

TRANSPORTATION RESEARCH BOARD

# Specifying Clay and Gravel for Road Surfacing

**December 9, 2020**

**@NASEMTRB**  
**#TRBwebinar**

# PDH Certification Information:

- 1.5 Professional Development Hour (PDH) – see follow-up email for instructions
- You must attend the entire webinar to be eligible to receive PDH credits
- Questions? Contact Reggie Gillum at [RGillum@nas.edu](mailto:RGillum@nas.edu)

*The Transportation Research Board has met the standards and requirements of the Registered Continuing Education Providers Program. Credit earned on completion of this program will be reported to RCEP. A certificate of completion will be issued to participants that have registered and attended the entire session. As such, it does not include content that may be deemed or construed to be an approval or endorsement by RCEP.*



**REGISTERED CONTINUING EDUCATION PROGRAM**

**#TRBwebinar**

# Learning Objectives

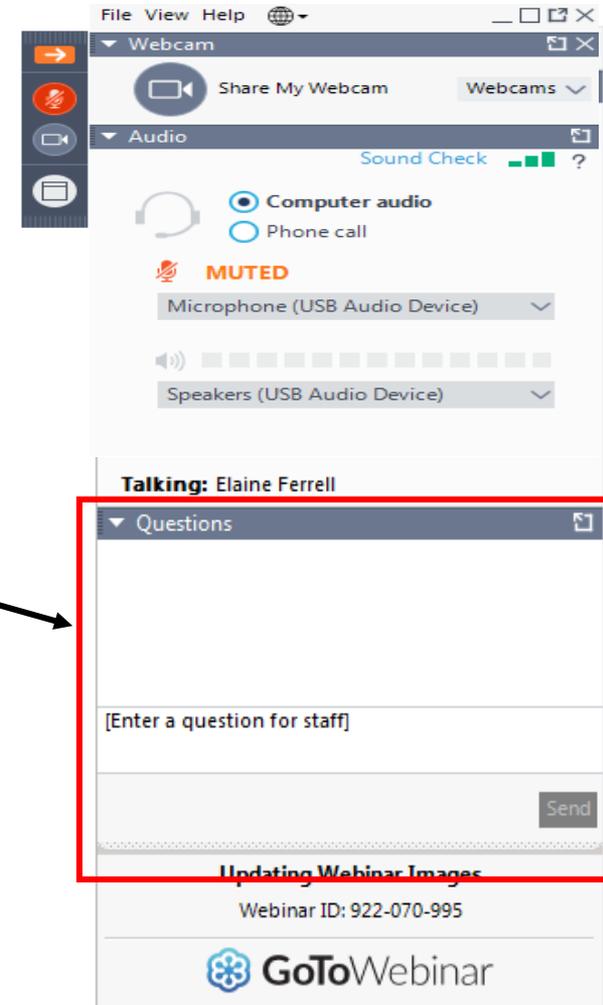
1. Identify rationales for selecting optimum clay content
2. Describe reasoning behind specification clauses
3. Discuss successful quality and quantity assurance methods

**#TRBwebinar**



# Questions and Answers

- Please type your questions into your webinar control panel
- We will read your questions out loud, and answer as many as time allows



**#TRBwebinar**

# Today's Panelists

- Steve Monlux, *LVR Consultants*
- Oscar Mena, *USDA*
- Brian Moore, *Iowa County Engineers Association Service Bureau*

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# Guide Specification for Gravel Road Surfacing

(TRB Paper Number 19-06145)

Stephen Monlux PE  
LVR Consultants LLC  
Missoula MT

Oscar Mena, Civil Engineer  
Uinta Wasatch Cache National Forest  
South Jordan, Utah

# The Need for a Guide Specification (Spec)

- Poor gravel surfacing performance



- Poor understanding of good gradation and clay content
- Not enough funding or personnel to administer the typical state spec
- Limited understanding of how to add clay binder
- Contract disputes that waste time

