory No. 8611916
Data Sheet No. A34408
E. A. C10218
Laboratory charge $ 510.00

PRELIMINARY COLD RECYCLE MIX DESIGN

Project Region 4 Recycle - Powell Butte - MP. 15
Highway Powell Butte Unit C Design #2
Contractor J C Compton
Submitted by Dan Olson Unit Code # 8041
Source of Material MP 5.3, MP 4.9, MP 0.9
Sampled or inspected at Roadway To be used In Place Cold Recycle A/C
Sampled or inspected by R & R Team Quantity represented

Date received 4/10/86
Date reported 8.7.86
Date sampled 4/8/86

*Test Gradation: of Pavement grindings calculated to 100% Passing 1"

P. 1" – 100	P ⅜ – 67	P #40 – 10
P. ¾" – 99	P ¼ – 50	P #200 – 1.8
P. ½" – 83	P #10 – 24	* Milling report 86-4653

Resistance to Deformation and Cohesion: AASHTO - T-246 & 247 (A/C - 7.8; Pen - 16)

% Water / % Emulsion CMS-2S @67% Residual	5.0 / 0.0	5.0 / 1.0	5.0 / 2.0	5.0 / 3.0
1st Compaction @ 140°F (After 15-24 hrs. Cure in Bread Pan @ 140°F)				
Hveem stability @ 77°F (Cured @ 140°F 15-24 hrs.)	37	27	28	10
Hveem stability @ 140°F (Cured @ 140°F 15-24 hrs.)	16	11	12	2
Hveem stability @ 140°F after 2nd Comp. (Compacted after 3-4 hrs. @ 240°F)	5	2	2	0.4
Bulk Specific Gravity - 1st Comp.	2.20	2.22	2.24	2.28
Bulk Specific Gravity - 2nd Comp.	2.23	2.24	2.27	2.30
Bulk Specific Gravity - 3rd Comp.	2.33	2.35	2.36	2.34
Percent Voids @ 3rd Comp.	3.2	1.1	0.2	0
Rice Method Real Gravity	2.406	2.375	2.364	2.342
Asphalt Film Thickness	Dry	Dry-Suff	Suff	Suff-Thick
Unconditioned Resilient Modulus (x 10^3) -	539.6	447.8	342.5	284.2
Vac. Sat. Resilient Modulus (x 10^3) -	487.2	436.6	338.0	272.0
Freeze-Thaw Resilient Modulus (x 10^3) -	186.4	286.5	267.1	204.4
M_R Ratio 1 (Vac. Sat./Uncond.) -	90%	98%	99%	96%
M_R Ratio 2 (Freeze-Thaw/Uncond.) -	35%	64%	78%	72%

Recommended water addition (Based on milling dry weight) - 5.0 %
" Emulsion content " " " " " - 1.0 %

REPORT TO:
- x ☐ Reg 4 RAS
- ☐ F.H.W.A.
- x ☑ Construction Engineer
- x ☐ RJ VanCleave
- ☐ Bridge Engineer
- ☐ Region Engineer
- x ☑ Project Manager Dan Olson
- ☐ Dist. Maintenance Supervisor
- x ☐ JC Compton Cont.
- ☐ Materials, Eugene
- x ☑ Files

RECOMMENDATION:

Material as represented by this sample does, does not comply with specifications.

Based on 7-29-86 Revised Criteria ~ 1.0 % CMS-2S

C-15

W. J. Ingram

LABORATORY RECORD

HIGHWAY DIVISION — MATERIALS SECTION

Laboratory No. 8610640

Data Sheet No. A-34409

E. A. C10218

Laboratory charge # 510-

PRELIMINARY COLD RECYCLE MIX DESIGN

Project Region 4 Recycle - Powell Butte - Prineville

Highway Ochoco Unit "D" Design #1

Contractor J.C. Compton

Date received 4/10/86

Submitted by Dan Olson Unit Code # 8041

Date reported 7.31.86

Source of Material MP. 7.9

Date sampled

Sampled or inspected at Roadway

To be used In Place Cold Recycle A/C

Sampled or inspected by R. & R. Tuan

Quantity represented

* Test Gradation: of Pavement grindings calculated to 100% Passing 1"

P. 1" - 100 P. 3/8" - 85 P. - #40 - 10

P. 3/4" - 98 P. 1/4" - 72 P. #200 - 1.6

P. 1/2" - 94 P. #10 - 32 * Millings report #86-4654

Resistance to Deformation and Cohesion: AASHTO - T-246 & 247 (A/C - 5.8; Run - 15)

% Water / % Emulsion CMS-2S @ 67% residue	4.0 / 1.0	4.0 / 2.0	4.0 / 3.0	4.0 / 4.0
1st Compaction @ 140°F (After 15-24 hrs. Cure in Bread Pan @ 140°F)				
Hveem stability @ 77°F (Cured @ 140°F 15-24 hrs.)	62	26	17	13
Hveem stability @ 140°F (Cured @ 140°F 15-24 hrs.)	16	2	1	1
Hveem stability @ 140°F after 2nd Comp. (Compacted after 3-4 hrs. @ 240°F)	2	1	1	1
Bulk Specific Gravity - 1st Comp.	2.31	2.33	2.35	2.35
Bulk Specific Gravity - 2nd Comp.	2.33	2.35	2.37	2.36
Bulk Specific Gravity - 3rd Comp.	2.35	2.37	2.39	2.38
Percent Voids @ 3rd Comp.	3.5	1.8	0.3	0.0
Rice Method Real Gravity	2.435	2.413	2396	2378
Asphalt Film Thickness	Dry+	Suff.	Suff.	Thick
Unconditioned Resilient Modulus (x 10^3) -	502.4	518.4	407.7	335.4
Vac. Sat. Resilient Modulus (x 10^3) -	407.5	504.0	426.6	340.9
Freeze-Thaw Resilient Modulus (x 10^3) -	165.0	348.8	276.8	243.1
M_R Ratio 1 (Vac. Sat./Uncond.) -	81%	97%	105%	102%
M_R Ratio 2 (Freeze-Thaw/Uncond.) -	33%	67%	68%	72%

Recommended Water addition (Based on millings Dry weight) - 4.0%

" Emulsion content " " " " " - 1.0%

REPORT TO:

x JC Compton Contractors
x ☐ RJ VanCleave
x ☐ Construction Engineer
☐ Maintenance Engineer
☐ Bridge Engineer
x ☐ Region Engineer x 4 RAS
x ☐ Project Manager Dan Olson
☐ Dist. Maintenance Supervisor
☐ Materials, Portland
3x ☐ G. Boyle, J. Wilson, G. Hicks
x ☐ Files

RECOMMENDATION:

Material as represented by this sample does, does not comply with specifications.

Based on 7-29-86 Revised Design Criteria - 1.0% CMS-2S

C-16

W. J. Young

RECEIVED AUG 13 1986

LABORATORY RECORD

HIGHWAY DIVISION — MATERIALS SECTION

Laboratory No. 8612044

Data Sheet No. A34410

PRELIMINARY COLD RECYCLE MIX DESIGN

E. A. C10218

Project Region 4 Recycle — Powell Butte — Prineville — Laboratory charge $510.00

Highway Ochoco Unit "D" Design #2

Contractor JC Compton — Date received 4/10/86

Submitted by Dan Olson — Unit Code # 8041 — Date reported 8.12.86

Source of Material MP 9.9, MP 10 — Date sampled 4/8/86

Sampled or inspected at Roadway — To be used In Place Cold Recycle A/C

Sampled or inspected by R & R Team — Quantity represented

*Test Gradation: of Pavement grindings calculated to 100% Passing 1"

P. 1" – 100	P. ⅜" – 83	P. #40 – 4
P. ¾" – 98	P. ¼" – 63	P. #200 – 0.9
P. ½" – 92	P. #10 – 22	*Milling report #86-4655

Resistance to Deformation and Cohesion: AASHTO – T-246 & 247 (A/C – 6.4 – Pen – 12)

% Water / % Emulsion CMS-2S @ 67% Residual	5.0 / 0.0	5.0 / 1.0	5.0 / 2.0	5.0 / 3.0
1st Compaction @ 140°F (After 15-24 hrs. Cure in Bread Pan @ 140°F)				
Hveem stability @ 77°F (Cured @ 140°F 15-24 hrs.)	50	40	28	14
Hveem stability @ 140°F (Cured @ 140°F 15-24 hrs.)	20	18	11	3
Hveem stability @ 140°F after 2nd Comp. (Compacted after 3-4 hrs. @ 240°F)	21	4	1	0.5
Bulk Specific Gravity – 1st Comp.	2.21	2.23	2.28	2.32
Bulk Specific Gravity – 2nd Comp.	2.24	2.27	2.32	2.34
Bulk Specific Gravity – 3rd Comp.	2.42	2.43	2.41	2.37
Percent Voids @ 3rd Comp.	1.6	0.2	0.2	1.0
Rice Method Real Gravity	2.459	2.434	2.414	2.394
Asphalt Film Thickness	Dry	Dry-Suff	Suff	Suff
Unconditioned Resilient Modulus (x 10^3) –	518.1	583.6	539.9	460.8
Vac. Sat. Resilient Modulus (x 10^3) –	389.3	523.6	514.6	464.2
Freeze-Thaw Resilient Modulus (x 10^3) –	113.6	239.2	344.5	352.5
M_R Ratio 1 (Vac. Sat./Uncond.) –	75%	90%	95%	100%+
M_R Ratio 2 (Freeze-Thaw/Uncond.) –	22%	41%	64%	77%

Recommended water addition (Based on millings Dry weight) – 5.0%

" Emulsion content " " " " " – 1.0%

REPORT TO:

- x RJ Vancleave
- ☐ F.H.W.A.
- x ☐ Construction Engineer
- ☐ Maintenance Engineer
- x ☐ Reg. 4 RAS
- ☐ Region Engineer
- x ☐ Project Manager Dan Olson
- ☐ Dist. Maintenance Supervisor
- ☐ Materials, Portland
- x ☐ JC Compton Contractors
- x ☐ Files

3x J. Wilson, G. Hicks, G. Boyle

RECOMMENDATION:

Material as represented by this sample does, does not comply with specifications.

Based on 7-29-86 Revised Design Criteria – 1.0% CMS-2S

W. J. Lawrence

LABORATORY RECORD

HIGHWAY DIVISION — MATERIALS SECTION

Laboratory No. 8612385

Data Sheet No. A-34411

E. A. C10210

Laboratory charge $510.00

PRELIMINARY COLD RECYCLE MIX DESIGN

Project Region 4 Recycle - Powell Butte - Prineville

Highway Ochoco Unit D Design #3

Contractor JC Compton

Submitted by Dan Olson Unit Code # 8041

Source of Material MP 14.6, MP 16.2

Sampled or inspected at Roadway

Sampled or inspected by R&R Team

Date received 4/10/86

Date reported 8.19.86

Date sampled 4/8/86

To be used In Place Cold Recycle A/C

Quantity represented

*Test Gradation: of pavement grindings calculated to 100% Passing 1"

P. 1" - 100	P. 3/8" - 75	P. #40 - 5
P. 3/4" - 97	P. 1/4" - 54	P. #200 - 1.3
P. 1/2" - 87	P. #10 - 20	* Milling report #86-4656

Resistance to Deformation and Cohesion: AASHTO - T-246 & 247 (A/C - 6.7 Pen - 13)

% Water / % Emulsion CMS-2S @ 67% Residual	5.0 / 0.0	5.0 / 1.0	5.0 / 2.0	5.0 / 3.0
1st Compaction @ 140°F (After 15-24 hrs. Cure in Bread Pan @ 140°F)				
Hveem stability @ 77°F (Cured @ 140°F 15-24 hrs.)	64	59	49	45
Hveem stability @ 140°F (Cured @ 140°F 15-24 hrs.)	20	20	15	13
Hveem stability @ 140°F after 2nd Comp. (Compacted after 3-4 hrs. @ 240°F)	44	19	4	1
Bulk Specific Gravity - 1st Comp.	2.10	2.12	2.15	2.17
Bulk Specific Gravity - 2nd Comp.	2.13	2.16	2.20	2.22
Bulk Specific Gravity - 3rd Comp.	2.35	2.37	2.39	2.39
Percent Voids @ 3rd Comp.	5.3	3.8	3.0	0.3
Rice Method Real Gravity	2.482	2.464	2.442	2.396
Asphalt Film Thickness	Dry	Dry	Dry-Suff	Dry-Suff
Unconditioned Resilient Modulus (x 10^3) -	203.8	381.4	428.2	408.4
Vac. Sat. Resilient Modulus (x 10^3) -	71.8	192.2	287.5	304.2
Freeze-Thaw Resilient Modulus (x 10^3) -	Too soft	104.7	162.1	161.5
M_R Ratio 1 (Vac. Sat./Uncond.) -	35%	50%	67%	74%
M_R Ratio 2 (Freeze-Thaw/Uncond.) -	—	27%	38%	40%

Recommended water addition (based on milling dry weight) - 5.0%

" Emulsion content " " " " " - 2.0%

REPORT TO:

- x RJ VanCleave
- x ☐ F.H.W.A.
- x ☐ Construction Engineer
- x ☐ Reg. 4 RAS
- ☐ Bridge Engineer
- ☐ Region Engineer
- x ☐ Project Manager Dan Olson
- ☐ Dist. Maintenance Supervisor
- ☐ Materials, Portland
- x ☐ JC Compton Contractors
- x ☐ Files
- 3x Jim Wilson, G. Boyle, C. Hicks

RECOMMENDATION:

Material as represented by this sample does, does not comply with specifications.

Based on 7-29-86 Revised Design Criteria - 1.0% CMS-2S

W. J. Dennis

LABORATORY RECORD

HIGHWAY DIVISION — MATERIALS SECTION

Laboratory No. 8610628

Data Sheet No. AB-33702

E. A. C10218

Laboratory charge # 510 –

Date received 4/23/86

Date reported 7-31-86

Date sampled

PRELIMINARY COLD RECYCLE MIX DESIGN

Project Region 4 Recycle - Ochoco Dam - MP35

Highway Ochoco Unit "E" Design #1

Contractor J. C. Compton

Submitted by Dan Olson Unit Code # 8041

Source of Material MP. 24.9

Sampled or inspected at Roadway To be used In Place Cold Recycle A/C

Sampled or inspected by R.&R. Team Quantity represented

* Test Gradation: of Pavement grindings calculated to 100% Passing!:

P. 1" – 100 P. 3/8" – 73 P. #40 – 6

P. 3/4" – 98 P. 1/4" – 54 P. #200 – 1.2

P. 1/2" – 89 P. #10 – 22 * Milling report #86-5053

Resistance to Deformation and Cohesion: AASHTO – T-246 & 247 (A/C – 4.8; Pen – 23)

% Water / % Emulsion CMS-2S @ 67% residual	3.0 / 1.0	3.0 / 2.0	3.0 / 3.0	3.0 / 4.0
1st Compaction @ 140°F (After 15-24 hrs. Cure in Bread Pan @ 140°F)				
Hveem stability @ 77°F (Cured @ 140°F 15-24 hrs.)	47	44	29	20
Hveem stability @ 140°F (Cured @ 140°F 15-24 hrs.)	29	26	15	5
Hveem stability @ 140°F after 2nd Comp. (Compacted after 3-4 hrs. @ 240°F)	36	15	4	3
Bulk Specific Gravity – 1st Comp.	2.21	2.24	2.27	2.30
Bulk Specific Gravity – 2nd Comp.	2.24	2.27	2.29	2.31
Bulk Specific Gravity – 3rd Comp.	2.36	2.38	2.39	2.38
Percent Voids @ 3rd Comp.	2.5	1.0	0.0	0.0
Rice Method Real Gravity	2.421	2.403	2.388	2.384
Asphalt Film Thickness	Dry	Suff.	Suff-Th.	Thick
Unconditioned Resilient Modulus ($\times 10^3$) –	265.2	338.2	317.8	328.4
Vac. Sat. Resilient Modulus ($\times 10^3$) –	215.9	338.1	338.8	320.0
Freeze-Thaw Resilient Modulus ($\times 10^3$) –	60.2	104.1	131.5	151.4
M_R Ratio 1 (Vac. Sat./Uncond.) –	81%	100%	107%	97%
M_R Ratio 2 (Freeze-Thaw/Uncond.) –	23%	31%	41%	46%

Recommended water addition (Based on milling dry weight) – 3.0%

" Emulsion content " " " " " – 2.0%

REPORT TO:

- x JC Compton Contractors
- x - RJ VanCleave
- x Construction Engineer
- Maintenance Engineer
- Bridge Engineer
- x Region 4 RAS
- x Project Manager Dan Olson
- Dist. Maintenance Supervisor
- 3x Materials, Portland G. Hicks, G. Boyle, J. Wilson
- x Files

RECOMMENDATION:

Material as represented by this sample does, does not comply with specifications.

