Otta Seal:

Thin flexible pavement surface treatment

60th Annual County Engineers' Workshop
Delta Hotels Muskegon Convention Center, Muskegon, MI
04 February 2026

Agenda

- Introduction
- History
- The Johnson County (Iowa) Otta Seal
- Wrap up
  - Lessons Learned
  - Questions

THANK YOU!

Michigan County Engineer’s Workshop

Pete Torola - Michigan Technological University

History

Johnson County Iowa (2000's)

1. Road performance issues
   a) Frost boils
   b) Vanishing rocks
   c) Impassible in spring
2. Macadam/Choke rehabilitation
3. Drainage improvements
4. Traditional double chipseals

What is Otta Seal?

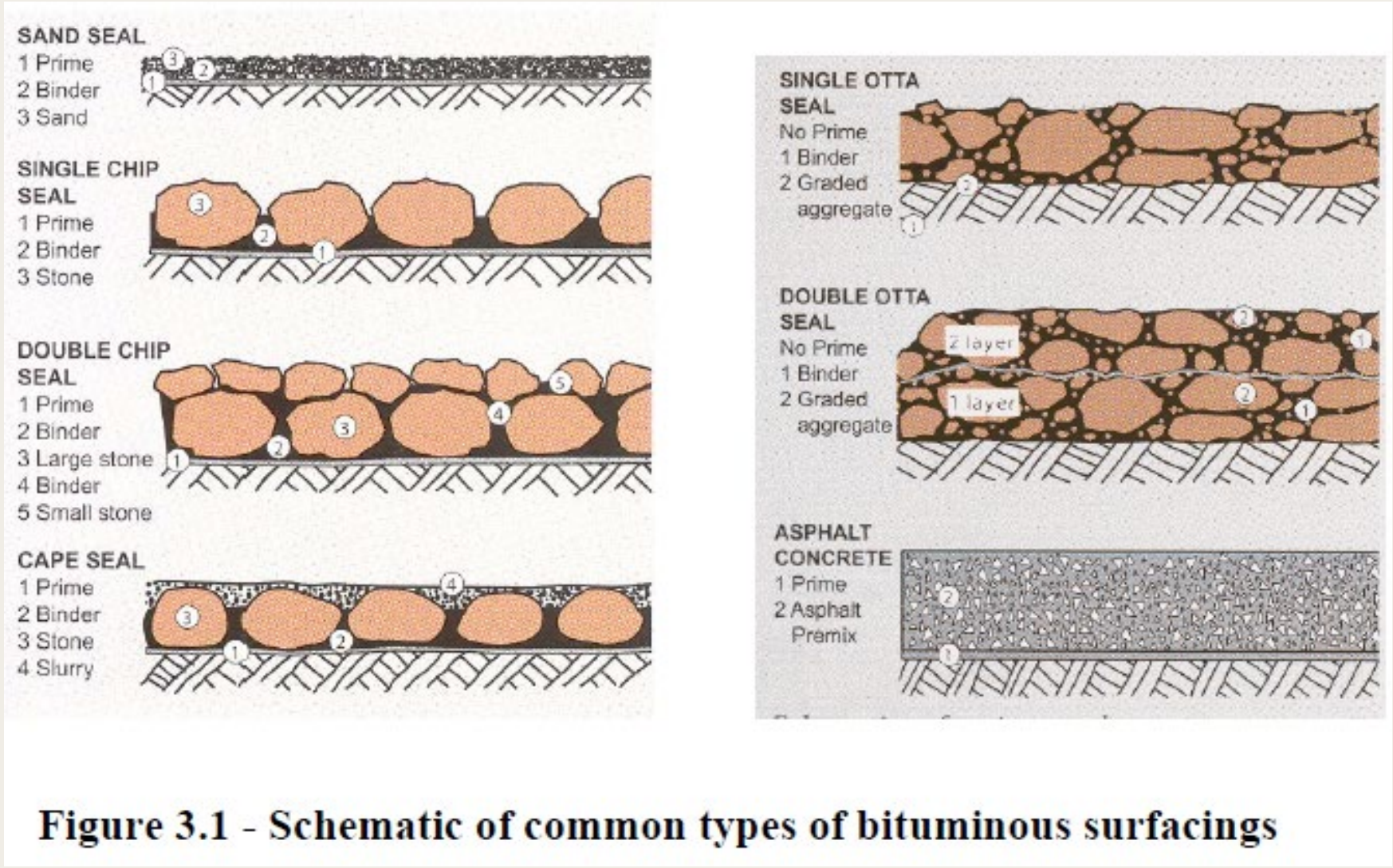


Figure 3.1 - Schematic of common types of bituminous surfacings

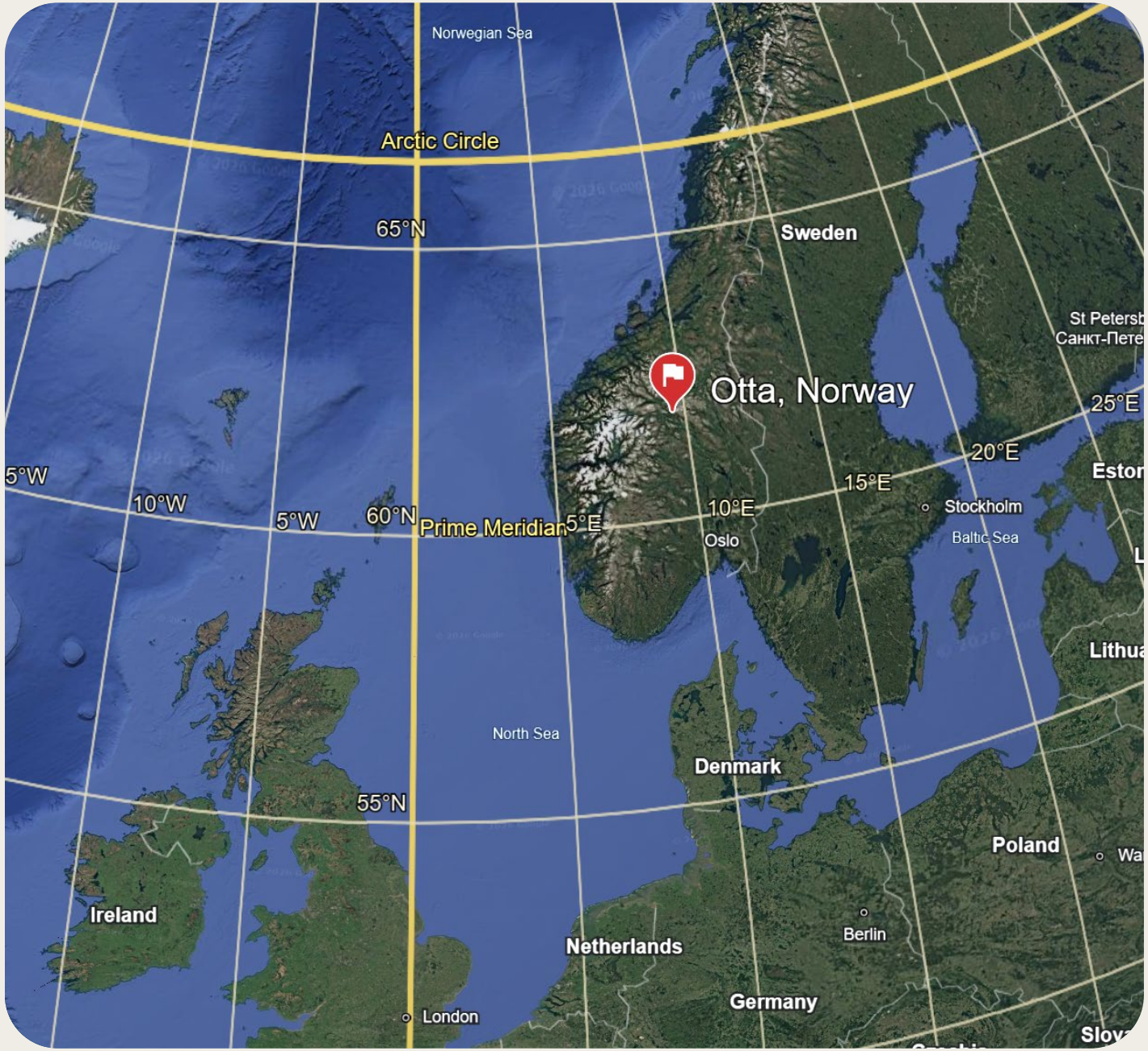
Image credit:*Overby/Pinard (2007) "The Otta Seal Surfacing" [Botswana]*

What is Otta Seal (Cont.)

Charles Overby (probably):

> “Do you have some cheap, local rocks?”
>
> “Do you have any recycled dinosaur products?”
>
> “Do you have any equipment that can bring those two things together?”
>
> “No equipment. Ok, how about inexpensive labor?”
>
> Hold my beer.

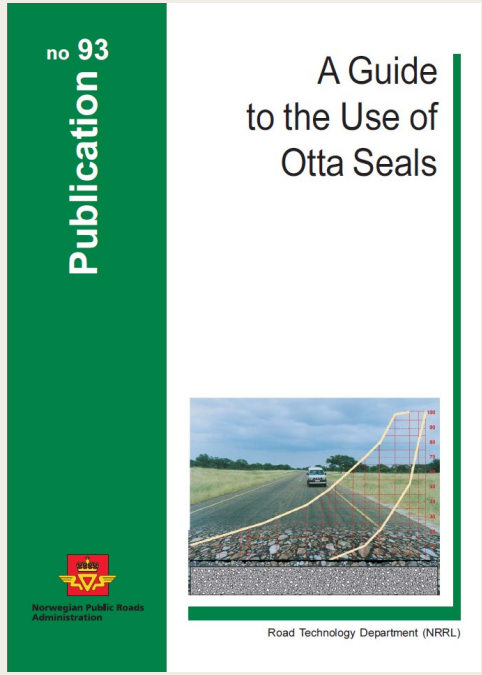
Image credit:*Overby/Pinard (2007) “The Otta Seal Surfacing” [Botswana]*