# Sources of Guide Spec Information and Ideas

- Counties and Road District Personnel
- Rock Crushing Contractors
- Testing Labs
- Guide Spec started in 2010, edited annually and posted on internet  
Google: “Guide Spec for Gravel Road Surfacing”

# Spec Overview

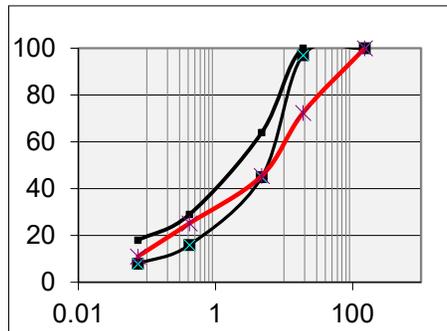
- Spec: 3 pages
- User Note: 3 pages
- Much more than Gradation & Plasticity Index
  - Options for adding clay
  - Sampling & testing
  - Quantity assurance
  - Pay adjustments for gradation and plasticity index
- Use parts you like – user notes explain purpose of clauses

# Determine Realistic Specification Limits

- Investigate Gravel Sources → Determine the following

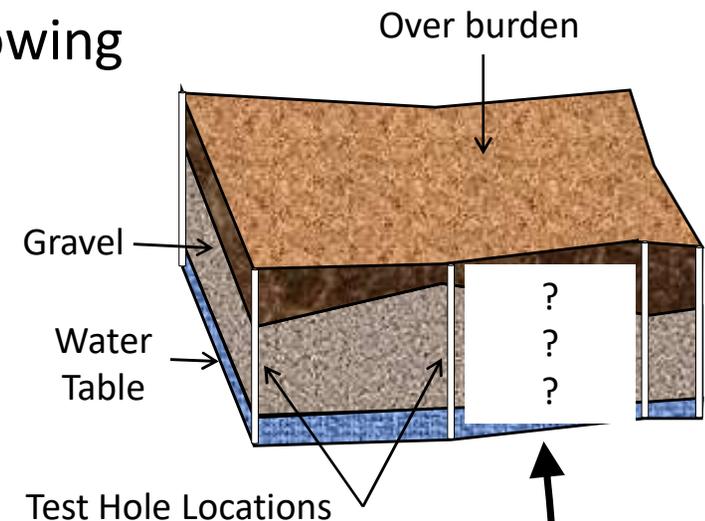
- Gradation and plasticity of layers
- Layer thicknesses
- Water table depth

- Select realistic spec limits
- Local Consultants can help



- Include two critical contract clauses

- Meeting specifications may require additional equipment and selective mining
- The quality and amount of gravel between test holes is not known

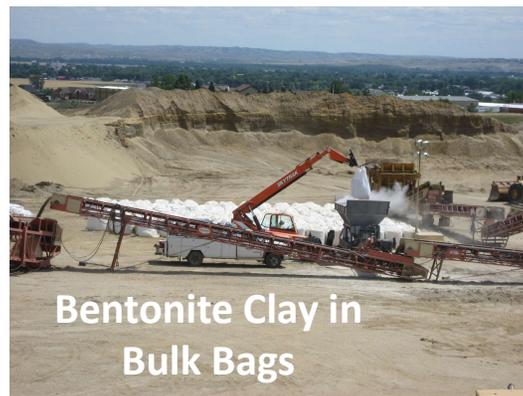


# Adding Clay for “Binder”

- Five different spec options for adding dry clay
- The best option depends on the following
  - If clay exists in the designated source
  - Sources of local clay
  - Cost of imported bentonite clay
  - Available funding
- Crushing contractors can figure out ways to add dry clay



Mon,12/7/2020



# Sampling & Testing

- Daily Composite Sample:

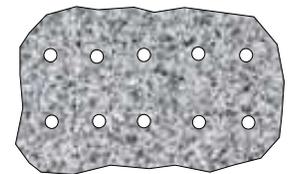
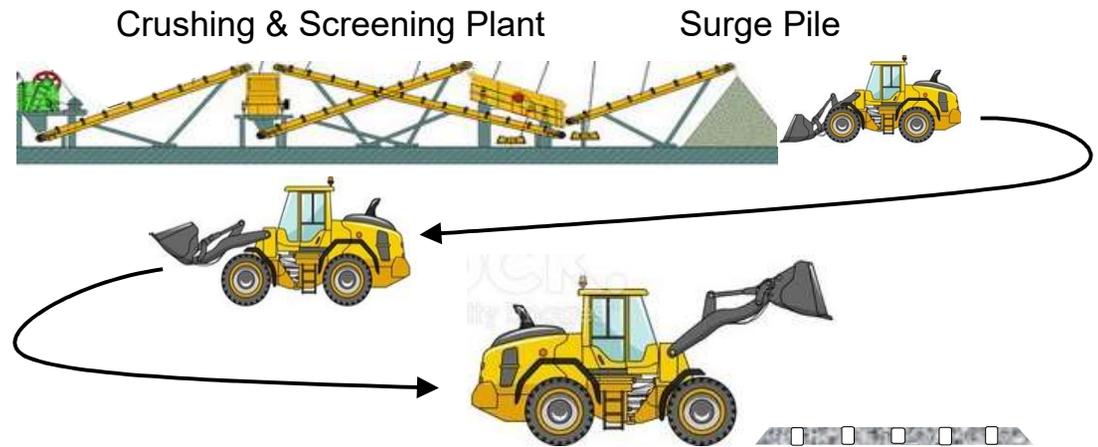
- Every two hours: Add 3 to 5 CY to sampling stockpile
- At end of day: Flattened stockpile and sample

- Testing – Two Options

- Contractor testing, check tested by Agency hired consultant lab - OR
- Agency consultant lab tests all acceptance samples

- Acceptance

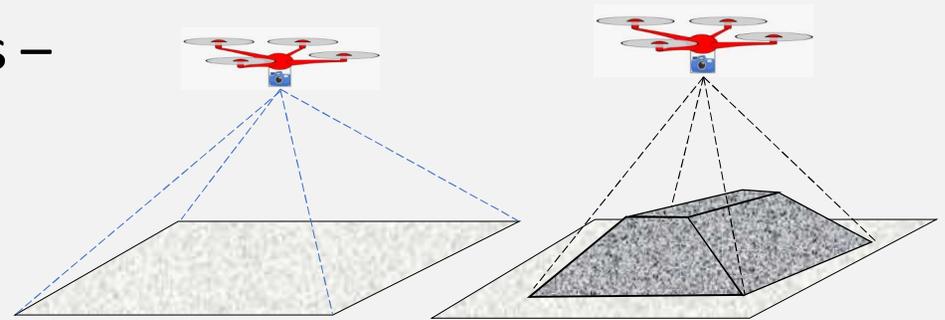
- Contract for crushing and stockpiling → Average all daily test results
- Contract for crushing and placing on road → Daily test result



AASHTO T2 &  
ASTM D75  
Sec 5.3.3.1

# Quantity Assurance

- Cubic Yards for Stockpile Contracts – measured by drone
- Agency pays for two surveys:
  - Stockpile floor
  - Stockpile
- If quantity less than 95% of specified, Contractor crushes more gravel and pays for final survey
- Pay on actual cubic yards in stockpile between 95% and 105% of specified quantity



# Pay Adjustment for Gradation, % Fracture & Plasticity

Pay Adjustment Factor	1.05	1	0.95	0.75	0.5	0
Sieve Size	Percent Passing					
1inch						
3/4 inch						
3/8 inch (8)						
No. 4 (6)						
No. 16 (4)						
No. 40 (3)						
No. 200 (2)						
% Fracture, one face, min (15)						
Plasticity Index (5)						
Values within parenthesis are maximum allowable differences between Consultant and Contractor Test results						