Based on 7-29-86 Revised Design Criteria – 1.0% CMS-2S

W. J. Dawson

LABORATORY RECORD
HIGHWAY DIVISION — MATERIALS SECTION

Laboratory No. 8610629
Data Sheet No. AB-33703
E. A. C10218
Laboratory charge * 510 -

PRELIMINARY COLD RECYCLE MIX DESIGN

Project Region 4 Recycle - Ochoco Dam - MP. 35
Highway Ochoco Unit "E" Design #2
Contractor J. C. Compton
Date received 4/23/86
Submitted by Dan Olson Unit Code # 8041
Date reported 7-31-86
Source of Material MP. 27.4
Date sampled
Sampled or inspected at Roadway To be used In Place Cold Recycle A/C
Sampled or inspected by R. & R. Team Quantity represented

* Test Gradation: of Pavement grindings calculated To 100% Passing 1".

P. 1" - 100	P. 3/8" - 69	P. #40 - 5
P. 3/4" - 98	P. 1/4" - 51	P. #200 - 1.0
P. 1/2" - 84	P. #10 - 19	* Milling report # 86-5054

Resistance to Deformation and Cohesion: AASHTO - T-246 & 247 (A/C - 5.2; Pen - 15)

% Water / % Emulsion CMS-2S @ 67% residual	3.0 / 1.0	3.0 / 2.0	3.0 / 3.0	3.0 / 4.0
1st Compaction @ 140°F (After 15-24 hrs. Cure in Bread Pan @ 140°F)				
Hveem stability @ 77°F (Cured @ 140°F 15-24 hrs.)	40	31	31	26
Hveem stability @ 140°F (Cured @ 140°F 15-24 hrs.)	16	17	17	14
Hveem stability @ 140°F after 2nd Comp. (Compacted after 3-4 hrs. @ 240°F)	13	20	2	1
Bulk Specific Gravity - 1st Comp.	2.08	2.10	2.12	2.14
Bulk Specific Gravity - 2nd Comp.	2.14	2.17	2.19	2.21
Bulk Specific Gravity - 3rd Comp.	2.36	2.38	2.39	2.37
Percent Voids @ 3rd Comp.	2.8	1.5	0.3	0.8
Rice Method Real Gravity	2.427	2.416	2.396	2.377
Asphalt Film thickness	Dry	Dry-Suff	Suff.	Thick
Unconditioned Resilient Modulus (x 10^3) -	133.5	159.4	175.7	178.6
Vac. Sat. Resilient Modulus (x 10^3) -	68.9	89.1	79.4	98.3
Freeze-Thaw Resilient Modulus (x 10^3) -	Too Soft	Too Soft	Too Soft	65.9
M_R Ratio 1 (Vac. Sat./Uncond.) -	52%	56%	45%	55%
M_R Ratio 2 (Freeze-Thaw/Uncond.) -	—	—	—	37%

Recommended Water addition (Based on Milling dry weight - 3.0%
" Emulsion content " " " " " - 2.5%

REPORT TO:
- x JC Compton Contractors
- x RJ VanCleave
- x ☑ Construction Engineer
- ☐ Maintenance Engineer
- ☐ Bridge Engineer
- x ☐ Region ~~Engineer~~ 4 RAS
- x ☐ Project Manager Dan Olson
- ☐ Dist. Maintenance Supervisor
- ☐ Materials, Portland
- 3x ☐ G. Boyle, J. Wilson, G. Hicks
- x ☑ Files

RECOMMENDATION:

Material as represented by this sample does, does not comply with specifications.

Based on 7-29-86 revised Design Criteria - 1.0% CMS-2S

W. J. Olson

LABORATORY RECORD
HIGHWAY DIVISION — MATERIALS SECTION

Laboratory No. 8612742
Data Sheet No. AB33704
E. A. C10218
Laboratory charge # 510 00

PRELIMINARY COLD RECYCLE MIX DESIGN

Project Region 4 Recycle - Ochoco Dam - MP35.00
Highway Ochoco Unit "E" Design # 3
Contractor JC Compton
Submitted by Dan Olson Unit Code # 8041
Source of Material MP 29.0, MP 29.1
Sampled or inspected at Roadway To be used In Place Cold Recycle A/C
Sampled or inspected by R&R Team Quantity represented

Date received 4/23/86
Date reported 8.19.86
Date sampled 4/21/86

*Test Gradation: of pavement grindings calculated to 100% Passing 1"

P. 1" – 100	P. 3/8" – 59	P. #40 – 3
P. 3/4 – 96	P. 1/4" – 41	P. #200 – 0.4
P. 1/2 – 77	P. #10 – 14	* Milling report #86-5055

Resistance to Deformation and Cohesion: AASHTO - T-246 & 247 (A/C-5.8 Pen - 21)

% Water / % Emulsion CMS-2S @ 67% Residual	5.0 / 0.0	5.0 / 1.0	5.0 / 2.0	5.0 / 3.0
1st Compaction @ 140°F (After 15-24 hrs. Cure in Bread Pan @ 140°F)				
Hveem stability @ 77°F (Cured @ 140°F 15-24 hrs.)	49	46	31	31
Hveem stability @ 140°F (Cured @ 140°F 15-24 hrs.)	21	17	15	13
Hveem stability @ 140°F after 2nd Comp. (Compacted after 3-4 hrs. @ 240°F)	33	29	2	1
Bulk Specific Gravity - 1st Comp.	2.16	2.21	2.24	2.27
Bulk Specific Gravity - 2nd Comp.	2.18	2.23	2.26	2.29
Bulk Specific Gravity - 3rd Comp.	2.35	2.37	2.38	2.36
Percent Voids @ 3rd Comp.	3.5	1.5	0.2	0.4
Rice Method Real Gravity	2.436	2.405	2.384	2.369
Asphalt Film Thickness	Dry	Dry-Suff	Dry-Suff	Suff
Unconditioned Resilient Modulus (x 10^3) -	271.3	275.3	221.9	236.2
Vac. Sat. Resilient Modulus (x 10^3) -	199.3	228.2	168.4	192.8
Freeze-Thaw Resilient Modulus (x 10^3) -	95.6	159.6	136.3	165.5
M_R Ratio 1 (Vac. Sat./Uncond.) -	73 %	83 %	76 %	82 %
M_R Ratio 2 (Freeze-Thaw/Uncond.) -	35 %	58 %	61 %	70 %

Recommended water addition (based on milling dry weight) – 5.0%
" emulsion content " " " " " – 1.5%

REPORT TO:
- x ☐ RJ VanCleave
- ☐ F.H.W.A.
- x ☐ Construction Engineer
- x ☐ Reg. 4 RAS
- ☐ Bridge Engineer
- ☐ Region ~~Engineer~~
- x ☐ Project Manager Dan Olson
- ☐ Dist. Maintenance Supervisor
- ☐ Materials, Portland –
- x ☐ JC Compton Contractors
- 3x ☐ Files J. Wilson, G. Hicks, G. Boyle

RECOMMENDATION:

Material as represented by this sample does, does not comply with specifications.

Based on 7-29-86 Revised Design Criteria – 1.0% CMS-2S

W. J. Jennings

LABORATORY RECORD

HIGHWAY DIVISION — MATERIALS SECTION

Laboratory No. 8612743

Data Sheet No. AB33705

E. A. C10218

Laboratory charge $510.00

PRELIMINARY COLD RECYCLE MIX DESIGN

Project Region 4 Recycle - Ochoco Dam - MP35.00

Highway Ochoco Unit 'E' Design #4

Contractor JC Compton

Date received 4/23/86

Submitted by Dan Olson Unit Code # 8041

Date reported 8.19.86

Source of Material MP 31.0, MP 31.05

Date sampled 4/21/86

Sampled or inspected at Roadway To be used In Place Cold Recycle A/C

Sampled or inspected by R & R Team Quantity represented

*Test Gradation: of pavement grindings calculated to 100% Passing 1"

P. 1" – 100	P. 3/8" – 78	P. #40 – 5
P. 3/4" – 98	P. 1/4" – 56	P. #200 – 0.7
P. 1/2" – 93	P. #10 – 22	* Milling report #86-5056

Resistance to Deformation and Cohesion: AASHTO - T-246 & 247 (A/C – 5.1 ; Pen - 12)

% Water / % Emulsion CMS-2S @ 67% Residual	5.0 / 0.0	5.0 / 1.0	5.0 / 2.0	5.0 / 3.0
1st Compaction @ 140°F (After 15-24 hrs. Cure in Bread Pan @ 140°F)				
Hveem stability @ 77°F (Cured @ 140°F 15-24 hrs.)	42	47	40	35
Hveem stability @ 140°F (Cured @ 140°F 15-24 hrs.)	42	22	19	16
Hveem stability @ 140°F after 2nd Comp. (Compacted after 3-4 hrs. @ 240°F)	43	16	6	1
Bulk Specific Gravity - 1st Comp.	2.15	2.21	2.27	2.34
Bulk Specific Gravity - 2nd Comp.	2.18	2.25	2.31	2.36
Bulk Specific Gravity - 3rd Comp.	2.43	2.48	2.49	2.47
Percent Voids @ 3rd Comp.	4.9	1.7	0.4	0.3
Rice Method Real Gravity	2.555	2.524	2.500	2.478
Asphalt Film Thickness	DRY	DRY - SUFF	SUFF	SUFF
Unconditioned Resilient Modulus (x 10^3) -	251.3	364.1	353.3	409.7
Vac. Sat. Resilient Modulus (x 10^3) -	91.6	242.7	276.0	317.9
Freeze-Thaw Resilient Modulus (x 10^3) -	–	103.2	176.2	234.3
M_R Ratio 1 (Vac. Sat./Uncond.) -	36%	67%	78%	78%
M_R Ratio 2 (Freeze-Thaw/Uncond.) -	–	28%	50%	58%

Recommended water addition (Based on milling dry weight) – 5.0%

" emulsion content " " " " " – 1.5%

REPORT TO:

- x ☐ RJ VanCleave
- ☐ F.H.W.A.
- x ☐ Construction Engineer
- ☐ Maintenance Engineer
- x ☐ Reg. 4 RAS
- ☐ Region Engineer
- x ☐ Project Manager Dan Olson
- ☐ Dist. Maintenance Supervisor
- x ☐ JC Compton Contractors
- ☐ Materials, Eugene
- x ☐ Files

3x J. Wilson, G. Boyle, G. Hicks

RECOMMENDATION:

Material as represented by this sample does, does not comply with specifications.

Based on 7-29-86 Revised Design Criteria – 1.0% CMS-2S

W. J. Zuniga

LABORATORY RECORD

HIGHWAY DIVISION — MATERIALS SECTION

Laboratory No. 86 6880

Data Sheet No. AB-33706

PRELIMINARY COLD RECYCLE MIX DESIGN

E. A. C10218

Project Region 4 Recycle Project - Keyes Cr. Summit - Ochoco Unit "F" Design #1 Laboratory charge # 510 —

Highway

Contractor T.C. Compton Date received 4/23/86

Submitted by Dan Olson Unit Code # 8041 Date reported 5-29-86

Source of Material M.P. 75.0, 77.4 Date sampled

Sampled or inspected at roadway To be used In place Cold Recycle H/C

Sampled or inspected by R. & R. Team Quantity represented

* Test Gradation: of pavement grindings calculated To 100% Passing 1"

P 1" = 100	P. 3/8" = 62	P. #40 = 4
P 3/4" = 93	P. 1/4" = 42	P. #200 = 0.6
P 1/2" = 79	P. #10 = 12	*Millings Report # 86-5057

Resistance to Deformation and Cohesion: AASHTO - T-246 & 247

% Water / % Emulsion (CMS-2S @ 67% residual)	2S / 1.0	2S / 2.0	2S / 3.0	2S / 4.0
1st Compaction @ 140°F (After 15-24 hrs. Cure in Bread Pan @ 140°F)				
Hveem stability @ 77°F (Cured @ 140°F 15-24 hrs.)	50	51	39	34
Hveem stability @ 140°F (Cured @ 140°F 15-24 hrs.)	13	15	10	13
Hveem stability @ 140°F after 2nd Comp. (Compacted after 3-4 hrs. @ 240°F)	7	2	1	4
Bulk Specific Gravity - 1st Comp.	2.120	2.122	2.124	2.126
Bulk Specific Gravity - 2nd Comp.	2.125	2.127	2.129	2.128
Bulk Specific Gravity - 3rd Comp.	2.137	2.139	2.141	2.139
Percent Voids @ 3rd Comp.	5.0	3.6	1.8	2.2
Rice Method Real Gravity	2.496	2.480	2.455	2.444
Asphalt Film Thickness	Dry	Dry/Suff.	Suff.	Suff/Th.
Unconditioned Resilient Modulus (x 10^3) -	193.8	149.7	154.9	164.7
Vac. Sat. Resilient Modulus (x 10^3) -	111.0	180.0	133.6	143.9
Freeze-Thaw Resilient Modulus (x 10^3) -	fell apart	fell apart	127.7	140.1
M_R Ratio 1 (Vac. Sat./Uncond.) -	0.57	1.20	0.86	0.87
M_R Ratio 2 (Freeze-Thaw/Uncond.) -	fell apart	fell apart	0.82	0.85

Recommended water addition (based on millings dry weight) - 2.5%

" emulsion content " " " " " - 3.0% CMS-2S

REPORT TO:

- x Reg. 4 RAS
- ☐ F.H.W.A.
- x ☑ Construction Engineer
- ☐ Maintenance Engineer
- ☐ Bridge Engineer
- ☐ Region Engineer
- x ☐ Project Manager Dan Olson
- x ☐ Dist. Maintenance Supervisor
- ☐ Materials, Portland
- ☐ Materials, Eugene
- 3x ☑ Files J. Wilson, G. Boyle, G. Hicks

RECOMMENDATION:

Material as represented by this sample does, does not comply with specifications.

Jack Sullivan

LABORATORY RECORD

HIGHWAY DIVISION — MATERIALS SECTION

Laboratory No. '86 6881

Data Sheet No. AB-33707

E. A. C10218

Laboratory charge A383

PRELIMINARY COLD RECYCLE MIX DESIGN

Project Region 4 Recycle Project - Key Cr. Summit-Antone

Highway Ochoco Unit "F" Design #2

Contractor J.C. Compton

Date received 4/23/86

Submitted by Dan Olson Unit Code # 8041

Date reported 5.29.86

Source of Material M.P. 81.3

Date sampled

Sampled or inspected at roadway

To be used In place Cold Recycle A/C

Sampled or inspected by R.&R. Team

Quantity represented

*Test Gradation: of pavement grindings calculated TO 100% Passing 1"

P. 1" = 100	P. 3/8" = 50	P. #40 = 2
P. 3/4" = 94	P. 1/4" = 31	P. #200 = 0.4
P. 1/2" = 75	P. #10 = 9	*Millings Report # 86-5058

Resistance to Deformation and Cohesion: AASHTO - T-246 & 247

% Water / % Emulsion (CMS-2S @ 67% residual)	2.5 / 1.0	2.5 / 2.0	2.5 / 3.0
1st Compaction @ 140°F (After 15-24 hrs. Cure in Bread Pan @ 140°F)			
Hveem stability @ 77°F (Cured @ 140°F 15-24 hrs.)	28	27	24
Hveem stability @ 140°F (Cured @ 140°F 15-24 hrs.)	16	10	13
Hveem stability @ 140°F after 2nd Comp. (Compacted after 3-4 hrs. @ 240°F)	25	2	3
Bulk Specific Gravity - 1st Comp.	2.130	2.32	2.35
Bulk Specific Gravity - 2nd Comp.	2.35	2.37	2.42
Bulk Specific Gravity - 3rd Comp.	2.48	2.50	2.51
Percent Voids @ 3rd Comp.	2.0	0.8	0.0
Rice Method Real Gravity	2.531	2.520	2.511
Asphalt Film Thickness	Suff.	Suff/Th.	Thick
Unconditioned Resilient Modulus (x 10^3) -	147.1	157.4	188.7
Vac. Sat. Resilient Modulus (x 10^3) -	121.9	163.9	151.2
Freeze-Thaw Resilient Modulus (x 10^3) -	fell apart	103.5	93.1
M_R Ratio 1 (Vac. Sat./Uncond.) -	0.83	1.04	0.80
M_R Ratio 2 (Freeze-Thaw/Uncond.) -	fell apart	0.66	0.49

Recommended water addition (based on millings dry weight) - 2.5%

" emulsion content " " " " " - 2.0% CMS-2S

REPORT TO:

- x Reg. 4 RAS
- ☐ F.H.W.A.
- x ☑ Construction Engineer
- ☐ Maintenance Engineer
- ☐ Bridge Engineer
- ☐ Region Engineer
- x ☐ Project Manager Dan Olson
- x ☐ Dist. Maintenance Supervisor
- ☐ Materials, Portland
- ☐ Materials, Eugene
- x ☐ Files

3x J. Wilson, G. Boyle, G. Hicks

RECOMMENDATION:

Material as represented by this sample does, does not comply with specifications.