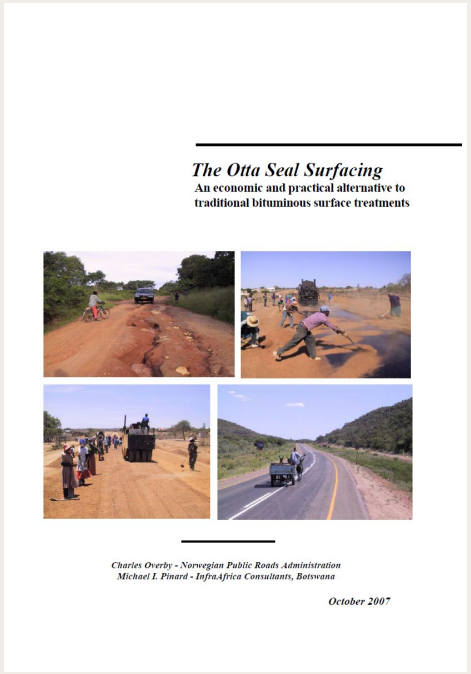


Norway

(Charles Øverby)

1. Named for the Otta Valley
2. 60+ years of construction & performance observations
3. Published in 1999 & 2007





Minnesota

1. Similar climate
2. Same road performance issues
3. Minnesota Road Research, 2003 & 2008

Otta Seal Surfacing of Aggregate Roads

2008 M&RR

Author: Greg Johnson, John Pantelis 2003, 2008

Description: An Otta seal is an asphalt surface treatment constructed by placing a graded aggregate on top of a thick application of relatively soft bituminous binding agent. Minnesota has used emulsified asphalt exclusively (HFMS-2s); it could be constructed with cutback asphalt if desired. The binder works its way into the aggregate with rolling and traffic. In comparison to other surface treatments, material and construction specifications are not as strict. Local aggregates that would not meet the requirements for high quality paving aggregate are often used in Otta seals.

Traffic Range: Very Low to High (AADT < 2000) for a double Otta seal.

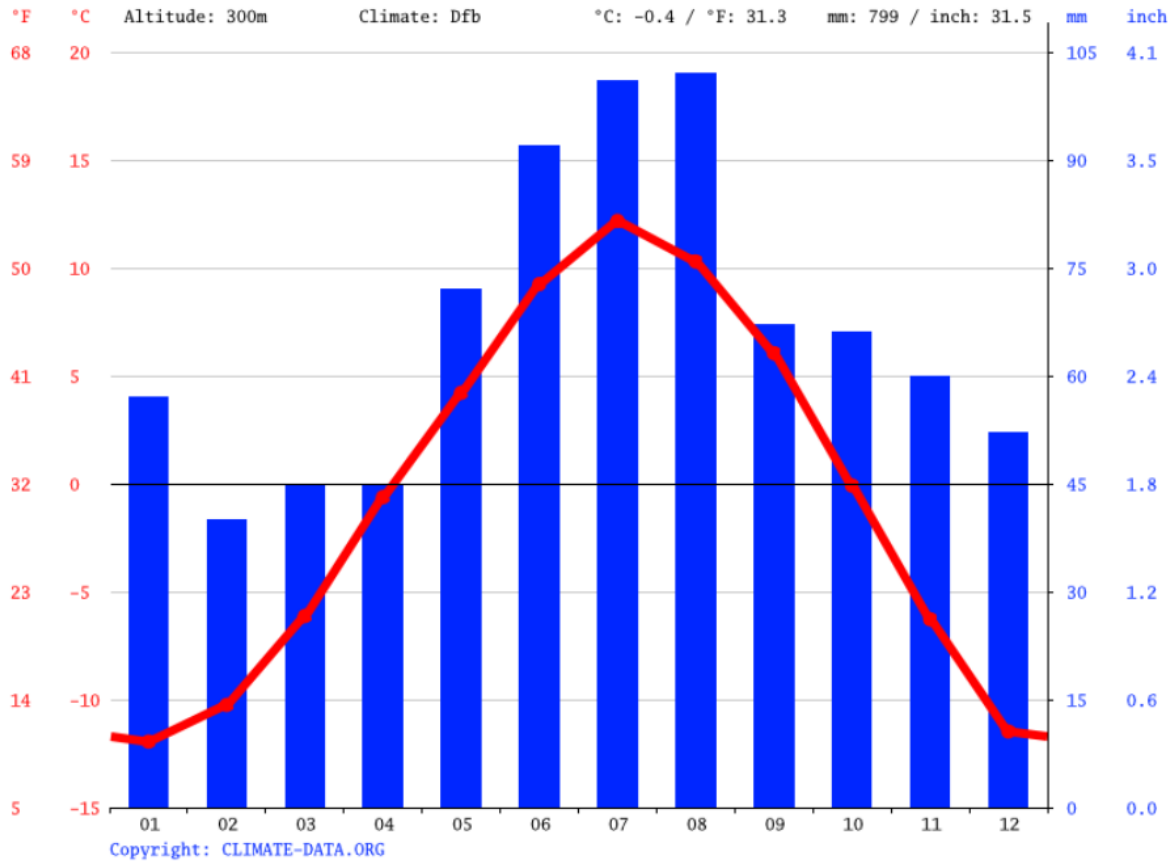
Base/Subbase Requirements: Otta seals are constructed over an aggregate base course. Since Otta seals do not add structural capacity to the roadway, the base/subbase must be designed to support the anticipated traffic loading. Subgrade and base materials should be compacted and graded to provide a stable working surface prior to Otta seal placement. A prime coat is usually not used above the aggregate base prior to Otta seal application.