# Suggestions

- Investigate gravel sources, pick realistic spec limits
- Get contractor feedback on spec before advertisement
- Allow two-year crushing option for lower costs
- Utilize parts of the guide spec that fit your needs – read user note
- Provide feedback

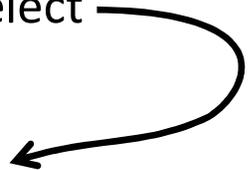
# Additional Information

- Pdf version of user guide and spec is available by
  - <https://www.mdt.mt.gov/research/projects/pave/oil.shtml> or
  - Google search for “Guide Spec for Gravel Road Surfacing” and then select

www.mdt.mt.gov › docs › research\_proj › oil\_boom › G... PDF

## Guide Spec for Gravel Road Surfacing 2020

Feb 2, 2020 — 2020 GUIDE SPEC FOR CRUSHING GRAVEL ROAD SURFACING AGGREGATE (2-2-2020 – Note that 2020 edits are in Red font). Please do ...



- Updates from “users” are made each year – note date in title (2020)

# Clay Content Optimization Test for Gravel Surfacing (TRB Paper Number 19-06146)

Stephen Monlux PE  
LVR Consultants LLC  
Missoula MT

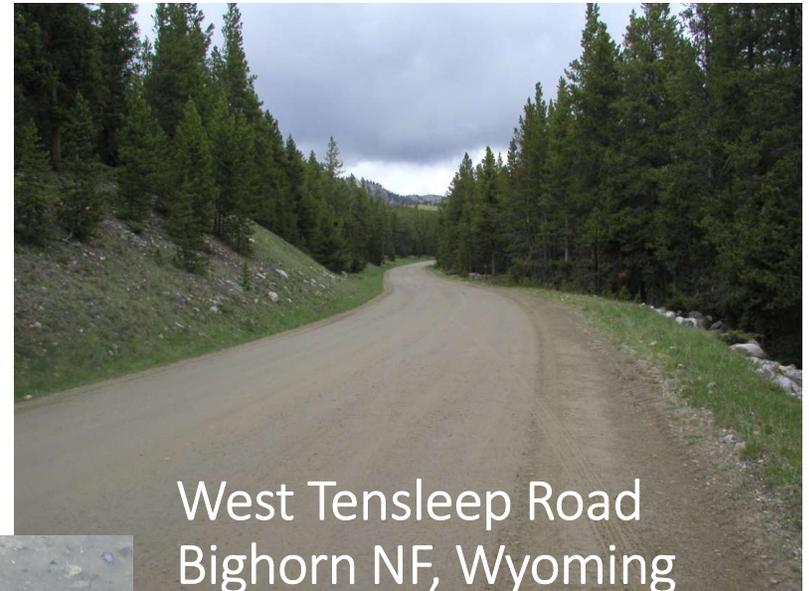
Oscar Mena, Civil Engineer  
Uinta Wasatch Cache National Forest  
South Jordan, Utah

Bethany Durie, Senior Testing Technician  
Holman Consulting Engineers  
Missoula MT

# The Need for a Clay Optimization Test

- Too much clay binder → rutting
- Too little clay binder → loose rock or washboards, chloride dust abatement leaching
- Good Gradation and Plasticity Index (PI) alone does not ensure success
- Voids in the compacted gravel are critical, but can't be specified

Decomposed Granitic "Gravel"  
with 4% Bentonite & 1.5% CaCl<sub>2</sub>



West Tensleep Road  
Bighorn NF, Wyoming

Photos taken two seasons  
after treatment

# Benefits of Clay Stabilization

- Relatively cheap binder
- Does not leach out
- Easy to blade in the spring
- Rebinds gravel year after year

# Amount and Type of Clay and Chloride Additive

- Chloride extends clay life by reducing dust losses
- Clay extends chloride life by reducing leaching
- Amount of Additives