Jack Sullivan

LABORATORY RECORD

HIGHWAY DIVISION — MATERIALS SECTION

Laboratory No. 86 6864

Data Sheet No. AB-33708

PRELIMINARY COLD RECYCLE MIX DESIGN

E. A. C10218

Project Region 4 Recycle Project - MP 90.5 - Jct ORE19 Laboratory charge #510 —

Highway Ochoco Unit G Design #1

Contractor J.C. Compton Date received 4/23/86

Submitted by Dan Olson Unit Code # 8041 Date reported 5.29.86

Source of Material M.P. 92.1, 93.9 and 97.0 Date sampled

Sampled or inspected at roadway To be used Inplace Cold Recycle A/C

Sampled or inspected by R. & R Team Quantity represented

*Test Gradation: of pavement grindings calculated to 100% Passing 1"

P. 1" = 100	P. 3/8" = 69	P. #40 = 6
P. 3/4" = 95	P. 1/4" = 51	P. #200 = 1.1
P. 1/2" = 82	P. #10 = 20	*Millings Report #86-5059

Resistance to Deformation and Cohesion: AASHTO - T-246 & 247

% Water / % Emulsion (CMS-2S @ 67% residue)	2.5 / 1.0	2.5 / 2.0	2.5 / 3.0	2.5 / 4.0
1st Compaction @ 140°F (After 15-24 hrs. Cure in Bread Pan @ 140°F)				
Hveem stability @ 77°F (Cured @ 140°F 15-24 hrs.)	64	52	59	45
Hveem stability @ 140°F (Cured @ 140°F 15-24 hrs.)	29	16	16	14
Hveem stability @ 140°F after 2nd Comp. (Compacted after 3-4 hrs. @ 240°F)	20	4	1	1
Bulk Specific Gravity - 1st Comp.	2.29	2.31	2.33	2.35
Bulk Specific Gravity - 2nd Comp.	2.29	2.33	2.36	2.38
Bulk Specific Gravity - 3rd Comp.	2.45	2.47	2.50	2.48
Percent Voids @ 3rd Comp.	4.5	2.0	0.5	0.3
Rice Method Real Gravity	2.566	2.546	2.512	2.488
Asphalt Film Thickness	V. Dry	Dry/Suff	Suff.	Suff/Thick
Unconditioned Resilient Modulus (x 10^3) -	281.4	330.3	354.6	363.5
Vac. Sat. Resilient Modulus (x 10^3) -	127.2	197.0	249.9	278.8
Freeze-Thaw Resilient Modulus (x 10^3) -	fell apart	49.9	87.2	194.0
M_R Ratio 1 (Vac. Sat./Uncond.) -	0.45	0.60	0.70	0.77
M_R Ratio 2 (Freeze-Thaw/Uncond.) -	fell apart	0.15	0.25	0.53

Recommended water addition (based on millings dry weight) - 2.5%

" emulsion content " " " " " -3.0% CMS-2S

REPORT TO:

- x ☐ Reg. 4 RAS
- ☐ F.H.W.A.
- x ☐ Construction Engineer
- ☐ Maintenance Engineer
- ☐ Bridge Engineer
- ☐ Region Engineer
- x ☐ Project Manager Dan Olson
- x ☐ Dist. Maintenance Supervisor
- ☐ Materials, Portland
- ☐ Materials, Eugene
- 3x ☐ Files J. Wilson, G. Boyle, G. Hicks

RECOMMENDATION:

Material as represented by this sample does, does not comply with specifications.

Jack Sullivan

LABORATORY RECORD

HIGHWAY DIVISION — MATERIALS SECTION

Laboratory No. 86 7680

Data Sheet No. AR-33717

E. A. C10274

PRELIMINARY COLD RECYCLE MIX DESIGN

Project District 10 #11 Recycling - MP 75-84 Laboratory charge # 510 -

Highway Central Oregon Unit 'A' Design #1 Test set. #1

Contractor Valentine Const. Date received 5/19/86

Submitted by Dan Olson Unit Code # 8041 Date reported 6-11-86

Source of Material MP. 77.2 Date sampled

Sampled or inspected at roadway To be used In Place Cold Recycle A/C

Sampled or inspected by R. & R. Team Quantity represented

X Test Gradation: of Pavement grindings calculated to 100% Passing 1"

P. 1" - 100 P. 3/8" - 84 P. #40 - 10

P. 3/4" - 99 P. 1/4" - 69 P. #200 - 1.2

P. 1/2" - 92 P. #10 - 30 *millings Report #86-6580

Resistance to Deformation and Cohesion: AASHTO - T-246 & 247

% Water / % Emulsion (CMS-2S @ 67% residue)	3.0 / 1.0	3.0 / 2.0	3.0 / 3.0	3.0 / 4.0
1st Compaction @ 140°F (After 15-24 hrs. Cure in Bread Pan @ 140°F)				
Hveem stability @ 77°F (Cured @ 140°F 15-24 hrs.)	47	52	43	41
Hveem stability @ 140°F (Cured @ 140°F 15-24 hrs.)	27	31	29	16
Hveem stability @ 140°F after 2nd Comp. (Compacted after 3-4 hrs. @ 240°F)	12	8	3	1
Bulk Specific Gravity - 1st Comp.	1.93	1.95	1.97	2.00
Bulk Specific Gravity - 2nd Comp.	2.01	2.03	2.05	2.07
Bulk Specific Gravity - 3rd Comp.	2.14	2.15	2.16	2.16
Percent Voids @ 3rd Comp.	3.3	2.1	1.1	0.5
Rice Method Real Gravity	2.214	2.196	2.184	2.161
Asphalt Film Thickness & % coated	Dry-Suff-70%	Dry-Suff-75%	Suff-85%	Suff-90%
Unconditioned Resilient Modulus (x 10^3) -				
Vac. Sat. Resilient Modulus (x 10^3) -				
Freeze-Thaw Resilient Modulus (x 10^3) -				
M_R Ratio 1 (Vac. Sat./Uncond.) -				
M_R Ratio 2 (Freeze-Thaw/Uncond.) -				

Recommended Water addition (based on millings dry weight) - 3.0%

" Emulsion content " " " " ") - 2.0%

REPORT TO:

- x ☐ Reg. 4 RAS
- ☐ F.H.W.A.
- x ☐ Construction Engineer
- ☐ Maintenance Engineer
- 2x ☐ J. Wilson, G. Boyle
- ☐ Region Engineer
- x ☐ Project Manager Dan Olson
- ☐ Dist. Maintenance Supervisor
- ☐ Materials, Portland
- ☐ Materials, Eugene
- x ☐ Files

RECOMMENDATION:

Material as represented by this sample does, does not comply with specifications.

W. J. Brown

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LABORATORY RECORD

HIGHWAY DIVISION — MATERIALS SECTION

Laboratory No. 86 7681
Data Sheet No. AB-3378
E. A. C10274
Laboratory charge $ 510 —

PRELIMINARY COLD RECYCLE MIX DESIGN

Project District 10 Recycle - MP 75-89
Highway Central Oregon Unit "A" Design #1
Contractor Valentine Const.
Submitted by Dan Olson Unit Code # 8041
Source of Material M.P. 81.0
Sampled or inspected at roadway To be used In Place Cold Recycle H/C
Sampled or inspected by
Date received 5/19/86
Date reported 6-11-86
Date sampled
Quantity represented

*Test Gradation: of Pavement grindings calculated TO 100% Passing 1"

P. 1" - 100	P. 3/8" - 82	P. #40 - 7
P. 3/4" - 99	P. 1/4" - 66	P. #200 - 0.7
P. 1/2" - 92	P. #10 - 27	* Millings Report #86-6581

Resistance to Deformation and Cohesion: AASHTO - T-246 & 247

% Water / % Emulsion (CMS-2S @ 67% residual)	3.0 / 1.0	3.0 / 2.0	3.0 / 3.0	3.0 / 4.0
1st Compaction @ 140°F (After 15-24 hrs. Cure in Bread Pan @ 140°F)				
Hveem stability @ 77°F (Cured @ 140°F 15-24 hrs.)	46	60	49	42
Hveem stability @ 140°F (Cured @ 140°F 15-24 hrs.)	24	25	19	15
Hveem stability @ 140°F after 2nd Comp. (Compacted after 3-4 hrs. @ 240°F)	9	9	3	1
Bulk Specific Gravity - 1st Comp.	1.92	1.95	1.97	2.00
Bulk Specific Gravity - 2nd Comp.	1.98	2.00	2.02	2.05
Bulk Specific Gravity - 3rd Comp.	2.12	2.13	2.14	2.14
Percent Voids @ 3rd Comp.	3.7	2.1	0.7	0.2
Rice Method Real Gravity	2.202	2.174	2.155	2.144
Asphalt Film Thickness & % coated	Dry - 45%	Dry - 60%	Dry, Suff - 75%	Suff - 85%
Unconditioned Resilient Modulus (x 10^3) -				
Vac. Sat. Resilient Modulus (x 10^3) -				
Freeze-Thaw Resilient Modulus (x 10^3) -				
M_R Ratio 1 (Vac. Sat./Uncond.) -				
M_R Ratio 2 (Freeze-Thaw/Uncond.) -				

Recommended Water addition (based on millings dry weight) - 3.0%
" emulsion content " " " " " " - 2.5%

REPORT TO:
- x ☐ Reg. 4 RAS
- ☐ F.H.W.A.
- x ☐ Construction Engineer
- ☐ Maintenance Engineer
- 2x ☐ J. Wilson, G. Boyle
- ☐ Region Engineer
- x ☐ Project Manager Dan Olson
- ☐ Dist. Maintenance Supervisor
- ☐ Materials, Portland
- ☐ Materials, Eugene
- x ☐ Files

RECOMMENDATION:
Material as represented by this sample does, does not comply with specifications.

W. J. Brunner

LABORATORY RECORD

HIGHWAY DIVISION — MATERIALS SECTION

Laboratory No. 86 10584

Data Sheet No. AB-33709

PRELIMINARY COLD RECYCLE MIX DESIGN

E. A. C10274

Project District 10&11 - Green Springs Jct - Lakeshore Dr. Laboratory charge 510 -

Highway Lake of the Woods Unit "B", Area #1

Contractor C. Valentine Date received 5/2/86

Submitted by Dan Olson Unit Code # 8041 Date reported 7.31.86

Source of Material MP. 66.7 Date sampled

Sampled or inspected at Roadway To be used In Place Cold Recycle A/C

Sampled or inspected by R.&R. Team Quantity represented

* Test Gradation: of Pavement grindings calculated to 100% Passing 1".

P. 1" - 100	P. 3/8" - 84	P. #40 - 8
P. 3/4" - 98	P. 1/4" - 68	P. #200 - 2.3
P. 1/2" - 93	P. #10 - 26	*Millings report #86-6394

Resistance to Deformation and Cohesion: AASHTO - T-246 & 247 (A/C = 5.1; Pen = 2)

% Water / % Emulsion CMS-2S @ 67% residue	4.0 / 0.0	4.0 / 1.0	4.0 / 2.0	4.0 / 3.0	4.0 / 4.0
1st Compaction @ 140°F (After 15-24 hrs. Cure in Bread Pan @ 140°F)					
Hveem stability @ 77°F (Cured @ 140°F 15-24 hrs.)	39	54	57	51	50
Hveem stability @ 140°F (Cured @ 140°F 15-24 hrs.)	17	19	21	13	14
Hveem stability @ 140°F after 2nd Comp. (Compacted after 3-4 hrs. @ 240°F)	37	40	23	1	1
Bulk Specific Gravity - 1st Comp.	2.13	2.18	2.22	2.25	2.27
Bulk Specific Gravity - 2nd Comp.	2.17	2.20	2.25	2.28	2.31
Bulk Specific Gravity - 3rd Comp.	2.36	2.36	2.39	2.41	2.43
Percent Voids @ 3rd Comp.	6.8	5.7	3.7	2.2	0.5
Rice Method Real Gravity	2.532	2.503	2.482	2.464	2.441
Asphalt Film Thickness	Dry	Dry	Dry +	Dry-Suff.	Suff.
Unconditioned Resilient Modulus (x 10^3) -	—	922.8	794.3	821.4	540.6
Vac. Sat. Resilient Modulus (x 10^3) -	—	453.6	533.5	651.9	493.2
Freeze-Thaw Resilient Modulus (x 10^3) -	—	167.5	304.6	376.7	367.4
M_R Ratio 1 (Vac. Sat./Uncond.) -	—	49%	67%	79%	91%
M_R Ratio 2 (Freeze-Thaw/Uncond.) -	—	18%	38%	46%	68%

Recommended Water addition (Based on milling dry weight) - 4.0%

" Emulsion content " " " " " - 3.0%

REPORT TO:

x JC Compton Contractors
x ☐ R.J VanCleave
x ☑ Construction Engineer
☐ Maintenance Engineer
☐ Bridge Engineer
x ☑ Region Engineer x 4 RAS
x ☑ Project Manager Dan Olson
☐ Dist. Maintenance Supervisor
☐ Materials, Portland
3x ☐ J. Wilson, G. Boyle, G. Hicks
x ☑ Files

RECOMMENDATION:

Material as represented by this sample does, does not comply with specifications.

Based on 7-29-86 R.U.I.S.D. Design Criteria - 1.4 % CMS-2S

W. J. Gruin

LABORATORY RECORD

HIGHWAY DIVISION — MATERIALS SECTION

Laboratory No. 8610585

Data Sheet No. AB-33712

E. A. C10274

PRELIMINARY COLD RECYCLE MIX DESIGN

Project District 10&11 - Green Springs Jct - Lake Shore Dr. Laboratory charge 7510-

Highway Lake of the Woods Unit "B" Test Sec. #1

Contractor C. Valentine Date received 5/2/86

Submitted by Dan Olson Unit Code # 8041 Date reported 7.31.86

Source of Material M.P. 63.0 - 63.19 Date sampled

Sampled or inspected at Roadway To be used In Place Cold Recycle H/C

Sampled or inspected by R. & R. Team Quantity represented

*Test Gradation: of Pavement grindings calculated to 100% Passing 1".

P. 1" - 100	P. 3/8" - 81	P. #40 - 6
P. 3/4" - 98	P. 1/4" - 62	P. #200 - 2.0
P. 1/2" - 91	P. #10 - 21	* millings report #86-6397

Resistance to Deformation and Cohesion: AASHTO - T-246 & 247 (W/C - 4.6, Pen - 4)

% Water / % Emulsion CMS-2S @ 67% residual	4.0 / 0.0	4.0 / 1.0	4.0 / 2.0	4.0 / 3.0
1st Compaction @ 140°F (After 15-24 hrs. Cure in Bread Pan @ 140°F)				
Hveem stability @ 77°F (Cured @ 140°F 15-24 hrs.)	30	31	31	27
Hveem stability @ 140°F (Cured @ 140°F 15-24 hrs.)	23	20	16	15
Hveem stability @ 140°F after 2nd Comp. (Compacted after 3-4 hrs. @ 240°F)	45	45	22	15
Bulk Specific Gravity - 1st Comp.	2.03	2.06	2.09	2.13
Bulk Specific Gravity - 2nd Comp.	2.11	2.14	2.17	2.20
Bulk Specific Gravity - 3rd Comp.	2.39	2.42	2.44	2.46
Percent Voids @ 3rd Comp.	6.7	4.2	2.2	0.8
Rice Method Real Gravity	2.563	2.526	2.496	2.481
Asphalt Film Thickness / % coated	— / —	Dry / 10%	Dry+ / 25%	Dry+ / 60%
Unconditioned Resilient Modulus (x 10^3) -	80.0	87.0	197.6	158.2
Vac. Sat. Resilient Modulus (x 10^3) -	Too	Too	103.2	118.9
Freeze-Thaw Resilient Modulus (x 10^3) -	Soft	Soft	Too Soft	36.2
M_R Ratio 1 (Vac. Sat./Uncond.) -			52%	75%
M_R Ratio 2 (Freeze-Thaw/Uncond.) -			—	23%

Recommended Water addition (Based on millings dry weight) - 4.0%

" Emulsion content " " " " " - 3.5%

REPORT TO:

- x JC Compton Contractors
- x ☐ RJ VanCleave
- x ☐ Construction Engineer
- ☐ Maintenance Engineer
- ☐ Bridge Engineer
- x ☐ Region Engineer 4 RAS
- x ☐ Project Manager Dan Olson
- ☐ Dist. Maintenance Supervisor
- ☐ Materials, Portland
- 3x ☐ J. Wilson, G. Hicks, G. Boyle
- x ☐ Files

RECOMMENDATION:

Material as represented by this sample does, does not comply with specifications.