Materials: An Otta seal is constructed of a graded aggregate on top of a thick application of relatively soft bituminous binding agent. The bituminous binding is typically an emulsified asphalt (e.g. HFMS-2s). Bituminous binder application rates vary from about 1.9 liter/m^2 (0.45 gal/yd^2) to 2.4 liter/m^2 (0.56 gal/yd^2) for emulsified asphalt, depending on aggregate gradation and type. In comparison to other surface treatments, material and construction specifications are not as strict. Local aggregates that would not meet the requirements for high quality paving aggregate are often used in Otta seals. Natural gravels are acceptable. The maximum aggregate size in the graded aggregate is generally 13 to 25 mm (0.50 to 1 in.). The graded aggregate can be crushed or uncrushed and contain up to 10% fines. Quantities of aggregate are usually around 50 lb/yd2. Otta seal design is empirical in nature and trial sections are recommended to determine the appropriate material application rates.

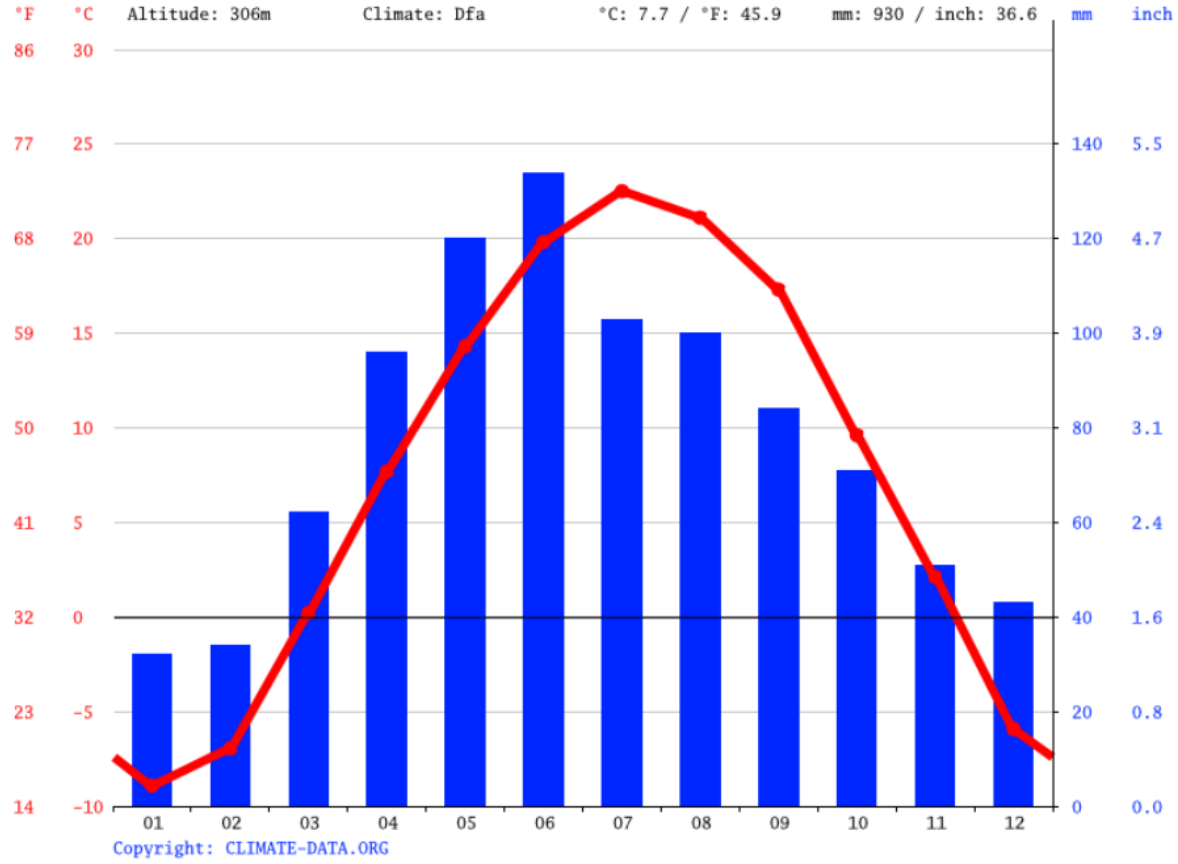
Otta Seal Const. 2007, Olmsted County CR58

Climate Comparison

CLIMOGRAPH OTTA



CLIMOGRAPH ROCHESTER



Climate Comparison

Otta, Norway

	January	February	March	April	May	June	July	August	September	October	November	December
Avg. Temperature °C (°F)	-11.9 °C (10.5) °F	-10.2 °C (13.6) °F	-6.1 °C (21) °F	-0.6 °C (30.9) °F	4.2 °C (39.6) °F	9.2 °C (48.6) °F	12.2 °C (53.9) °F	10.3 °C (50.5) °F	6 °C (42.9) °F	-0.1 °C (31.8) °F	-6.3 °C (20.7) °F	-11.5 °C (11.3) °F
Min. Temperature °C (°F)	-14.6 °C (5.7) °F	-13.2 °C (8.3) °F	-9.6 °C (14.7) °F	-4.3 °C (24.2) °F	0.1 °C (32.2) °F	4.7 °C (40.5) °F	8 °C (46.3) °F	6.6 °C (43.8) °F	2.8 °C (37) °F	-2.7 °C (27.1) °F	-9 °C (15.7) °F	-14.5 °C (5.9) °F
Max. Temperature °C (°F)	-9.5 °C (14.8) °F	-7.6 °C (18.4) °F	-2.9 °C (26.8) °F	2.7 °C (36.9) °F	7.7 °C (45.9) °F	13 °C (55.4) °F	15.8 °C (60.4) °F	13.7 °C (56.7) °F	9.3 °C (48.8) °F	2.5 °C (36.5) °F	-3.9 °C (24.9) °F	-8.7 °C (16.4) °F
Precipitation / Rainfall mm (in)	57 (2)	40 (1)	45 (1)	45 (1)	72 (2)	92 (3)	101 (3)	102 (4)	67 (2)	66 (2)	60 (2)	52 (2)
Humidity(%)	85%	82%	80%	76%	71%	68%	73%	78%	83%	87%	90%	84%
Rainy days (d)	10	8	8	8	10	11	12	11	9	9	9	9