<b>Additive Type</b>	<b>Percent (a)</b>
Dry Calcium Chloride	1.5
Clay Type	
Bank Run	3, 5 & 7
Bentonite	2, 3 & 4

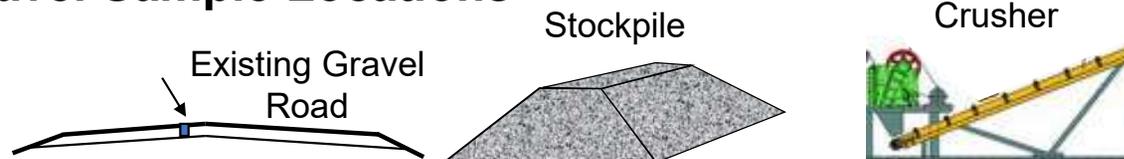
(a) Percent is based on dry gravel weight & additives at 0% moisture



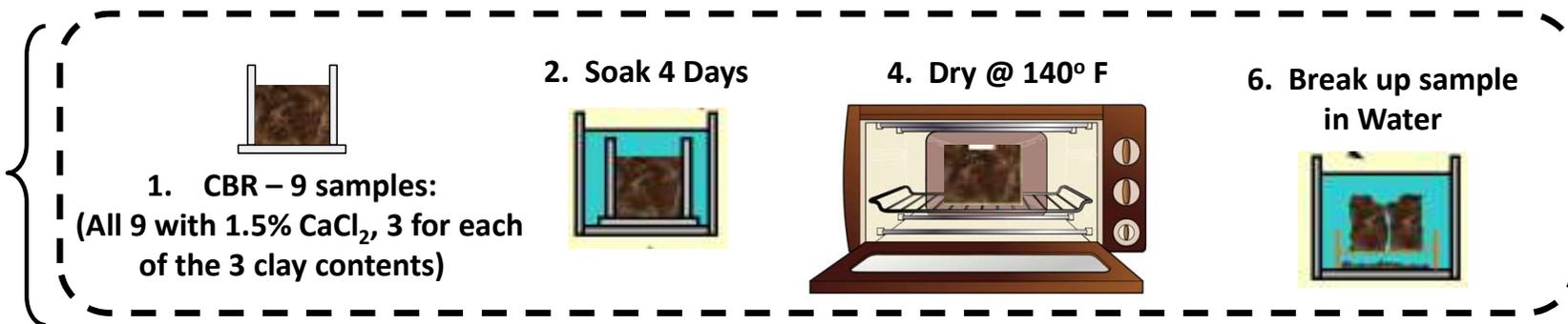
% Clay is influenced by % #200 & Plasticity Index (PI) of gravel

# Clay Content Optimization Test

## Gravel Sample Locations

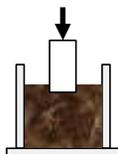


## Sample Preparation



## Testing

3. CBR (Wet Strength)

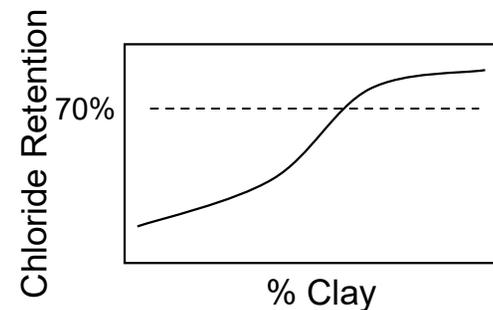
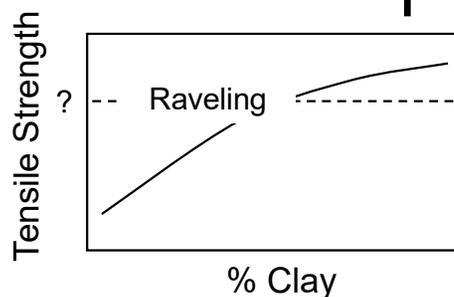
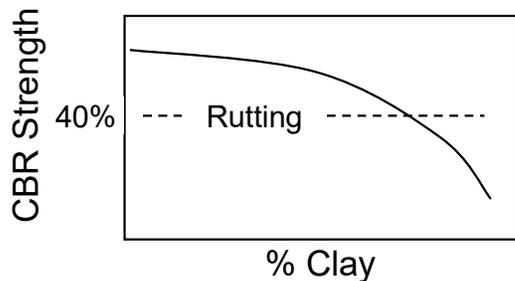