Based on 7-29-86 Revised Design Criteria - 1.0% CMS-2S

W. J. Zunino

LABORATORY RECORD

HIGHWAY DIVISION — MATERIALS SECTION

Laboratory No. 86 10586

Data Sheet No. AB-33711

E. A. C10274

Laboratory charge # 510-

PRELIMINARY COLD RECYCLE MIX DESIGN

Project District 10#1 - Green Springs - Lakeshore Dr.

Highway Lake of the Woods Unit "B", Test Sec. #2

Contractor C. Valentine

Date received 5/2/86

Submitted by Dan Olson Unit Code # 8041 Date reported 7-31-86

Source of Material MP. 63.4

Date sampled

Sampled or inspected at Roadway To be used In Place Cold Recycle A/C

Sampled or inspected by R.&R. Team Quantity represented

* Test Gradation: of Pavement grindings calculated To 100% Passing 1":

P. 1" - 100 P. 3/8" - 77 P. #40 - 7

P. 3/4" - 96 P. 1/4" - 60 P. #200 - 2.4

P. 1/2" - 88 P. #10 - 21 * Milling report #86-6396

Resistance to Deformation and Cohesion: AASHTO - T-246 & 247 (W/C - 4.4; Pen - 4)

% Water / % Emulsion CMS-2S @ 67% residual	4.0 / 0.0	4.0 / 1.0	4.0 / 2.0	4.0 / 3.0
1st Compaction @ 140°F (After 15-24 hrs. Cure in Bread Pan @ 140°F)				
Hveem stability @ 77°F (Cured @ 140°F 15-24 hrs.)	72	78	76	76
Hveem stability @ 140°F (Cured @ 140°F 15-24 hrs.)	34	42	33	30
Hveem stability @ 140°F after 2nd Comp. (Compacted after 3-4 hrs. @ 240°F)	57	57	42	8
Bulk Specific Gravity - 1st Comp.	2.20	2.24	2.28	2.35
Bulk Specific Gravity - 2nd Comp.	2.21	2.25	2.30	2.36
Bulk Specific Gravity - 3rd Comp.	2.37	2.40	2.43	2.47
Percent Voids @ 3rd Comp.	7.6	5.7	3.6	1.0
Rice Method Real Gravity	2.565	2.545	2.522	2.495
Asphalt Film Thickness / % coated	Dry / 55%	Dry/Soft / 60+%	Soft. / 70%	Soft. / 85%
Unconditioned Resilient Modulus (x 10^3) -	457.0	752.0	867.9	1,064.5
Vac. Sat. Resilient Modulus (x 10^3) -	166.7	474.0	668.3	948.3
Freeze-Thaw Resilient Modulus (x 10^3) -	29.9	151.5	239.0	524.8
M_R Ratio 1 (Vac. Sat./Uncond.) -	36%	63%	77%	89%
M_R Ratio 2 (Freeze-Thaw/Uncond.) -	7%	20%	28%	49%

Recommended water addition (Based on milling dry weight) - 4.0%

" Emulsion content " " " " " - 2.5%

REPORT TO:

- x JC Compton Contractors
- x RJ VanCleave
- x Construction Engineer
- Maintenance Engineer
- Bridge Engineer
- x Region Engineer 4 RAS
- x Project Manager Dan-Olson
- Dist. Maintenance Supervisor
- Materials, Portland
- 3x G. Boyle, G. Hicks, J. Wilson
- x Files

RECOMMENDATION:

Material as represented by this sample does, does not comply with specifications.

Based on 7-29-86 Revised Design Criteria - 1.3% CMS-2S

LABORATORY RECORD

HIGHWAY DIVISION — MATERIALS SECTION

Laboratory No. 86 10587

Data Sheet No. AB-33710

E. A. C-10274

Laboratory charge # 510 -

PRELIMINARY COLD RECYCLE MIX DESIGN

Project District 10 #11 - Green Springs — Lakeshore Dr.

Highway Lake of The Woods Unit "B", Test Sec. 3

Contractor C. Valentine

Date received 5/2/86

Submitted by Dan Olson Unit Code # 8041 Date reported 7-31-86

Source of Material MP. 63.65

Date sampled

Sampled or inspected at Roadway To be used In Place Cold Recycle A/C

Sampled or inspected by R. & R. Team Quantity represented

* Test Gradation: of Pavement grindings calculated to 100% Passing 1":

P. 1" - 100	P. 3/8" - 80	P. #40 - 8
P. 3/4" - 97	P. 1/4" - 61	P. #200 - 1.9
P. 1/2" - 89	P. #10 - 23	*milling report #86-6395

Resistance to Deformation and Cohesion: AASHTO - T-246 & 247 (W/C - 5.1; Run - 5)

% Water / % Emulsion CMS-2S @ 67% residual	4.0 / 0.0	4.0 / 1.0	4.0 / 2.0	4.0 / 3.0
1st Compaction @ 140°F (After 15-24 hrs. Cure in Bread Pan @ 140°F)				
Hveem stability @ 77°F (Cured @ 140°F 15-24 hrs.)	73	76	75	73
Hveem stability @ 140°F (Cured @ 140°F 15-24 hrs.)	38	34	27	25
Hveem stability @ 140°F after 2nd Comp. (Compacted after 3-4 hrs. @ 240°F)	54	47	43	40
Bulk Specific Gravity - 1st Comp.	2.21	2.24	2.27	2.32
Bulk Specific Gravity - 2nd Comp.	2.22	2.26	2.30	2.34
Bulk Specific Gravity - 3rd Comp.	2.36	2.41	2.43	2.45
Percent Voids @ 3rd Comp.	9.1	6.0	4.2	2.4
Rice Method Real Gravity	2.596	2.565	2.536	2.509
Asphalt Film Thickness / % coated	Dry / 60%	Dry+ / 70%	Dry+ / 80%	Surface / 90%
Unconditioned Resilient Modulus (x 10^3) -	568.4	636.8	787.0	909.8
Vac. Sat. Resilient Modulus (x 10^3) -	340.0	459.3	739.9	895.5
Freeze-Thaw Resilient Modulus (x 10^3) -	34.3	100.0	408.4	643.6
M_R Ratio 1 (Vac. Sat./Uncond.) -	60%	72%	94%	98%
M_R Ratio 2 (Freeze-Thaw/Uncond.) -	6%	16%	52%	71%

Recommended Water addition (Based on milling dry weight) - 4.0%

" Emulsion content " " " " " - 2.5%

REPORT TO:

- x ☐ JC Compton Contractors
- x ☐ RJ VanCleave
- x ☐ Construction Engineer
- ☐ Maintenance Engineer
- ☐ Bridge Engineer
- x ☐ Region Engineer 4 RAS
- x ☐ Project Manager Dan Olson
- ☐ Dist. Maintenance Supervisor
- ☐ Materials, Portland
- x ☐ G. Hicks, G. Boyle, J. Wilson
- x ☐ Files

RECOMMENDATION:

Material as represented by this sample does, does not comply with specifications.

Based on 7-29-86 Revised Design Criteria - 1.5% CMS-2S

W. J. [illegible]

LABORATORY RECORD

HIGHWAY DIVISION — MATERIALS SECTION

Laboratory No. 86 9092

Data Sheet No. AB-33713

E. A. C10274

Laboratory charge 510-

Date received 5/2/86

Date reported 7.11.86

Date sampled

PRELIMINARY COLD RECYCLE MIX DESIGN

Project District 10#11 - US97 - ORE 39

Highway Lower Klamath Unit "C"

Contractor C. Valentine

Submitted by Dan Olson Unit Code # 8041

Source of Material M.P. 1.5

Sampled or inspected at roadway To be used In Place Cold Recycle A/C

Sampled or inspected by R&R. Team Quantity represented

*Test Gradation: of Pavement grindings calculated to 100% Passing 1"

P. 1" - 100 P. 3/8" - 74 P #40 - 7

P. 3/4" - 96 P. 1/4" - 55 P. #200 - 1.8

P. 1/2" 85 P. #10 - 21 *millings report #86-6398

Resistance to Deformation and Cohesion: AASHTO - T-246 & 247 (A/C - 5.4; Pen = 6)

% Water / % Emulsion CMS-2S @ 67% residue	5.0 / 1.0	5.0 / 2.0	5.0 / 3.0	5.0 / 4.0
1st Compaction @ 140°F (After 15-24 hrs. Cure in Bread Pan @ 140°F)				
Hveem stability @ 77°F (Cured @ 140°F 15-24 hrs.)	71	73	69	74
Hveem stability @ 140°F (Cured @ 140°F 15-24 hrs.)	14	16	18	19
Hveem stability @ 140°F after 2nd Comp. (Compacted after 3-4 hrs. @ 240°F)	44	36	18	4
Bulk Specific Gravity - 1st Comp.	2.04	2.08	2.13	2.16
Bulk Specific Gravity - 2nd Comp.	2.14	2.16	2.18	2.20
Bulk Specific Gravity - 3rd Comp.	2.28	2.30	2.32	2.35
Percent Voids @ 3rd Comp.	6.7	4.8	3.3	1.1
Rice Method Real Gravity	2.444	2.417	2.399	2.375
Asphalt Film Thickness	Dry	Dry-Suff	Suff.	Suff-Th.
Unconditioned Resilient Modulus (x 10^3) -	447.4	508.7	682.6	656.1
Vac. Sat. Resilient Modulus (x 10^3) -	209.3	356.0	576.9	516.1
Freeze-Thaw Resilient Modulus (x 10^3) -	46.6	94.8	179.9	283.8
M_R Ratio 1 (Vac. Sat./Uncond.) -	47%	70%	85%	79%
M_R Ratio 2 (Freeze-Thaw/Uncond.) -	10%	19%	26%	43%

Recommended Water addition (Based on millings dry weight) — 5.0%

" Emulsion content " " " " " — 3.5%

REPORT TO:

- x ☐ Reg. 4 RAS
- x ☐ RJ VanCleave
- x ☑ Construction Engineer
- x ☐ J. Wilson
- x ☐ G. Boyle
- ☐ Region Engineer
- x ☐ Project Manager Dan Olson
- ☐ Dist. Maintenance Supervisor
- x ☐ Gary Hicks
- x ☐ JC Compton Co.
- ✓ ☐ Files

RECOMMENDATION:

Material as represented by this sample does, does not comply with specifications.

LABORATORY RECORD

HIGHWAY DIVISION — MATERIALS SECTION

Laboratory No. 86 9093

Data Sheet No. AB-33714

E. A. C-10274

Laboratory charge 7 510 -

PRELIMINARY COLD RECYCLE MIX DESIGN

Project District 10&11 - Dairy - Ritter Rd

Highway Klamath Falls-Lakeview Unit "D" Design #1

Contractor C. Valentine

Date received 5/2/86

Submitted by Dan Olson Unit Code # B041

Date reported 7-11-86

Source of Material MP 19.0 & 23.5

Date sampled

Sampled or inspected at roadway To be used In Place Cold Recycle A/C

Sampled or inspected by R&R Team Quantity represented

*Test Gradation: of Pavement grindings calculated to 100% Passing 1".

P. 1" - 100 P. 3/8" - 85 P. #40 - 6

P. 3/4" - 98 P. 1/4" - 65 P. #200 - 1.4

P. 1/2" - 94 P. #10 - 24 * millings report #86-6399

Resistance to Deformation and Cohesion: AASHTO - T-246 & 247 (A/C = 6.7; Pen = 16)

% Water / % Emulsion CMS-2S @ 67% residual	3.0 / 1.0	3.0 / 2.0	3.0 / 3.0	3.0 / 4.0
1st Compaction @ 140°F (After 15-24 hrs. Cure in Bread Pan @ 140°F)				
Hveem stability @ 77°F (Cured @ 140°F 15-24 hrs.)	45	25	16	6
Hveem stability @ 140°F (Cured @ 140°F 15-24 hrs.)	14	9	5	1
Hveem stability @ 140°F after 2nd Comp. (Compacted after 3-4 hrs. @ 240°F)	12	6	3	2
Bulk Specific Gravity - 1st Comp.	2.23	2.26	2.28	2.30
Bulk Specific Gravity - 2nd Comp.	2.26	2.28	2.30	2.31
Bulk Specific Gravity - 3rd Comp.	2.29	2.31	2.33	2.34
Percent Voids @ 3rd Comp.	4.6	3.0	1.4	0.2
Rice Method Real Gravity	2.400	2.382	2.364	2.345
Asphalt Film Thickness	Dry/Suff.	Suff.	Suff.	Suff+
Unconditioned Resilient Modulus (x 10^3) -	669.5	555.7	450.4	296.3
Vac. Sat. Resilient Modulus (x 10^3) -	720.6	652.3	564.0	408.6
Freeze-Thaw Resilient Modulus (x 10^3) -	220.8	247.6	324.3	256.2
M_R Ratio 1 (Vac. Sat./Uncond.) -	105%	117%	125%	138%
M_R Ratio 2 (Freeze-Thaw/Uncond.) -	33%	45%	72%	86%

Recommended Water addition (Based on millings dry weight) - 3.0%

" Emulsion content " " " " " " - 3.0%

REPORT TO:

- x ☐ Reg. 4 RAS
- x ☐ RJ VanCleave
- x ☑ Construction Engineer
- x ☐ J. Wilson
- ☐ Bridge Engineer
- ☑ Region ~~Engineer~~
- x ☑ Project Manager Dan Olson
- x ☐ ~~DE~~ Compton Inc.
- x ☐ G. Boyle
- x ☐ Gary Hicks

RECOMMENDATION:

Material as represented by this sample does, does not comply with specifications.

LABORATORY RECORD

HIGHWAY DIVISION — MATERIALS SECTION

Laboratory No. 86 9094

Data Sheet No. AB-33715

E. A. C10274

Laboratory charge # 510-

PRELIMINARY COLD RECYCLE MIX DESIGN

Project District 10&11 — Dairy — Ritter Rd

Highway Klamath Falls - Lakeview Unit "D" Design # 2

Contractor C. Valentine

Date received 5/2/86

Submitted by Dan Olson Unit Code # 8041

Date reported 7-11-86

Source of Material M.P. 23.5 - 25.0

Date sampled

Sampled or inspected at roadway To be used In Place Cold Recycle A/C

Sampled or inspected by R&R Team Quantity represented

X Test Gradation: of Pavement grindings calculated to 100% passing 1".

P. 1" - 100 P. 3/8" - 80 P. #40 - 7

P. 3/4" - 98 P. 1/4" - 63 P. #200 - 2.1

P. 1/2" - 92 P. #10 - 23 * Millings report #86-6400

Resistance to Deformation and Cohesion: AASHTO - T-246 & 247 (A/C = 5.5; Pen = 5)

% Water / % Emulsion CMS-2S @ 67% residual	3.0 / 1.0	3.0 / 2.0	3.0 / 3.0	3.0 / 4.0
1st Compaction @ 140°F (After 15-24 hrs. Cure in Bread Pan @ 140°F)				
Hveem stability @ 77°F (Cured @ 140°F 15-24 hrs.)	65	45	36	29
Hveem stability @ 140°F (Cured @ 140°F 15-24 hrs.)	19	18	22	10
Hveem stability @ 140°F after 2nd Comp. (Compacted after 3-4 hrs. @ 240°F)	62	52	10	5
Bulk Specific Gravity - 1st Comp.	2.13	2.16	2.19	2.22
Bulk Specific Gravity - 2nd Comp.	2.18	2.21	2.24	2.27
Bulk Specific Gravity - 3rd Comp.	2.34	2.36	2.38	2.39
Percent Voids @ 3rd Comp.	4.9	3.4	1.8	0.1
Rice Method Real Gravity	2.460	2.443	2.424	2.392
Asphalt Film thickness	Dry	Suff.	Suff.	Suff.+
Unconditioned Resilient Modulus (x 10^3) -	712.9	1,082.9	1,037.9	811.2
Vac. Sat. Resilient Modulus (x 10^3) -	362.8	769.0	968.8	800.7
Freeze-Thaw Resilient Modulus (x 10^3) -	83.3	187.5	296.3	339.5
M_R Ratio 1 (Vac. Sat./Uncond.) -	51%	71%	93%	99%
M_R Ratio 2 (Freeze-Thaw/Uncond.) -	11%	17%	29%	42%

Recommended Water addition (Based on millings dry weight) - 3.0%

" Emulsion content " " " " " - 2.0%

REPORT TO:

- x JC Compton Inc.
- x ☐ RJ VanCleave
- x ☑ Construction Engineer
- x ☐ J. Wilson
- ☐ Bridge Engineer
- x ☑ Region Engineer 4 RAS
- x ☑ Project Manager Dan Olson
- x ☐ Dist. Maintenance Supervisor Gary Hicks
- x ☐ G. Boyle
- x ☐ Files

RECOMMENDATION:

Material as represented by this sample does, does not comply with specifications.