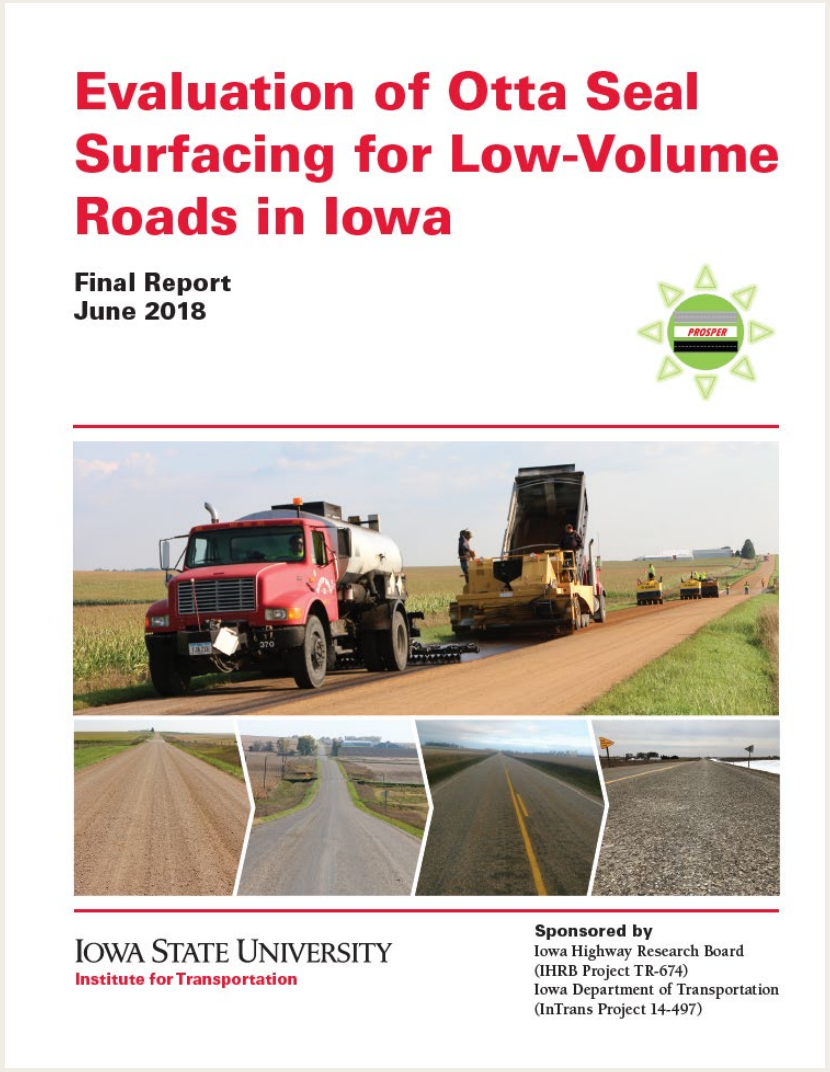
Rochester, MN

	January	February	March	April	May	June	July	August	September	October	November	December
Avg. Temperature °C (°F)	-8.9 °C (15.9) °F	-7 °C (19.5) °F	0.2 °C (32.4) °F	7.7 °C (45.9) °F	14.3 °C (57.8) °F	19.8 °C (67.7) °F	22.5 °C (72.5) °F	21.1 °C (70) °F	17.3 °C (63.2) °F	9.6 °C (49.3) °F	2.1 °C (35.8) °F	-5.9 °C (21.3) °F
Min. Temperature °C (°F)	-12.5 °C (9.4) °F	-10.8 °C (12.5) °F	-3.9 °C (24.9) °F	3.1 °C (37.6) °F	9.8 °C (49.7) °F	15.5 °C (59.9) °F	18.2 °C (64.8) °F	17 °C (62.6) °F	13.4 °C (56.1) °F	6.1 °C (43) °F	-1 °C (30.2) °F	-9.2 °C (15.5) °F
Max. Temperature °C (°F)	-4.4 °C (24.1) °F	-2 °C (28.5) °F	5.7 °C (42.2) °F	13.6 °C (56.4) °F	19.6 °C (67.4) °F	24.7 °C (76.4) °F	27.1 °C (80.8) °F	25.7 °C (78.2) °F	22.1 °C (71.8) °F	14.1 °C (57.4) °F	6.3 °C (43.3) °F	-2 °C (28.3) °F
Precipitation / Rainfall mm (in)	32 (1)	34 (1)	62 (2)	96 (3)	120 (4)	134 (5)	103 (4)	100 (3)	84 (3)	71 (2)	51 (2)	43 (1)
Humidity(%)	75%	74%	69%	65%	65%	69%	69%	71%	66%	68%	72%	75%
Rainy days (d)	5	5	6	9	10	9	8	8	6	6	5	6
avg. Sun hours (hours)	4.7	5.6	7.0	8.2	9.4	10.5	10.8	9.5	8.4	6.5	5.7	4.2

2014 Crash & burn

1. Wrote my own specification since Iowa didn’t have one.
2. Followed Overby’s guidelines almost to the letter.
3. Couldn’t get a contractor to build it for a reasonable price.