5. Split Tensile (Dry Strength)



7. Determine Chloride Retention

## Plot Test Results



# Split Tensile Test → Raveling



Load Testing Apparatus

Specimen after CBR and Tensile Testing. Note CBR Piston Hole & Tensile Crack



Specimen that split completely apart during Tensile testing



# CBR Specimens After 4-Day Soak, CBR & Split Tensile Tests

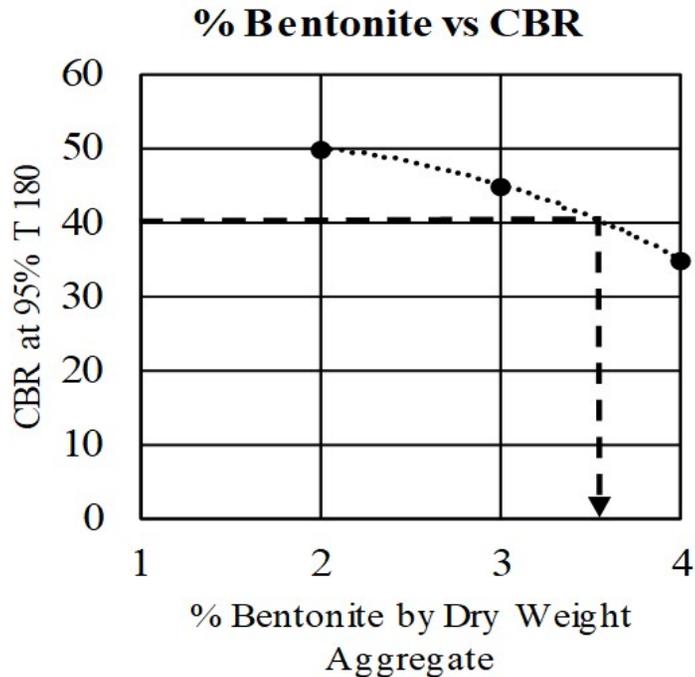


50:50 Rap Aggregate Blend with 2, 3 and 4% Bentonite

# Optimum Clay Content

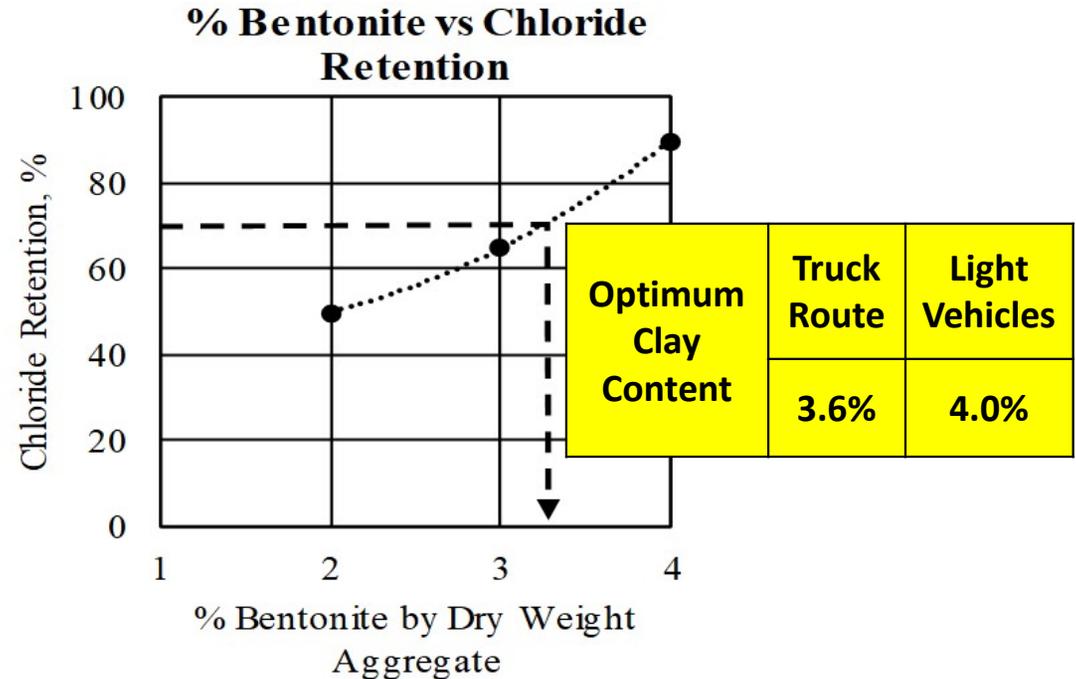
## • CBR Thresholds

- >40 for roads with truck traffic
- >30 for roads with light traffic



## • % Chloride Retention Thresholds

- >70% Retention: Mix 1.5% CaCl<sub>2</sub> with clay
- <70% Retention: Use annual CaCl<sub>2</sub> or MgCl<sub>2</sub> brine top treatments



# Benefits

- Lowers life cycle cost by extending life of gravel and chloride
- Road user costs decrease
- Road user satisfaction increases

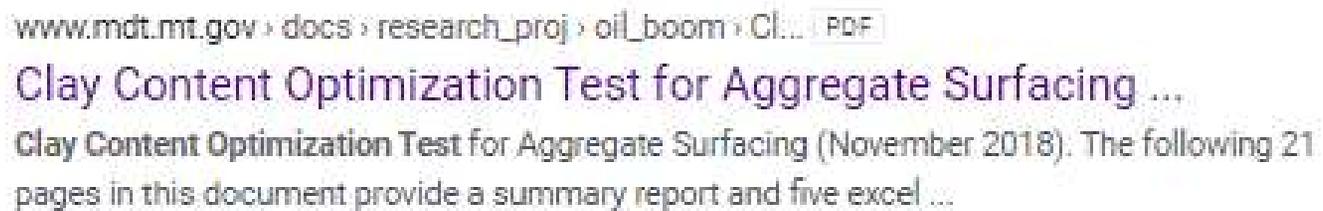
# Limitations

- Test result thresholds are
  - Not exact
  - Have not been determined for wetter climates outside the northern great plains states
- Road surface can be slick in spring for several days if crown not maintained
- 4% road crown is critical to reduce potholes
- Road crews must pay close attention to details
- Laboratory testing costs about \$3000

# Conclusions

- The optimization test has worked well on many gravel roads with over 500 trucks per day
- Significant savings in gravel loss, blading maintenance and chloride use for dust abatement
- Process has greatest payback where traffic is very heavy and gravel loss is significant

# Additional Information

- Pdf of Optimization Procedure is available by:
  - <https://www.mdt.mt.gov/research/projects/pave/oil.shtml> or
  - Google search “**Clay Content Optimization Test for Aggregate Surfacing**” and select:  
A screenshot of a Google search result. The breadcrumb path is 'www.mdt.mt.gov > docs > research\_proj > oil\_boom > Cl... PDF'. The main title is 'Clay Content Optimization Test for Aggregate Surfacing ...'. The snippet below reads: 'Clay Content Optimization Test for Aggregate Surfacing (November 2018). The following 21 pages in this document provide a summary report and five excel ...'.
- Contents of Optimization Procedure
  - Summary Report
  - Moisture Density Batching and Graph
  - CBR Batching and Compaction
  - CBR Penetration Data
  - Chloride Retention
  - Calcium Chloride Brine Preparation

# Questions?