AMENDED REPORT 7-2-86
(Additional test data)

LABORATORY RECORD

HIGHWAY DIVISION — MATERIALS SECTION

Laboratory No. 86 8164
Data Sheet No. AB-33716
E. A. C10274
Laboratory charge $ 510 —

PRELIMINARY COLD RECYCLE MIX DESIGN

Project District 10#11 - Sprague River Rd Blg
Highway Klamath Falls Lakeview Unit "E"
Contractor C. Valentine
Submitted by Dan Olson Unit Code # 8041
Source of Material MP. 52.15
Sampled or inspected at roadway To be used In Place Cold Recycle A/C
Sampled or inspected by R & R. Team Quantity represented

Date received 5/2/86
Date reported 6-20-86
Date sampled

* Test Gradation: of Pavement grindings calculated To 100% Passing 1"

P. 1" - 100	P. 3/8" - 81	P #40 - 6
P. 3/4" - 98	P. 1/4" - 66	P #200 - 1.9
P. 1/2" - 91	P. #10 - 24	*Millings report #86-6401

Resistance to Deformation and Cohesion: AASHTO - T-246 & 247 (A/C = 5.1, Pan = 13)

% Water / % Emulsion (CMS-2S @ 67% resid.)	4.0 / 1.0	4.0 / 2.0	4.0 / 3.0	4.0 / 4.0
1st Compaction @ 140°F (After 15-24 hrs. Cure in Bread Pan @ 140°F)				
Hveem stability @ 77°F (Cured @ 140°F 15-24 hrs.)	55	61	58	54
Hveem stability @ 140°F (Cured @ 140°F 15-24 hrs.)	18	14	16	10
Hveem stability @ 140°F after 2nd Comp. (Compacted after 3-4 hrs. @ 240°F)	17	4	1	1
Bulk Specific Gravity - 1st Comp.	2.11	2.16	2.21	2.27
Bulk Specific Gravity - 2nd Comp.	2.19	2.24	2.28	2.32
Bulk Specific Gravity - 3rd Comp.	2.32	2.35	2.38	2.41
Percent Voids @ 3rd Comp.	6.6	4.4	2.5	0.3
Rice Method Real Gravity	2.485	2.459	2.441	2.418
asphalt Film Thickness / % coated	Dry / 50-60	Dry-Suff / 60-70	Suff / 75-85	Suff-Thick / 85-95
Unconditioned Resilient Modulus (x 10^3) -	567.4	565.0	491.9	618.4
Vac. Sat. Resilient Modulus (x 10^3) -	303.3	388.6	440.6	569.6
Freeze-Thaw Resilient Modulus (x 10^3) -	71.6	106.5	175.6	321.1
M_R Ratio 1 (Vac. Sat./Uncond.) -	53%	69%	90%	91%
M_R Ratio 2 (Freeze-Thaw/Uncond.) -	13%	19%	36%	52%

Recommended Water addition (Based on millings dry weight) - 4.0%
" Emulsion content " " " " - 3.0% CMS-2S

REPORT TO:

- [ ] F.H.W.A.
- [x] Construction Engineer
- [ ] Maintenance Engineer
- [ ] Bridge Engineer
- [x] Region Engineer — Reg. 4 RAS
- [x] Project Manager — Dan Olson
- [ ] Dist. Maintenance Supervisor
- [ ] Materials, Portland
- [ ] Materials, Eugene
- [x] Files

3x To Wilson, G. Boyle, G. Hicks

RECOMMENDATION:

Material as represented by this sample does, does not comply with specifications.

H. J. Ivanis

APPENDIX D

PROJECT INSPECTION REPORTS--1986 PROJECTS

Region

PROJECT INSPECTION REPORT

Oregon Department of Transportation
HIGHWAY DIVISION

Intermediate [X]
Final [ ]

Project Name: Region 4 Recycle Project				Contract No.: 10,218
Highway: Ochoco			County: Wheeler	Prefix No.: C10218
Contract Time Elapsed %	Contract Work Completed %	Contract Work Quality	Contract Work Progress	F.A. Project No.: STATE
Inspection date: May 14, 1986		By: Stephen H. Macnab, Region Operations Engineer		
In company with: Dale Allen, Dick Nelson, Dan Olson				

REMARKS

(Scope of inspection, Findings, Recommendations, Instructions, etc.)

This is my initial inspection on the project. The Contractor is currently is working on Unit G, east of Mitchell. He has completed the in-place CTB shoulder treatment work to the specified depth of 6-inch nominal. Soft spots in the shoulder are being dug out and rebased. All of his traffic control signing is in place, and meets contract requirements. One element of the signing diagram for this project is not necessary, in my estimation, and should be eliminated on future contracts.

The signing diagram shows work area signing which is ground-mounted with flags. In addition, the ground-mounted "Road Construction Ahead" sign requires a flasher. The installation of a flasher unit on a ground-mounted sign is not appropriate where the signing is in place only during daylight hours. High level warning flags are more than sufficient during daylight hours to warn motorists. It is my recommendation that these flashers on such signing diagrams be eliminated on future contracts.

At the time of this inspection the Contractor was just beginning his recycling operation. He was working at the east end of the unit with a new recycling train. He had sufficient equipment and personnel on the site to do the work required. During the course of the work shift he was only able to recycle approximately 1500 feet of pavement because of equipment failures. In addition, the spray bar for tacking did not provide the desirable coverage and application rate. This bar was tested prior to moving onto the roadway and found to be acceptable. The tacking system will be adjusted prior to future use.

(USE ADDITIONAL SHEETS AS REQUIRED)

FINAL INSPECTION CHECKLIST

_____ Date opened to traffic or in operation
_____ Date of Second Notification
_____ Date Contractor's notice for semi-final inspection received
_____ Date Contractor removed equipment, plant, etc.
_____ Estimated submittal date of semi-final estimate
_____ Recommended acceptance date of completed contract work

Original to: Construction Engineer
Copy to: Region Engineer
District Engineer
Resident Engineer
Project Mgt. (Final Only)
FHWA (Final F.A. Only)
Project Engineer (If Applicable)

Signed S H Macnab

Title Region 4 Operations Engineer

Form 734-1384 (Rev. 9/78)

SP*70731-734

The mix design called for 2½% asphalt, but was based on only milled asphalt materials. The construction of this section requires milling portions of the in-place CTB material. This required a field adjustment in the asphalt to 3%±.

Breakdown compaction was done initially with a vibratory roller, followed by a pneumatic tired roller. Breakdown compaction resulted in densities of approximately 83%. Intermediate and final rolling resulted in compactions of 90%+. The project calls for a two-stage rolling with the second stage being done in approximately one week. Numerous rolling patterns are being tried.

PROJECT INSPECTION REPORT

Oregon Department of Transportation
HIGHWAY DIVISION

Intermediate [X]

Final [ ]

Project Name				Contract No.
Region 4 Recycle Project				10,218
Highway			County	Prefix No.
Ochoco			Wheeler	
Contract Time Elapsed %	Contract Work Completed %	Contract Work Quality	Contract Work Progress	F.A. Project No.
				STATE
Inspection date		By		
June 2, 1986		Steve Macnab		
In company with				
Dan Olson				

REMARKS

(Scope of inspection, Findings, Recommendations, Instructions, etc.)

The Contractor has completed the recycling work on Unit F and is currently working on Unit G. The mix design for Unit F called for adding 3%± emulsion to the RAP. This has proven to be an excessive amount of oil. Traffic has continued to pick the recycled mixture and maintenance is sanding periodically to minimize this.

At the time of this inspection the Contractor was recompacting the recycled pavement on Unit F and attaining densities in the 93-100% range.

Several soft spots will need to be corrected by the contractor, due to his process control of the recycled material. The Project Manager is writing a letter to the Contractor indicating the location of these areas.

The oil content on Unit G has been reduced to between 1.6 and 1.8% contrary to the mix design. This was to prevent the problems that were encountered in the mix designs on Unit F. Even with this reduced asphalt content, the pavement appears to be rich in oil.

Ride on the recompaction section Unit F is good but some corrective work is needed. A cold mix overlay on Unit F is scheduled for late June, early July.

The ride on Unit G, following initial compaction, appears better than that was on Unit F.

(USE ADDITIONAL SHEETS AS REQUIRED)

FINAL INSPECTION CHECKLIST

_____ Date opened to traffic or in operation
_____ Date of Second Notification
_____ Date Contractor's notice for semi-final inspection received
_____ Date Contractor removed equipment, plant, etc.
_____ Estimated submittal date of semi-final estimate
_____ Recommended acceptance date of completed contract work

Original to: Construction Engineer
Copy to: Region Engineer
District Engineer
Resident Engineer
Project Mgt. (Final Only)
FHWA (Final F.A. Only)
Project Engineer (If Applicable)

Signed S. K. Macnab

Title Region Operations Engineer

PROJECT INSPECTION REPORT

Oregon Department of Transportation
HIGHWAY DIVISION

Intermediate [X]
Final [ ]

Project Name: L District 10 & 11 Recycle and Seal Project				Contract No.: 10,274
Highway: Various			County: Klamath/Lake	Prefix No.: C10274
Contract Time Elapsed %	Contract Work Completed %	Contract Work Quality	Contract Work Progress	F.A. Project No.: STATE
Inspection date: July 2, 1986		By: Steve Macnab		
In company with: Dan Olson				

REMARKS

(Scope of inspection, Findings, Recommendations, Instructions, etc.)

This covers Units B and F on the subject project. Unit F was added by Price Agreement and involves the recycling of approximately six centerline miles of US 97 north of Spring Creek Hill.

The contractor completed his recycling work today on Unit A between Beatty and Bly. With the exception of a few isolated locations, the mix and ride on this unit are good. The mix design calls for the addition of approximately 3% asphalt. This amount was placed in a test section and resulted in instability and flushing in the final mix. In general, the Project Manager has been holding the asphalt to a total extracted amount of 7½-8%. This appears to be the appropriate content for the unit. Initial compaction is running in the area of 82-87% of Rice.

Correction of the surface ride will be performed by the contractor by profiling in the near future and a chip seal will be placed within the next month.

The inspection on Unit F was made on July 1, 1986. This unit was added to respond to a ravelling problem on the existing pavement. The recycling depth was set at 2-3/4" and included recycling of polymer seal, "E" mix, and portions of the underlying "B" mix. Initially it was felt that the addition of dry lime should be added to help prevent stripping in the future. However, during the course of the initial work on this unit, the lime was found to be detrimental to the mix and was abandoned after the first three hours.

(USE ADDITIONAL SHEETS AS REQUIRED)

FINAL INSPECTION CHECKLIST

_____ Date opened to traffic or in operation
_____ Date of Second Notification
_____ Date Contractor's notice for semi-final inspection received
_____ Date Contractor removed equipment, plant, etc.
_____ Estimated submittal date of semi-final estimate
_____ Recommended acceptance date of completed contract work

Original to: Construction Engineer
Copy to: Region Engineer
District Engineer
Resident Engineer
Project Mgt. (Final Only)
FHWA (Final F.A. Only)
Project Engineer (If Applicable)

Signed S K Macnab

Title Region Operations Engineer

SP*70731-734

There was no mix design for this unit due to the emergency nature of the work. Instability in the mix has been a problem since the recycling. Rutting to a depth of approximately 1/2" has been measured. During recompaction the following week, an attempt was made to eliminate this rutting. However, on the date of this inspection, rutting was still a problem with some dual tire tracks noted in the wheel paths.

It is felt that the stability can be regained in this unit by profiling and eliminating the excess oil that is working its way to the surface. This would also eliminate the rutting that has been observed to date. Profiling, if done, will be by Price Agreement.

Region

Oregon Department of Transportation
HIGHWAY DIVISION

PROJECT INSPECTION REPORT

INTERMEDIATE [X]
FINAL [ ]

PROJECT NAME (SECTION)			CONTRACT NO.
Region 4 Recycle Project			10,218
HIGHWAY		COUNTY	F.A. PROJECT NO.
Ochoco		Wheeler	STATE
CONTRACT TIME ELAPSED %	CONTRACT WORK COMPLETED %	CONTRACT WORK QUALITY	CONTRACT WORK PROGRESS
INSPECTION DATE		BY	
August 4, 1986		Steve Macnab	
IN COMPANY WITH			
Jim Dumler			

REMARKS (SCOPE OF INSPECTION, FINDINGS, RECOMMENDATIONS, INSTRUCTIONS, ETC.)

The Contractor completed his chip seal work on Unit F last week. This was a two-day operation and at the end of the first day, it was discovered that instead of using CRS-2, the Contractor had received and used CMS-2 Emulsified Asphalt. The remainder of the oil for the project was en route and the Contractor used the CMS-2 the following day to match up.

Through this last weekend, the Contractor has provided a broom and has periodically rebroomed the surface to maintain an adequate chip cover on the seal. He has been advised that we will observe the condition of this seal and may require him to reseal the surface with the proper emulsion. No payment for the seal or traffic control will be made until it has been determined that the seal is acceptable This may require keeping the contract open until next spring and checking on its condition at that time. If the seal has been damaged significantly during that winter period, the Contractor would be required to come back and reseal it.

Unit G, for the most part, is still in excellent condition. There are a few areas of coarse material where some minor loss of aggregate was observed. Maintenance forces are scheduled to seal this unit in the near future with a polymer fog seal.

(USE ADDITIONAL SHEETS AS REQUIRED)

FINAL INSPECTION CHECKLIST

_____ DATE OPENED TO TRAFFIC OR IN OPERATION
_____ DATE OF SECOND NOTIFICATION
_____ DATE CONTRACTOR'S NOTICE FOR FINAL INSPECTION RECEIVED
_____ DATE CONTRACTOR REMOVED EQUIPMENT, PLANT, ETC.
_____ ESTIMATED SUBMITTAL DATE OF SEMI-FINAL ESTIMATE

ORIGINAL TO: CONSTRUCTION SECTION
COPY TO: REGION
DISTRICT MAINTENANCE SUPERVISOR
PROJECT MANAGER OR LIAISON (STATE)
PROGRAM SECTION (FINAL ONLY)
FHWA (FINAL F.A. ONLY)
CONSULTANT OR LOCAL AGENCY (IF APPLICABLE)

SIGNED D H Macnab

TITLE Region Operations Engineer

734-1384 (REV. 6-86)

Region

Oregon Department of Transportation
HIGHWAY DIVISION

PROJECT INSPECTION REPORT

INTERMEDIATE ☐
SEMI-FINAL X

PROJECT NAME (SECTION)			CONTRACT NO.
District 10 & 11 Recycle & Seal Project			10,274
HIGHWAY		COUNTY	F.A. PROJECT NO.
Various		Klamath & Lake	STATE
CONTRACT TIME ELAPSED	CONTRACT WORK COMPLETED	CONTRACT WORK QUALITY	CONTRACT WORK PROGRESS
76 %	100 %	Satisfactory	Satisfactory
INSPECTION DATE		BY	
August 6, 1986		Steve Macnab	
IN COMPANY WITH			

REMARKS (SCOPE OF INSPECTION, FINDINGS, RECOMMENDATIONS, INSTRUCTIONS, ETC.)

All recycle and seal work in District 11 has been completed, including the placement of the required chip seals. For the most part, the final products looked excellent.

The chip seal on the Beatty-Bly Section was a polymer seal using 5/8" cold mix aggregate. There were some initial laydown problems with it, primarily with the loss of the coarse aggregate. The seal, on the date of this inspection, looked excellent and the polymer is providing good chip retention. No damage to the seal was observed at any of the major road intersections and curves which has been a problem with CRS-2.

A problem on the Beatty-Bly Section was observed with the raised pavement markers. There has been a significant loss of these over the past week-and-a-half since the original placement. These appear to be breaking under traffic approximately a quarter to half-inch above the seal. Similar losses on the other units of this Contract were not noted.