2018 Academia to the rescue

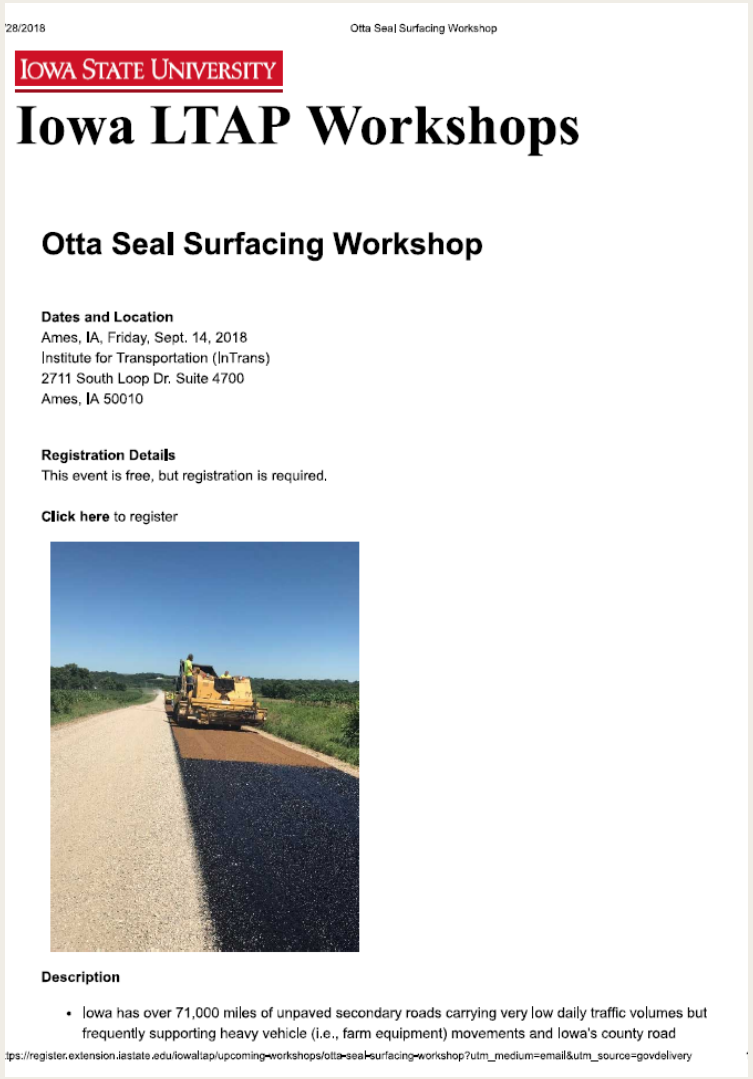


Evaluation of Otta Seal Surfacing for Low-Volume Roads in Iowa

Final Report
June 2018

IOWA STATE UNIVERSITY
Institute for Transportation

Sponsored by
Iowa Highway Research Board
(IHRB Project TR-674)
Iowa Department of Transportation
(InTrans Project 14-497)



'28/2018 Otta Seal Surfacing Workshop

IOWA STATE UNIVERSITY

Iowa LTAP Workshops

Otta Seal Surfacing Workshop

Dates and Location
Ames, IA, Friday, Sept. 14, 2018
Institute for Transportation (InTrans)
2711 South Loop Dr. Suite 4700
Ames, IA 50010

Registration Details
This event is free, but registration is required.

Click here to register

Description

- Iowa has over 71,000 miles of unpaved secondary roads carrying very low daily traffic volumes but frequently supporting heavy vehicle (i.e., farm equipment) movements and Iowa's county road

tps://register.extension.iastate.edu/iowaltap/upcoming-workshops/otta-seal-surfacing-workshop?utm_medium=email&utm_source=govdelivery

Special thanks:

Dr. Halil Ceylan (ISU, PROSPER)
Dr. Charles Jahren (ISU)
Dr. Keith Knapp (Iowa LTAP)
Brian Moore, PE (ICEASB)
Mr. Charles Overby

Iowa DOT
All of the counties and engineers that participated in the research program.

Shaping and drainage

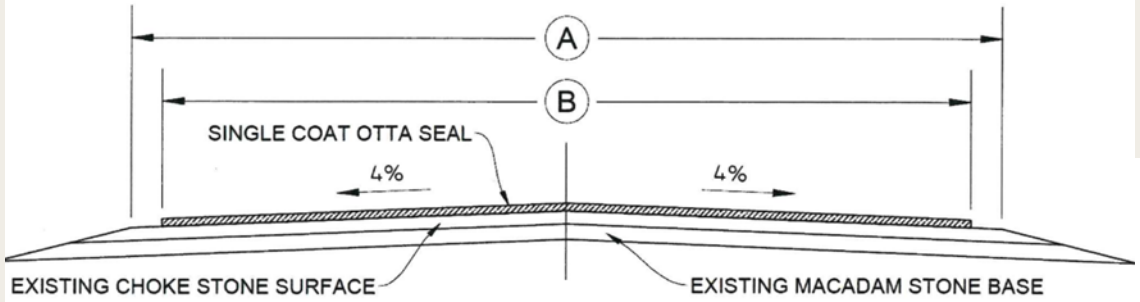
Macadam (daylighted to ditch)