(USE ADDITIONAL SHEETS AS REQUIRED)

FINAL INSPECTION CHECKLIST

N/A	DATE OPENED TO TRAFFIC OR IN OPERATION
August 19, 1986	DATE OF SECOND NOTIFICATION
August 1, 1986	DATE CONTRACTOR'S NOTICE FOR FINAL INSPECTION RECEIVED
August 1, 1986	DATE CONTRACTOR REMOVED EQUIPMENT, PLANT, ETC.
October 1, 1986	ESTIMATED SUBMITTAL DATE OF SEMI-FINAL ESTIMATE

ORIGINAL TO: CONSTRUCTION SECTION
COPY TO: REGION
DISTRICT MAINTENANCE SUPERVISOR
PROJECT MANAGER OR LIAISON (STATE)
PROGRAM SECTION (FINAL ONLY)
FHWA (FINAL F.A. ONLY)
CONSULTANT OR LOCAL AGENCY (IF APPLICABLE)

SIGNED S H Macnab
TITLE Region Operations Engineer

734-1384 (REV. 6-86)

Form 81-734-1384 (9-77)

Oregon Department of Transportation
HIGHWAY DIVISION

PROJECT INSPECTION REPORT

Intermediate [X]
Final [ ]

Project Name				Contract No.
Region 4 Recycle Overlay & Seal Projects				10218
Highway			County	Prefix No.
Various			Various	C10218
Contract Time Elapsed 100 %	Contract Work Completed 99 %	Contract Work Quality	Contract Work Progress	F.A. Project No.
		Good	Good	State
Inspection date		By		
11-5-86		Daniel L. Olson, Project Manager		
In company with				
Dick Nelson, District Maintenance Supervisor, District 10				

REMARKS

(Scope of inspection, Findings, Recommendations, Instructions, etc.)

Purpose of inspection was 3/8"-#10 Chip Seal on Unit "F" Ochoco Highway M.P. 73.4 to 81.6.
Seal was placed the 4th week of July.
Has been open to traffic for more than 3 months.
Aggregate is well imbedded.
Dick Nelson felt it looked good and could not see that there would be a problem with it in the future.
Recommends we accept project upon completion of aggregate production at Warm Springs (B.I. 17).

ROM RE ~~RDE~~ RAS FAS
RTS RECEIVED GEO
RUS NOV 19 1986 RDS
RSO REGION 4 RBI
ASSIGNED

(USE ADDITIONAL SHEETS AS REQUIRED)

FINAL INSPECTION CHECKLIST

N/A Date opened to traffic or in operation
N/A Date of Second Notification
N/A Date Contractor's notice for semi-final inspection received
N/A Date Contractor removed equipment, plant, etc.
N/A Estimated submittal date of semi-final estimate
N/A Recommended acceptance date of completed contract work

Original to: Construction Engineer
Copy to: Region Engineer
District Engineer
Resident Engineer
Project Mgt. (Final Only)
FHWA (Final F.A. Only)
Project Engineer (If Applicable)

Signed D. L. Olson

Title P. M.

tel;

REGION 4 RECYCLE PROJECT
10218
$/YD & $/ Mile

ITEM	RECYCLE		LAYDOWN		3/8-10 POLY CHIP SEAL		3/8 - 10 CHIP SEAL		TOTAL	
	24'		24'		26'		32'		Sq. Yd.	Mile
	Sq.Yd.	Mile	Sq.Yd.	Mile	Sq.Yd.	Mile	Sq.Yd.	Mile	Sq. Yd.	Mile
Lab TP & D	$0.06	$846.00	$0.02	$254.00	$0.06	$817.00			$0.14	$1,917.00
Labor/ Equip.	$0.50	$7,140.00	$0.15	$2,112.	-	-	-	-	$0.65	$9,252.00
Emulsion	$0.34	$4,723.00	$0.10	$1,423.	$0.37	$5,660.00	-	-	$0.81	$11,806.00
Aggregate	-	-	-	-	$0.39	$5,880.00			$0.39	$ 5,880.00
TOTAL	$0.90	$12,709.	$0.27	$3,789.	$0.82	$12,357.00			$1.99	$28,855.00
Lab, TP&D	$0.06	$846.00	$0.02	$254.	-	-	$0.06	$901.00	$0.14	$2,001.00
Labor/ Equip.	$0.50	$7,140.00	$0.15	$2,112.	-	-	-	-	$0.65	$9,252.00
Emulsion	$0.34	$4,723.00	$0.10	$1,423.	-	-	$0.24	$4,467.00	$0.68	$10,613.00
Aggregate	-	-	-	-	-	-	$0.13	$2,428.00	$0.13	$ 2,428.00
TOTAL	$0.90	$12,709.	$0.27	$3,789.	-	-	$0.43	$7,796.00	$1.10	$24,294.00

APPENDIX E

RECOMMENDED 1987 SPECIFICATIONS

SECTION 420 - COLD INPLACE RECYCLED (CIR) ASPHALT CONCRETE PAVEMENT

Description

Subsection 420.01 Scope - This work shall consist of constructing Cold Inplace Recycled (CIR) asphalt concrete pavement using Class I and Class II recycling treatments in accordance with these specifications, and in reasonably close conformity to the lines, grades, thicknesses and cross sections shown on the plans or established by the Engineer.

Definitions

420.04 CIR Asphalt Concrete Pavement - CIR asphalt concrete pavement is a mixture of pulverized existing asphalt pavement (RAP), which has been removed and mixed with emulsified asphalt cement and water, then relayed and compacted in a continuous operation.

420.05 Class I Recycling Treatment - Class I recycling treatment is performed on a uniform pavement, designed and built to specifications. The CIR mixture produced under Class I is based on a rational mix design method.

420.06 Class II Recycling Treatment - Class II recycling treatment is performed on either a pavement with significant maintenance patches over a uniform pavement or a pavement with minimal design used in the original construction. The CIR mixture produced under Class II is less uniform than for Class I and is based on either a rational mix design method or mix design guidelines.

(Use following paragraph when single unit is allowed.)

420.07 Option A or B - Under these specifications the Contractor shall perform CIR work using either a recycling train (Equipment Option A) or a single processing unit (Equipment Option B) as hereinafter specified.

420.08 Prepaving Conference - The Contractor and the Contractor's supervisory personnel plus any subcontractors and their supervisory personnel who are to be involved in the recycle and paving work shall meet with the Engineer's representatives for a prepaving conference at a time mutually agreed upon. At this conference, the Contractor shall present the methods of accomplishing all phases of the recycle and paving work. The plan of the work, order of work and other details of performance shall meet with the approval of the Engineer.

New supervisory personnel replacing anyone engaged in the recycle and paving work, after the first conference, shall be required to attend a new prepaving conference prior to performing their duties on this project.

Materials

420.11 Asphalt - Emulsified asphalt shall be CMS-2S or HFE-150 as directed by the Engineer and shall meet the applicable requirements of Section 702.

420.12 Water - Water shall conform to the requirements of subsection 233.11.

(Use bracketed item when single unit option is allowed.)

420.13 Recycled Asphalt Pavement (RAP) - Recycled material removed from the existing asphalt pavement (using Equipment Option A) shall have a maximum size of 1-1/2-inch prior to entering the mixer unless otherwise directed by the Engineer. Any recycled material larger than 1-1/2-inch shall be separated by screening or other means, broken down by mechanical means to pass a 1-1/2-inch sieve and uniformly reincorporated with the balance of the recycled material.

(Use following paragraph when single unit option is allowed.)

Recycled material removed from the existing asphalt pavement using Equipment Option B shall have a maximum size of two inches. Incidental oversize may be allowed by the Engineer if it is not detrimental to the mixture or wearing surface. If the gradation is determined to be detrimental, the Contractor shall take such action necessary to correct the oversize problem. These actions may include reducing the milling speed, crusher, changing screen

size (when screens are used) or other such measures as may be necessary. Failure of the Contractor to be able to provide an acceptable product will cause a rejection of the equipment or processing equipment.

(Use the following paragraph when the Contractor will produce choke aggregate.)

420.14 Choke Aggregate - The material to be used as choke aggregate shall be either clean sand, crushed gravel or quarry rock free of clay, loam or other extraneous material and shall conform to the following:

Sieve Size	Percent Passing
3/8"	100
1/4"	95-100
40	20-40
100	0-5

(Use the following paragraph with State-furnished material.)

420.14 Choke Aggregate - Choke aggregate will be furnished by the State. Material to be used on this project is stockpiled on State-controlled property located on Highway _____ at Milepost _____.

420.15 Job Mix Formula - The CIR asphalt concrete mixture shall consist of RAP from the existing pavement, emulsified asphalt cement and water combined in the proportions designated by the Engineer. Variability in the composition of the RAP material may require changes in the proportions of the constituents, as directed by the Project Manager. Normally, the emulsified asphalt content will be between 0.3 and 2.5 percent, by weight, and water between 1.5 and 4.0 percent by weight.

420.16 Process Control Testing - Process control sampling and testing will be performed by the Engineer.

420.17 Acceptance of CIR Mixture - The CIR mixture will be accepted visually on the grade following initial compaction. Any mixture that ravels or does not provide any acceptable wearing surface shall be corrected. Any area showing an excess or deficiency of emulsified asphalt cement shall be reprocessed or

replaced. Replacement shall be by a method approved by the Engineer. Removal and replacement under these provisions shall be at the expense of the Contractor unless the Engineer determines that the defects, excesses or deficiencies are not caused by or the fault of the Contractor's operations.

Construction

420.31 Season and Weather Limitations - Inplace recycling of existing asphalt concrete pavement shall not begin until the pavement surface temperature is 70°F and rising. Pavement damaged by rain after placement shall be reprocessed, or other method approved by the Engineer, at the Contractor's expense. The construction of CIR asphalt concrete pavement will not be allowed before May 15 or after August 1, except the Engineer may approve a start-up before the pavement surface temperature is 70°F under the following conditions:

(1) The Contractor requests such an early start in writing;

(2) The Contractor assumes all financial responsibility for correction of raveling problems with the CIR mixture during the early start period. This includes, but is not limited to, the cost of complete recycling, additional choke, rollers, pilot cars and flaggers, etc. as determined by the Engineer.

If recycling and placement operations are not completed by August 1, the Contractor will not be allowed to resume operations until May 15 of the following year.

The Contractor shall stop milling work at the end of each day when the temperature of the mixture behind the paver drops below 90°F or three hours before sunset, whichever occurs first.

420.32 Rate of Progress and Scheduling - The Contractor shall plan and schedule the recycle operation in such a manner that the materials are removed, mixed, replaced and the area open to traffic immediately after initial compaction is completed.

All recycled areas shall be competely backfilled with reprocessed and compacted asphalt concrete materials so the area is open to two-way traffic during all hours of darkness.

(Use bracketed item when single unit option is allowed.)

(Equipment Option A)

420.34 Recycling Train - (Under this option the) existing pavement shall be recycled using a recycling train consisting of the following major components: (a) Planing machine or grinder, (b) crusher and (c) pugmill mixer.

(a) Planning machine or grinder - The existing pavement shall be removed by a self-propelled planing machine having a minimum 144-inch wide rotary cutter and be capable of removing the existing pavement to a depth of four inches in a single pass.

The unit, also, shall be capable of accurately establishing profile grades within a tolerance of 0.02-foot by reference from either the existing pavement or from independent grade control and shall have a positive means for controlling cross slope elevations. The equipment shall incorporate a totally enclosed cutting drum with replaceable cutting teeth and shall have an effective means for removing excess material from the surface and for preventing dust from escaping into the air. The use of a heating device to soften the pavement will not be permitted.

The unit shall be equipped to discharge not less than 70 gallons of water per minute into the cutting chamber, with fully variable control and meter capable of measuring the rate of feed within five gallons per minute.

(b) Crusher - The crusher shall be of the portable type capable of reducing the oversized RAP materials to the specified size.

(c) Pug mill mixer - The CIR asphalt concrete mixture shall be mixed in a pug mill type plant capable of providing a mix of RAP, emulsified asphalt and water at a minimum rate of 700 tons/hour to uniform proportions as designated by the Engineer.

Mixing plants shall be equipped with a positive control linking the RAP, emulsified asphalt and water feed in a manner that will maintain a constant ratio of each constituent. The plant shall be equipped with facilities so that the Contractor can verify and calibrate the RAP, asphalt and water quantities by a method acceptable to the Engineer.

The RAP shall be measured by weight and the emulsified asphalt and water may be proportioned by either weight or volume. The equipment shall be capable of feeding and maintaining a constant rate of RAP feed within a tolerance of plus or minus 5% (by weight) or the designated amount and a constant rate of emulsified asphalt and water feeds within plus or minus 0.2% (by weight) of the designated amounts.

The mixing plant shall be equipped with positive displacement pumps and a computerized metering system which can accurately meter the amount of emulsified asphalt and water. The pumps shall be interlocked belt weighing system that measures the quantity of RAP material entering the mixing plant. The interlock shall be designed so that emulsified asphalt and water cannot be added until RAP material enters the mixer. Overrides of the interlock system shall be equipped with short duration timers to prevent their continuous use. Overrides shall be used only during start-up periods.

The belt weighing device and computerized-metering system shall have readouts that indicate the quantity in tons of RAP, water and emulsified asphalt being fed into the mixer at any given time. Totalizer readouts shall also be provided to allow determination of accumulative quantities of each constituent.

(Use following four paragraphs when single unit option is allowed.)

Equipment Option B - Single Processing Unit:

Under this option the existing pavement shall be processed using a planing machine meeting all of the requirements of a planing machine under "Equipment Option A".

In addition, the planing machine shall be capable of adding emulsified asphalt and water to the RAP in amounts directed by the Engineer to produce a uniform mixture.

Positive displacement pumps which can accurately meter the planned amount of emulsified asphalt and water into the pulverized asphalt concrete shall be used. The pumps shall be interlocked to the movement of the machinery used to apply the emulsified asphalt and water to provide that no emulsified asphalt or water can be added when the machinery is not moving.

The emulsified asphalt and water feeds shall have positive readout capabilities so that the amount of emulsified asphalt and water in tons incorporated into at any given time can be read directly. Totalizer readouts shall also be provided to allow determination of accumulative quantities of water and emulsified asphalt used in the mixture.

(d) Asphalt storage and heating tanks - Storage tanks shall be equipped with accurate volume measuring devices or manufactures calibration charts for each storage tank and a thermometer for measuring the temperature of tank's contents.

Between the storage tanks and the liquid asphalt mixing device or recycling equipment, a parallel piping filter system with at least one filter per line shall be used. Filters shall be capable of eliminating solid or semisolid particles from the emulsified asphalt liquid.

Each filtering line shall be equipped with on-off valves and changeable filter elements.

The emulsified asphalt cement shall be routed alternately through each filter line for a period of two to four hours, and alternate filters changed on the same frequency unless otherwise directed by the Engineer.

Loads of emulsified asphalt which break prematurely in the storage tanks or haul vehicles or which cause frequent plugging of the filters as determined by the Engineer will be rejected for use.

420.35 Asphalt Concrete Pavers - Pavers shall be self-contained, power-propelled units, provided with an activated screed or strike-off assembly, heated if necessary, and capable of spreading and finishing layers of recycled asphalt concrete material in widths applicable to the specified typical sections, and to required thicknesses, lines, grades and cross sections.

Extensions added to the paver when used on traffic lanes shall have the same augering and screeding equipment as the rest of the paver.

The paver shall be equipped with a receiving and distribution system of sufficient capacity for a uniform spreading operation and capable of placing the mixture uniformly in front of the screed without segregation of materials.

The paver shall be designed to compensate for minor irregularities of the base on which it is supported so that such will not be reflected immediately in the surface of the layer being placed. The weight of the paver shall be supported on tracks or wheels, none of which shall contact the mixture being laid. The contact area of the screed or strike-off assembly shall be uniform over the entire width of the strip of mixture being placed.

Pavers shall be equipped with a paver control system which shall automatically control the layer of the mixture to specified cross slope and grade. The control system shall be automatically actuated from independent line and grade control references through a system of mechanical sensors and sensor-directed devices which shall automatically maintain the paver screed in proper position to provide specified results.

The screed of strike-off assembly shall produce a finished surface of the required evenness and texture without tearing, shoving or gouging the mixture.

420.36 Compactors - Rollers shall be steel wheel, pneumatic tire, vibratory or a combination of these types as specified. They shall be in good condition and capable of reversing without backlash.

(a) Steel wheeled rollers - Steel wheeled rollers shall have a minimum gross static weight of 10 tons and a minimum static weight on the drive wheel of 250 pounds per inch of width.

(b) Vibratory rollers - Vibratory rollers shall be a tandem steel wheeled type having a minimum gross static weight of 8 tons and shall be equipped with amplitude and frequency controls and shall be specifically designed for compaction of asphalt concrete mixtures. The rollers shall be capable of frequencies of not less than 2,000 vibrations per minute.

(c) Pneumatic rollers - The pneumatic-tired rollers shall have a minimum static weight of 20 tons and shall be self-propelled, tandem or multiple axle, multiple wheel type with smooth-tread pneumatic tires of equal size staggered on the axles at such spacings and overlaps as will provide uniform capacting pressure for the full compacting width of the roller and shall be capable of exerting ground pressures of at least 80 pounds per square inch of tire contact area.

420.37 Preparation of Foundation - Just prior to windrowing the recycled pavement mixture, a tack coat conforming to Section 407 of these special provisions shall be applied to the entire profiled area including the vertical edges. Rates of application shall be as directed by the Engineer.

Care shall be taken to minimize the amount of fines on the milled surface that can be detrimental to a proper bond of the tack coat.

420.40 Heating Emulsified Asphalt Cement - The temperature of the emulsified asphalt cement prior to entry into the mixture shall be not less than 125°F nor more than 185°F.

420.41 Mixing - All the various required components of the asphalt concrete mixer shall be utilized and operated in a manner to assure compliance with this section.

The RAP, emulsified asphalt cement and water shall be measured and introduced into the mixer in the amounts specified in the "job mix formula" and as designated by the Engineer.

Mixing shall continue until the emulsified asphalt water have been distributed through the RAP to form a uniformly coated mixture.

420.43 Control of Line and Grade - The line and grade reference control shall be a floating beam device of adequate length and sensitivity to provide adequate control on either or both sides of the paver.

Manual control of line and grade for the paver will be permitted when approved by the Engineer.

420.44 Spreading - Except for unavoidable delay or breakdown, recycling and placing recycled pavement by the paving machine shall be at a rate sufficient to provide continuous operation of the paving machine. If paving operations result in excessive stopping of the paving machine, as determined by the Engineer, recycling and paving operations shall be suspended until the Contractor can synchronize the rate of recycle with the capacity of the paving machines.

(a) General - The mixture shall be laid on an approved surface, spread and struck off to established grade and elevation. Specified asphalt pavers shall be used to distribute the mixture.

The asphalt mixture shall be deposited in a windrow, then picked up and placed in the asphalt paver.

The loading equipment shall be self-supporting and shall not exert any vertical load on the paving machine nor cause vibrations or other motions which could have a detrimental effect on the riding quality of the completed pavement. The loading equipment shall pick up substantially all of the material deposited on the roadbed and place it directly into the receiving hopper of the paving machine.

In areas where patching, irregularities or unavoidable obstacles make the use of specified equipment impracticable, the mixture may be spread with special hopper equipment with adjustable strike-off or by other equipment and means approved by the Engineer, provided the surface finish is within a tolerance of 0.01-foot of that hereinafter set forth.

(b) Drop-offs - Prior to any suspension of operations at the end of each shift, the full width of the area to be paved, including outside shoulders, shall be completed to the same elevation with no longitudinal drop-offs.

If unable to complete the pavement without longitudinal drop-offs as specified above, the Contractor shall, within the specified time constraints, construct and maintain a wedge of asphalt concrete at a slope of 10:1 or flatter along the exposed longitudinal joint located within the area to be paved. Longitudinal joints one inch or less will not require a wedge. The wedge shall be removed and disposed of prior to continuing paving operations. Construction, material, maintenance, removal and disposal of the temporary wedge shall be at the Contractor's expense.

Where allowable abrupt or sloped drop-offs occur within or at the edge of the paved surface the Contractor shall provide, at his expense, suitable warning signs as required under Section 111.

(c) Finishing and details - Special care shall be taken at longitudinal joints to provide positive bond and to provide density and finish to new mixture equal in all respects to the mixture against which it is placed.

420.45 Choke Aggregate Placement - Immediately prior to the last roller coverage during initial compaction as hereinafter specified and before opening to traffic, the Contractor shall place choke aggregate at a rate of approximately 0.001 to 0.003 cubic yard per square yard. Choke aggregate shall be spread by a method that provides uniform coverage across the CIR mat. Any piles, ridges or uneven distribution of choke aggregate shall be eliminated by spreading and/or removing with hand tools or mechanical means as the Contractor elects prior to the final roll or coverage.

If raveling of the CIR mixture occurs following placement, the Contractor shall provide traffic control for these areas immediately or as directed by the Engineer. When the Engineer determines that additional rolling of the raveled areas is required, the additional rolling will be paid as Extra Work.

420.46 Compaction:

(a) General - Immediately after the CIR asphalt concrete mixture has been spread, struck off and surface irregularities and other defects remedied, it shall be thoroughly and uniformly rolled until the mixture is compacted as hereinafter set forth.

(a-1) Surface repair - Any displacement of the mat regardless of thickness occurring as a result of the reversing of the direction of a roller, or from other causes, shall be corrected. Steel roller wheels shall be moistened with water or other approved material to the least extent necessary to prevent pickup of mixture.

When the rolling causes undue tearing, displacement, cracking or shoving the Contractor shall make changes in compaction equipment and/or rolling procedures necessary to alleviate the problem.

(a-2) Rolling - The CIR asphalt concrete mixture shall be compacted with rollers conforming to the requirements hereinbefore set forth. The type, number and weight of rollers shall be sufficient to compact the mixture.

Rollers shall move at a slow but uniform speed recommended by the manufacturer with the drive rolls or wheels nearest the paver. Vibratory rollers, when used in the vibratory mode, shall be operated at frequencies of at least 2,000 vibrations per minute. The maximum operating speed of pneumatic rollers shall be 5 MPH.

Normal rolling shall begin at the sides and proceed longitudinally parallel to the road centerline, each trip overlapping one-half the roller width, gradually progressing to the center. On superelevated curves the rolling shall begin at the low side and progress to the high side, each trip overlapping one-half the roller width. When paving is in echelon or when abutting a previously placed lane, the longitudinal joint shall be rolled first followed by the regular rolling procedure. Rollers shall not make sharp turns on the course being compacted and they shall not be parked on the fresh CIR mixture. Alternate trips of a roller shall terminate in stops at least five feet distant longitudinally from adjacent preceding stops.

(b) Initial compaction - Compaction of the fresh CIR asphalt concrete mixture shall be performed with a minimum of two vibratory rollers meeting the requirements hereinbefore set forth. Rollers shall be operated in either vibratory or static mode as directed by the Engineer. The mixture shall be compacted with at least one coverage by each roller and such additional coverages as the Engineer may direct.

The overlapping of one-half of roller width on each trip by the rollers as required does not constitute two coverages on that particular area rolled.

(c) Recompaction - After initial compaction and prior to recompaction, the CIR asphalt concrete pavement shall be opened to public traffic and allowed to cure. Recompaction shall be performed between 3 and 15 days after laydown when directed by the Engineer. Rolling shall not be performed when the surface temperature is less than 90°F.

The entire recycled pavement area shall be recompacted with at least one steel wheeled roller and one pneumatic roller. Each roller shall make at least three coverages and such additional coverages as the Engineer may direct.

420.49 Pavement Smoothness:

(a) General - The top surface of CIR asphalt concrete pavement shall be tested with a 12-foot straightedge furnished and operated by the Contractor parallel to or perpendicular to the centerline, and shall not vary by more than 0.02-foot. The Engineer will observe this testing and may require additional testing.

When utility appurtenances such as manhole covers and valve boxes are located in the traveled way and they are not required to be adjusted or are required to be adjusted before paving, this tolerance will not apply.

(b) Corrective action - When tests show the pavement is not within the specified tolerance, the Contractor shall take immediate action to correct equipment or procedures in his paving operation to eliminate the unacceptable pavement roughness.

Any surface irregularities exceeding the specified tolerances shall be corrected by the Contractor within the period of 2 to 5 days following initial compaction using one of the following methods:

(1) Remove, replace or reprocess the surface course.

(2) Grind the pavement surface utilizing the planing machine or grinder as hereinbefore set forth to a maximum depth of 0.3-inch.

The cost of all corrective work, including traffic control and furnishing of materials, shall be performed at the Contractor's expense and no adjustment in contract time will be made for corrective work.

Measurement

420.81 Measurement - The number of square yards of recycled emulsified asphalt mixture shall be based on the paved widths and milled depths shown on the plans and the horizontal measurement along the centerline of the actural length of the pavement recycled.

No allowance will be made for pavement recycled in excess of the paved width and milled depth shown on the plans unless directed by the Engineer.

No change in unit price per square yard will be made for depths deviating from plan depths unless the milled depth is deviated by more than plus or minus one-half inch from the nominal thickness called for by the plans and directed by the Engineer. Where the Engineer directs construction of recycled emulsified asphalt concrete to a thickness other than plus or minus of one-half inch from the nominal thickness specified, these areas will be adjusted by converting in one-half-inch increments to the equivalent number of square yards of nominal thickness on a proportionate volume basis above or below the specified tolerance limits.

For example, if the plans require a nominal depth of 1-1/2-inch and the Engineer directs a milling depth of 2-1/2 inches, the adjustment will be based on an additional 1/2-inch depth. (2-1/2"-1-1/2"-1/2" (tolerance) = 1/2" adjustment)

The quantity of emulsified asphalt in the recycled asphalt concrete mixture to be paid for will be the number of tons used in the accepted mixture measured as set forth in subsection 109.01 of the Standard Specifications.

The quantity of water used in the mixture will be measured as set forth in Section 233.

The quantity of choke aggregate to be paid for will be the number of cubic yards actually spread on the inplace recycled emulsified asphalt mixture at the rate specified, measured as set forth in subsection 109.01 of the Standard Specifications.

Payment

420.91 Payment - Payment when made at the contract unit price per square yard for the item "Recycled Emulsified Asphalt Pavement Mixture" will be full compensation for all equipment, labor and incidentals required to remove and pulverize the existing surfacing, and to mix the materials, place, compact and finish the work as specified.

Payment, when made at the contract unit price per ton for "Emulsified Asphalt in Recycled Mixture", will be full compensation for all costs of material, labor, tools and equipment necessary for the addition of the emulsion as specifed.

(Use word "furnish" when Contractor is to supply choke aggregate.)

Payment, when made at the contract unit price per cubic yard for "choke aggregate", will be full compensation for all costs to (furnish,) haul and place choke aggregate as specified.

Payment for water used in the CIR asphalt concrete mixture will be made as set forth in Section 233 and will comprise full compensation for the water used in connection with the recycle work.

SECTION 407 - ASPHALT TACK COAT

Delete Section 407 of the 1984 Standard Specifications and insert the following:

Description

407.01 Scope - This work shall consist of the furnishing of asphalt and the application thereof to a prepared asphalt concrete surface to ensure thorough bond between profiled asphalt cement surface and recycled emulsified asphalt mixture. The tack coat shall be applied on the areas designated by the Engineer in accordance with these specifications.

Materials

407.11 Asphalt - The asphalt to be used in the tack coat shall be CMS-2S and shall meet the applicable requirements of Section 702. The material may be conditionally accepted at the source or point of loading for transport to the project.

Emulsified asphalt in tack shall be diluted prior to application with 15-30 percent additional water conforming to the requirements of subsection 233.11, as determined by the Engineer.

Construction

407.31 General - The tack coat shall be applied to the milled surface prior to placement of the recycled emulsified asphalt mixture is placed in a berm into the profiled area.

The tack coat shall be applied to the entire milled surface including the vertical edges.

407.32 Distribution Equipment - The asphalt shall be spread by means of a pressure distribution system capable of applying the tack coat uniformly on surfaces having widths of up to 13 feet at readily determined and controlled rates from 0.05 to 2.0 gallons per square yard with uniform pressure, and with an allowable variation from any specified rate not to exceed 0.05 gallon per square yard.

Distribution system equipment shall include pressure gauges, accurate volume measuring devices or a calibrated tank and a thermometer for running temperature of tank contents. The distribution system shall have a power unit for the pump and a full circulation system for the tank and spray bar.

The spray bar shall be capable of being easily adjustable laterally.

407.33 Application Rate - Normally, the diluted emulsified asphalt shall be applied to the milled surface at a rate of 0.05-0.20 gallon/sq.yd. as directed by the Engineer.

Measurement

407.81 General - Asphalt used as directed in the asphalt tack coat will be measured by the ton as set forth in Section 109.

Payment

407.91 General - The accepted quantity will be paid for at the contract price per ton for the item "Asphalt in Tack Coat". The water in the tack coat will be measured and paid for in accordance with subsections 233.81 and 233.91 of the Standard Specifications.

APPENDIX F

Development of a Laboratory Procedure for Preparing CIR Laboratory Test Samples

by

Randy Davis and David Foster

1.0 Introduction

In order to reproduce the appearance and densities of the field samples, a number of laboratory specimens were prepared for the following projects:

1) Warm Springs Highway
2) Lake of the Woods Highway

All of this testing took place in the Region 4 laboratories, Bend, OR.

2.0 Samples

After considerable trials, the procedure given in Table F.1. was developed. The factors that lead to the final selection included:

1) Determination of mixing, compacting and curing temperatures which will simulate actual conditions encountered in the field using the train method of recycle along with two stage compaction.
2) Determination of number of blows to use (50 or 75) to represent field densities.
3) Curing times between first and second compaction. (After running several variations on the Marshall tests it was found that 50 blows per side simulated first compaction values obtained in the field and the final 25 blows per side simulated the second compaction values.)

3.0 Results

Table F.2 summarizes the results of the lab density analysis and compares these with the field cores. As indicated, the following can be stated:

1) Densities after 50 blows to each side closely simulated the densities achieved after first compaction in the field.

Table F.1. Proposed Sample Preparation Procedure for CIR

1) Millings are split into approximately 3500 gr. batches; this size sample makes 3-4, 2.5-inch high molds and can still be mixed thoroughly by hand with ease.

2) Sample is screened over 1-inch sieve. The material retained is reduced in size to 100% passing 1-inch sieve using 3-lb. hammer. This is because the retained 1-inch is too large for 4-inch molds.

3) Samples are heated to ±140° prior to mixing (1-2 hours).

4) Water is added to the millings in the appropriate proportion based on the air dry weight of the millings: % water = 4.5% total liquid - % added emulsion. Water is mixed into millings thoroughly by hand.

5) Emulsion is added to the premoistened millings using the recommended content. The added emulsion is based upon the air dry weight of the millings. The emulsion is preheated to ±140°F (1 hour) and mixed thoroughly into the batch by hand.

6) The material is spread into a 12-inch x 17-inch baking pan and allowed to cure for one hour at ±140°F to simulate average time elapsed between paver laydown and initial compaction during actual construction.

7) Samples are molded using standard Marshall procedure (ASTM D-1559) to produce ±2.5-inch high briquets as described below.

   a) Molds are preheated to ±140°F.

   b) Compact 50 blows per side as per instructions.

   c) Filter papers are removed from both ends of the briquets.

   d) Cure overnight at 140°F and recompact 25 blows/side.

   e) The molds are laid on their side and the briquets are cured for 24 hours @ ±140°F prior to extrusion.

   f) Briquets are extruded with the compression testing machine.

   g) Briquets are laid on their side to maximize surface exposure and cured for 72 hours @ ± room temperature prior to testing.

Table F.2. Comparison of Laboratory Samples vs. Field Cores
Districts 10 and 11 Recycle Green Springs Jct. - Lakeshore Dr.
Lake of the Woods Hwy.

a) Marshall Procedure

Sample #	Test Section	Emulsion Content,%	Water Content,%	Blows/ Side	Rice Density pcf	Bulk Density pcf	Percent Compaction	Percent Voids	Field Densities, pcf
17A	1	1.8	1.6	75	153.3	121.1	79.0	21.0	78.9
18A	1	1.8	1.6	75	153.3	118.7	77.4	22.6	77.4
21A	1	1.8	1.6	75	153.3	118.9	77.6	22.4	77.5
22A	1	1.8	1.6	75	153.3	120.3	78.5	21.5	78.5
1B	2	1.8	2.7	50	154.3	106.1	68.8	31.2	71.9*
1C	2	1.8	2.7	50	154.3	103.7	67.2	32.8	69.7*
1D	2	1.8	2.7	50	154.3	100.9	65.4	34.6	62.5*

b) CTB Procedure (OSHD T-208)

Sample #	Test Section	Emulsion Content,%	Water Content,%	Water Loss ml	Rice Density pcf	Bulk Density pcf	Percent Compaction	Percent Voids
CTB 1	2	1.8	2.7	6.2	154.3	119.1	77.2	22.8
CTB 2	2	1.8	2.7	1.8	154.3	119.0	77.1	22.9

* Initial compaction values

2) Bulk densities achieved after 50 blows to each side, curing in an oven and 25 more blows were within 0.1 pounds per cubic foot of the densities achieved in the field.

4.0 Summary

4.1 Marshall Procedure

The modified Marshall procedure successfully simulated actual field compaction for a given water and asphalt content.

4.2 CTB Procedure

The use of the modified Cement Treated Base test method (Appendix G) indicated the optimum total liquid can be rapidly verified in the field. The densities obtained using this method are comparable to the bulk densities found from the cores taken in the field.