Choke stone surface shaped

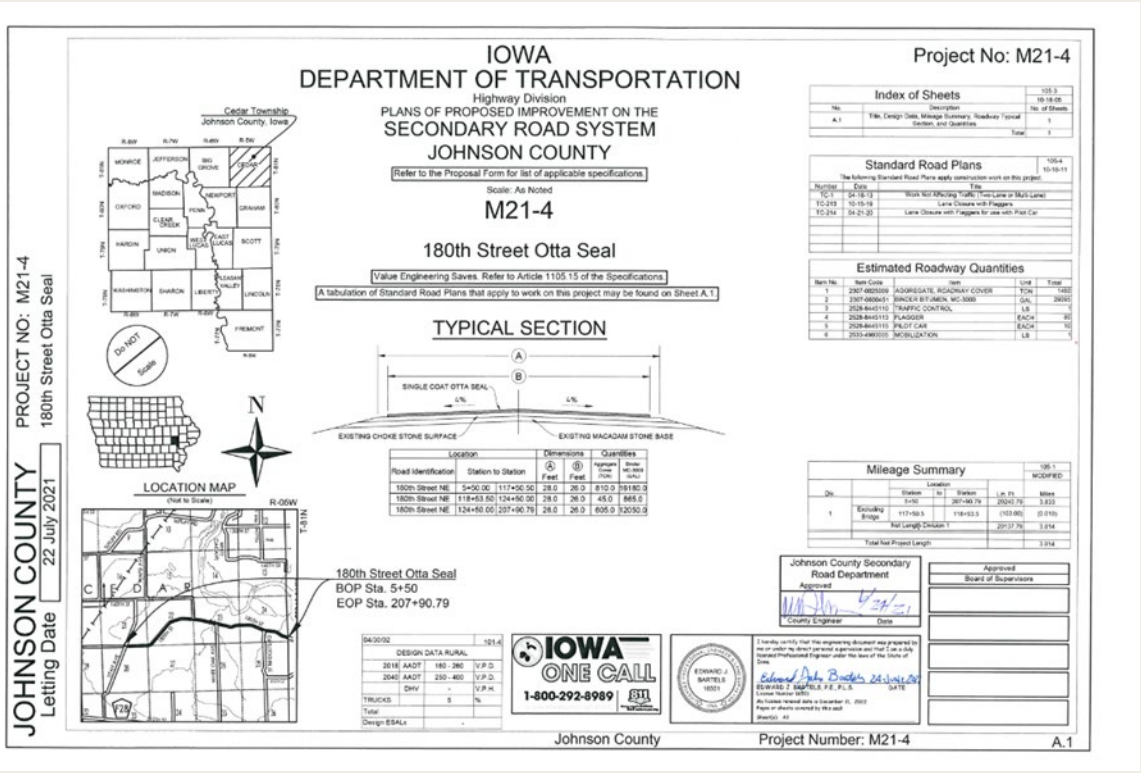
Putting it all together

2021 - Aged to “pretty good”