Our experience with the modified CTB procedure is limited to laboratory testing. Initial findings indicate that from the color of the liquid loss during this test a determination of not only the optimum total liquid but optimum emulsion and water can be estimated.

With further research this test method may prove to be an effective and rapid project control test. Preliminary conclusions indicate when liquid loss is between 15 and 20 ml., the total liquid (emulsion and water) is near the desired content. With less liquid loss the mix does not handle well and/or inadequate coating occurs. With more loss the mixture may flush the emulsion to the surface. This is particularly true if vibratory rollers are being used.

If the liquid loss is near the desired amount (zone), the following observations were noted and may lead to a method of making rapid field control tests of the desired emulsion and water content.

Emulsion Content	Color of Liquid
1) When emulsion content was at design content	Slightly off color, (tan to brown)
2) When emulsion content was 0.3%± below design	Clear
3) When emulsion content was 0.3% above design	Emulsion obvious in water-emulsion colored liquid

APPENDIX G

Total Liquids

Test Procedure (OSHD TM-126) and Evaluation

by

Jim Wilson

Randy Davis and David Foster

OSHD test Method 126-86
Modified for
FIELD ADJUSTMENT OF COLD RECYCLE MIX
or
(Rapid Project Control Test)

1.0 Scope

The purpose of this method is to provide a field basis for adjustment of water and emulsion content to obtain satisfactory mixing, laydown and compaction of cold mix recycle. With the variations found in gradation, asphalt content and properties of millings, adjustments of the cold mix from the design recommendations are necessary to obtain optimum pavement durability.

2.0 Apparatus

Balance with capacity of 3000 grams, accurate to 0.1 gram.

Metal scoop and mixing bowl or bucket.

Split compaction mold, 4 inch diameter x 11.5 inches as shown in Figure G.

Compression machine consisting of a 20 - 25 ton capacity hydraulic jack fitted with a spherically seated head and mounted in a 30 inch frame. (Figure G)

Bottom and upper plunger for compression jack.

Bullet nosed rod, 3/8 inch diameter and approx. 20 inches long.

Hand tamper, one inch diameter by approx. 20 inches long, weighing 6.00 ± 0.05 pounds.

Tin or galvanized liner, four inches x four inches in diameter.

Four inch diameter filter paper (medium filtration speed).

3.0 Sample Preparation

The sample should be taken from within the windrow immediately behind the recycle train. A sample size from 1600 to 1700 grams is normally required to

fill the tin. After compaction a gap down from the top of the tin ranging from 1/4 to 1/2 of an inch did not appear to affect the results. Do not over-fill the tin. After obtaining the sample, weigh and record its initial weight. At the beginning of a project it may be necessary to run a test mold to verify the quantity of RAP required to fill the tin mold.

Care should be taken to keep the sample at the representative moisture content. The test should not take more than 15 minutes from the time the sample is removed from the windrow to the time it is weighed for liquid loss.

4.0 Procedure

1. Weigh a tin liner and 2 filter papers together. Record the weight and the sample number on the liner. (It will save time during the test to weigh and record several liners along with their filter paper in advance.)

2. Assemble the 4" split mold with the tin liner in place and the bottom plunger pinned 3 holes from the bottom. For some materials it may be necessary to pin the bottom plunger further away or closer to the bottom of the mold. The proper pin setting can be determined during compaction of a trial specimen. (I have not experienced a project yet that required a pin adjustment.)

3. Set the mold upright on a solid block, such as concrete, at a convenient height. Put in one filter paper and put on the extension sleeve.

4. Spoon approximately 1/2 the sample into the mold and rod 25 times around the edge of the mold with a 3/8" bullet nosed rod to prevent rock pockets. Tamp with the 3/4" faced small end of the 6 pound tamper for 50 blows. Physical exertion in tamping should be only sufficient to move the tamper up and down approximately 4 inches in travel. Guide the tamper over the entire surface of the specimen. The actual compaction should be provided only by the combined weights of the tamper and the operator's hand

5. Place the remaining portion of the sample in the mold and rod the sample 25 times around the edge of the mold. Tamp the second lift using 100 blows with the small (3/4") end of the hand tamper. Level off the top of the compacted specimen by tamping lightly with the large (2") end of the tamper in order to provide a smooth surface and an even plane at right angles to the axis of the mold. After tamping is complete, remove the extension sleeve, brush down the sides of the mold and put on the filter paper. Care must be taken to include the entire sample initially weighed as any material loss will be erroneously shown as liquid loss later.

6. Place the top plunger in position, then place the entire assembly on the hydraulic jack in the compression frame (see Figure G-1). If necessary, place one or more of the spacing rings between the top plunger and the top of the frame to prevent excessive travel of the jack. Remove the pin that holds the bottom in place and gradually

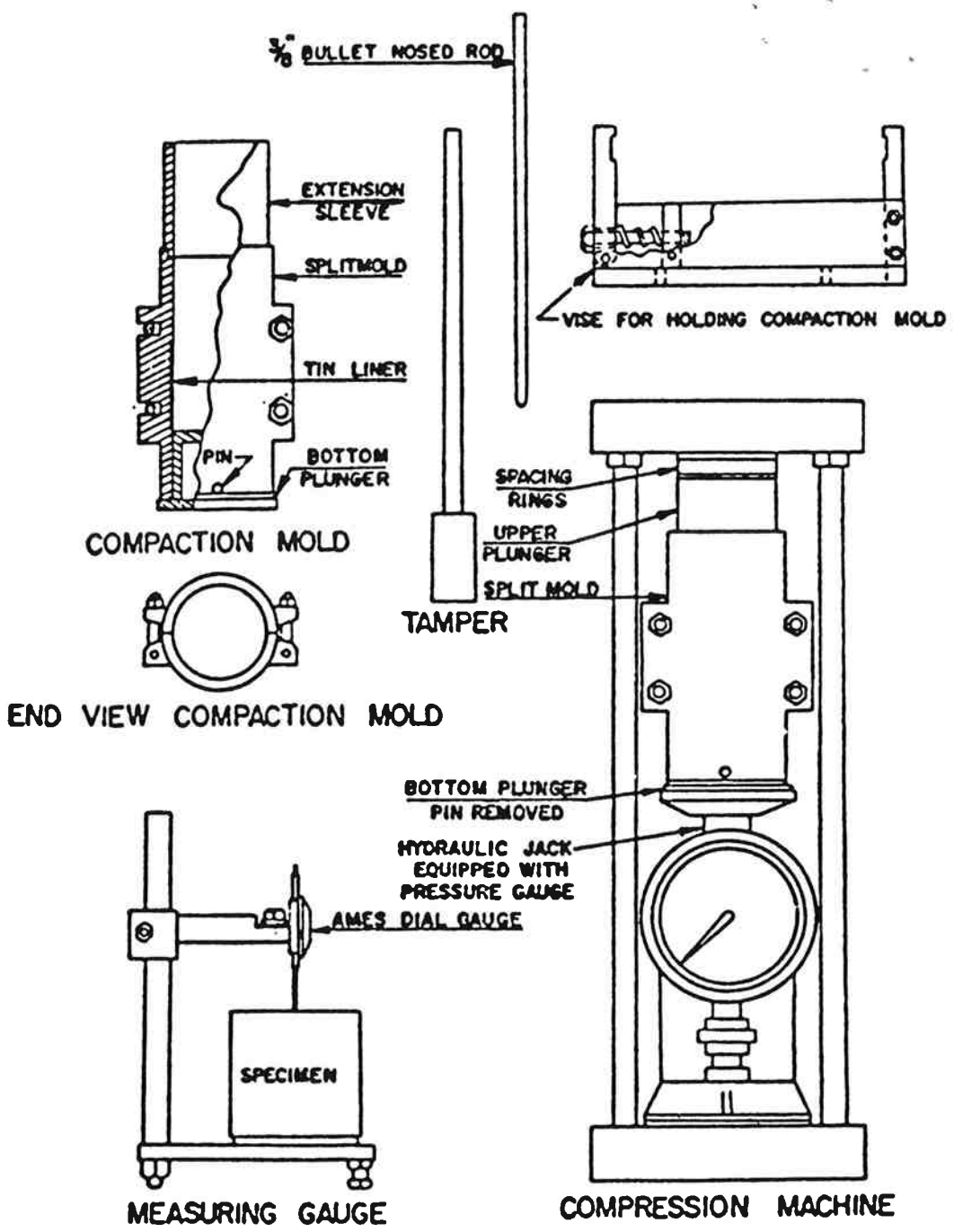

Fig. G.1. Hydraulic Compaction Apparatus (OSHD Test Method 126-86).

apply a total load of 25,000 lbs. Use 1 minute to attain the first 20,000 lbs., and another 1/2 of a minute to attain the next 5,000 lbs. Hold this 25,000 lbs. for 1 minute, then release the load. Remove the assembly from the jack being sure to hold the bottom plunger so it doesn't fall out.

7. Remove the liner from the split mold and wipe any free liquid off from the tin mold and the filter papers. Weigh the specimen (specimen, 2 filters and liner) and record this weight. Subtract the weight of the liner and filter paper to get the net weight of the specimen.

8. The difference between the initial weight of the sample and the net weight of the specimen is the liquid loss.

5.0 Results and Evaluation

Table G.1 and Figure G.2 summarize the results of trial batches of recycle mixture in which the emulsion and the water contents were varied. The emulsion was varied from the actual content used during construction to 0.9% above and 0.5% below this content of 1.0%. The added water was varied from 0.0% to a content in which 20 milliliters, 20 grams, were lost during the test. This 20 milliliter loss occurred at or above 4.5% total liquid (emulsion and water).

These results are obtained using the RAP from the Warm Springs unit. During the casting of the Marshall Molds a water content that would result, when added to the amount of emulsion, in 4.0% total liquid was found to be optimum.

Of the 17 tests recorded, 3 were recast as they appeared to be outside the curve. A standard deviation was not calculated due to the small number of

tests. All materials were heated to 140°F prior to mixing, this created some water loss during mixing and usually 2 or more grams of water were added to bring the mixture back up to the required water content prior to adding the emulsion. It was observed at the higher emulsion content that the liquid lost was primarily emulsion. At the lower emulsion content of 0.5% the lost liquid was clear water. The majority of the liquid lost at the mix design emulsion content was water discolored slightly with a small amount of emulsion. The variations in gradation that were visually discernible did not seem to effect the test. All RAP was screened over a 3/4" sieve, the retained material was broken with a hammer.

6.0 Conclusions

Mix that does not loose liquid during compaction requires an increase in emulsion or water content. From our experience with the following data obtained during the 1986 recycle projects a liquid loss between 15 and 20 grams appears to be the optimum.

The void content of the compacted mix specimen can be calculated after measurement of the specimen volume, drying the mix, calculating the dry density and determining the maximum dry specific gravity. The specimens produced under this procedure have reproduced the densities achieved in the roadway. Currently the Marshall data is being used to calculate maximum density and no data are available on the void content of the liquid loss specimen.

Table G.1 CTB Water Loss Test

Emulsion Content	Dry Wt.	H^2O Wt.	Emulsion Weight	% H^2O	% Emulsion	Total Liquid	Sample Weight	CTB Weight	ml Loss
1.9%	1700.8	1700.8	1733.1	0.0	1.9	1.9	1704.9	1702.0	2.9
which is	1654.8	1671.3	1702.7	1.0	1.9	2.9	1618.1	1612.9	5.2
0.9% over	1701.2	1726.7	1759.0	1.5	1.9	3.4	1740.4	1730.4	10.0
design	1700.2	1734.2	1766.5	2.0	1.9	3.9	1743.7	1724.1	19.6
	1702.3	1746.6	1778.9	2.6	1.8	4.5	1754.8	1733.1	21.7
1.0%	1705.2	1722.3	1739.4	1.0	1.0	2.0	1719.7	1715.7	4.0
this is	1700.1	1725.6	1742.6	1.5	1.0	2.5	1741.3	1734.4	6.9
mix design	1699.0	1733.0	1750.0	2.0	1.0	3.0	1740.5	1731.0	9.5
content	1700.7	1743.2	1760.2	2.5	1.0	3.5	1756.1	1744.7	11.4
	1702.8	1753.9	1770.9	3.0	1.0	4.0	1760.8	1744.5	16.3
	1705.5	1765.2	1782.3	3.5	1.0	4.5	1763.2	1740.9	22.3
0.5	1702.5	1719.5	1728.0	1.0	0.5	1.5	1723.5	1720.5	3.0
This is	1704.6	1738.7	1747.2	2.0	0.5	2.5	1736.1	1732.1	4.0
0.5% below	1700.3	1742.8	1751.3	2.5	0.5	3.0	1742.6	1737.3	5.3
mix design	1699.0	1750.0	1758.5	3.0	0.5	3.5	1735.0	1726.6	8.4
	1700.4	1760.0	1768.4	3.5	0.5	4.0	1755.9	1735.2	20.7
	1701.1	1769.1	1777.7	4.0	0.5	4.5	1766.1	1740.9	25.2

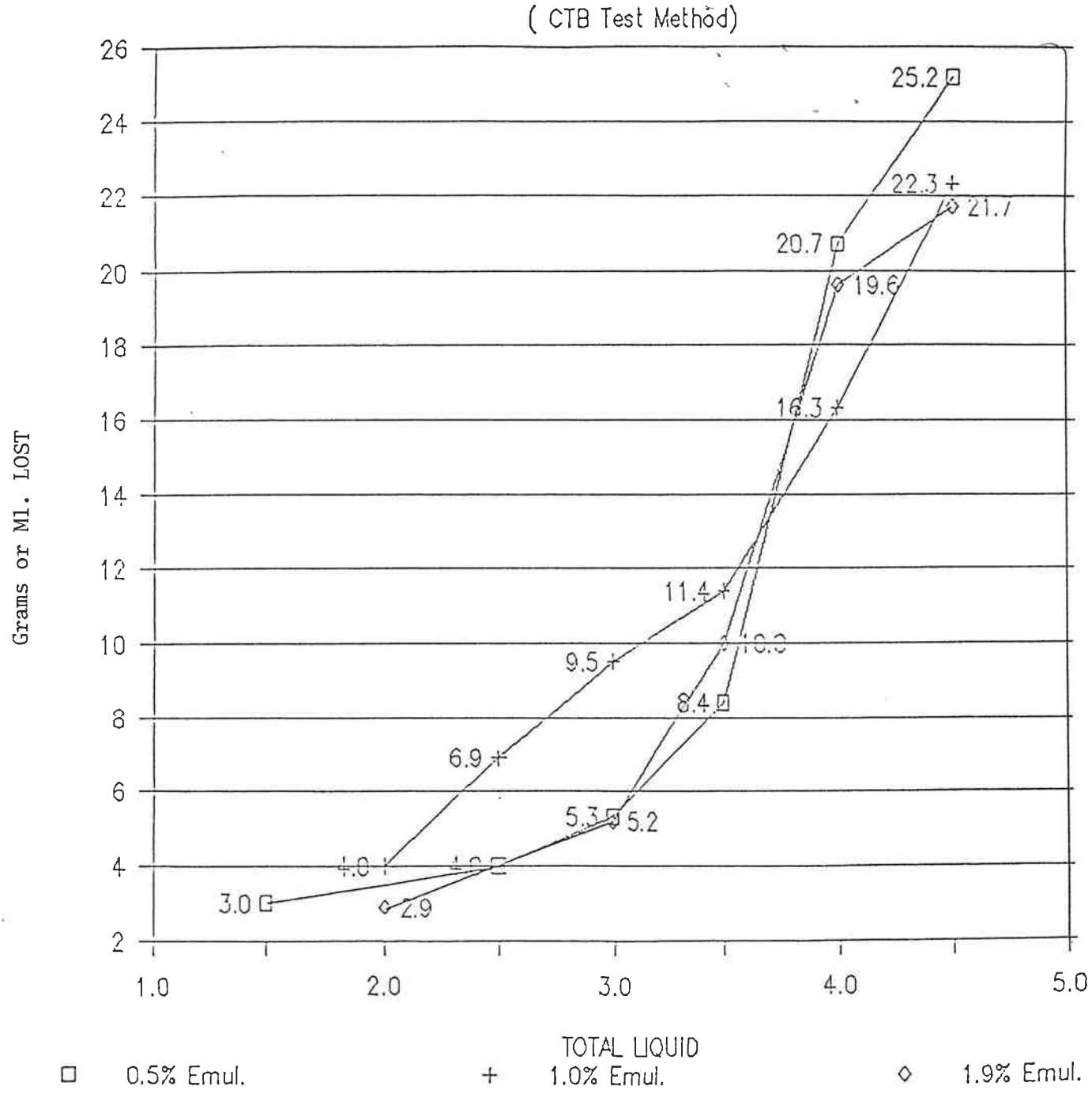

Fig. G.2. Liquid Content vs. Water Loss.