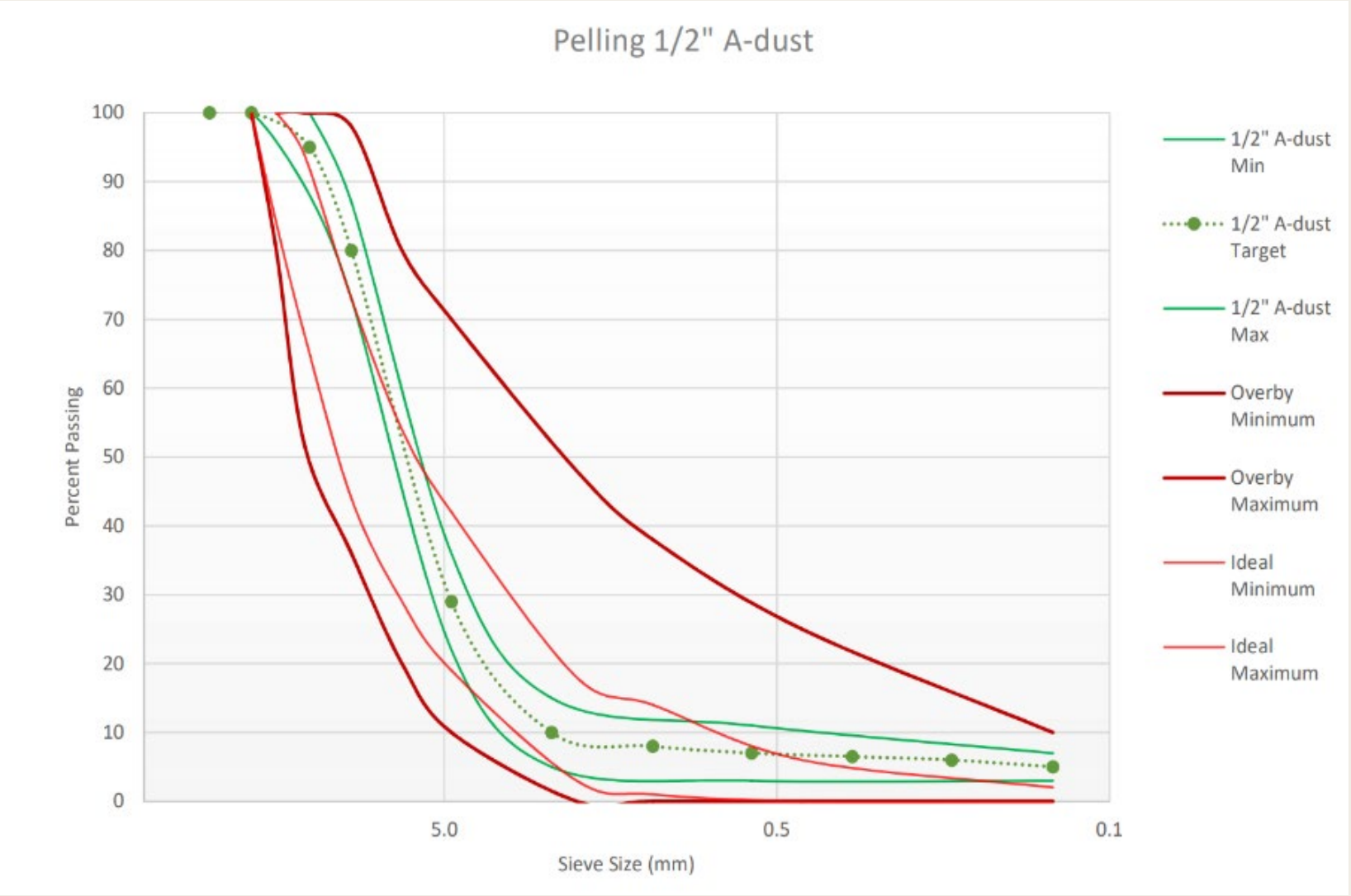
TYPICAL SECTION



Location			Dimensions		Quantities	
Road Identification	Station to Station		Ⓐ Feet	Ⓑ Feet	Aggregate Cover (TON)	Binder MC-3000 (GAL)
180th Street NE	5+50.00	117+50.50	28.0	26.0	810.0	16180.0
180th Street NE	118+53.50	124+50.00	28.0	26.0	45.0	865.0
180th Street NE	124+50.00	207+90.79	26.0	26.0	605.0	12050.0



2021 - Aged to “pretty good”



2021 - Aged to “pretty good”

		Overby Publication 93 1999 - Open Grading: AADT<100		Overby Publication 93 1999 - Med. Grading: 100<AADT<1000		Overby Publication 93 1999 - Dense Grading: AADT>1000		Overby Publication 93 1999 - General Grading		IADOT Gradation #11 - Class A		Pelling Gradation 1/2" A-dust		
Sieve Size/No.		%Passing		%Passing		%Passing		%Passing		%Passing		%Passing		
English Standard	Metric (mm)	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Target	Max
1-1/2"	38.1													
1"	25.4									100.0		100.0	100.0	
3/4"	19.0	100.0		100.0		100.0		100.0		95.0	100.0	100.0	100.0	
5/8"	16.0	80.0	100.0	84.0	100.0	93.0	100.0	80.0	100.0					
0.52	13.2	52.0	82.0	68.0	94.0	84.0	100.0	52.0	100.0					
1/2"	12.7									70.0	90.0	88.0	95.0	100.0
3/8"	9.51	36.00	58.00	44.00	73.00	70.00	98.00	36.00	98.00			73.0	80.0	87.0
0.265	6.70	20.00	40.00	29.00	54.00	54.00	80.00	20.00	80.00					
4	4.76	10.00	30.00	19.00	42.00	44.00	70.00	10.00	70.00	30.0	55.0	22.0	29.0	36.0
8	2.38									15.0	40.0	5.0	10.0	15.0
10	2.00	0.00	8.00	3.00	18.00	20.00	48.00	0.00	48.00					
16	1.18	0.00	5.00	1.00	14.00	15.00	38.00	0.00	38.00				8.0	
30	0.595											3.0	7.0	11.0
40	0.420	0.000	2.000	0.000	6.000	7.000	25.000	0.000	25.000					
50	0.297												6.5	
100	0.149												6.0	
200	0.074	0.000	1.000	0.000	2.000	3.000	10.000	0.000	10.000	6.0	16.0	3.0	5.0	7.0

2022 Update - Aged to “near perfect”

2022 Update - Aged to “near perfect”

2022 Update - Aged to “near perfect”

2025 Update - are you kidding me?

2025 Update - are you kidding me?

2025 Update - are you kidding me?

Wrap-up

Otta Seal - A Recipe for Success

STEP 1 - Prepare

- Get the water out
  - Ditches below your base
  - Evaluate and replace pipes
  - Large gaps - no pore space
  - Daylight base/Wicking fabrics?
- Stabilize your base
  - Mechanical
    - Macadam
    - Geogrid/Geosynthetics
  - Chemical (Base 1, etc.)
- Establish Crown (+ drainage)

STEP 2 - Otta Seal

- Local Rocks
  - *~50 lbs/SY*
  - Well-graded
  - Keep the train tight!
- Match binder to use case
  - MC-3000
  - HFMS-2
  - CRS-2P
  - *~0.50 gal/SY*
- Roll and roll and roll some more
  - 14T Pneumatics
  - Delivery vehicles

QUESTIONS????

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