TECHNOLOGY FOR
Alaskan Transportation
DOT Statewide Research, Development, & Technology Transfer
Local Technical Assistance Program
Keeping Alaska moving through service and infrastructure with applied research, training, and technology transfer

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In this issue . . .

Performance of Wicking Fabric H2Ri in Silty Gravel, Sand, and Organic Silt

It's no secret that excessive water in a pavement structure is detrimental to overall performance and creates a variety of engineering challenges.

A wicking fabric referred to as H2Ri is gaining popularity for removing moisture from roadway embankments. Alaska's first experience with using this material was at Beaver Slide, milepost (MP) 110.5 on the Dalton Highway. Beaver Slide has been a problem since construction in 1975. The site is situated on a sidehill cut with a roadway grade that exceeds 6%. The soil at Beaver Slide is dense grade sand with gravel; about 6% passes the #200 sieve. This soil combination allowed water to move across and along the road, causing

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A Message from the Chief

Carolyn Morehouse, Chief of Research, Development, and Technology Transfer

It is hard to image I have been in research for almost three years.

I would like to thank my team: Anna Bosin; Simon Howell; Dave Waldo; Janelle White and our newest team member Jim Horn for another great year. Their continued focus on customer service and innovation has led to Research & T2's success.

Our 2017 research program is underway. Our work plan is available at http://www.dot.state.ak.us/stwddes/research/assets/documents/current_research.pdf

We will be taking a look at research projects completed five years ago to see if there is something more needed for implementation—a training/workshop or a new specification or drawing.

Alaska can leverage funding with other states by for joining a pooled fund study. Pooled funds are available at http://www.pooled-fund.org/ If you think there is a pooled fund out there that could benefit the state please contact me. We also welcome staff's short term rapid research needs. These include short term, low cost research or technology transfer projects that rapidly respond to opportunities to improve, practices, procedures or processes.

We also manage FHWA's experimental feature program. This program can be thought of as a sort of insurance policy for trying new things. Our goal is to see at least one experimental feature going in each region. Again the Research and T2 team is here to help.

Please read the newsletter to get more information on our projects and training.

Thank you,
Carolyn Morehouse

Wicking Fabric *(continued)*

wet soft spots in the roadway. Freeze-thaw activity exacerbated the problem. Installation of H2Ri eliminated it. For five years, the roadway has been free of soft spots.

The Alaska Department of Transportation and Public Facilities used H2Ri on another Dalton Highway project at MP 197–209. To date that roadway has not developed problems. However, Alaska DOT&PF has asked two questions:

1. Are there soil types in which H2Ri is not effective?
2. Will H2Ri continue to work when length requirements exceed the width of the wicking fabric?

The Alaska University Transportation Center (AUTC) at UAF did a study of laboratory performance of wicking fabric H2Ri in sandy gravel, sand, and organic silt, sponsored by Alaska DOT&PF Research, Development, and Technology Transfer. This study answers the questions.

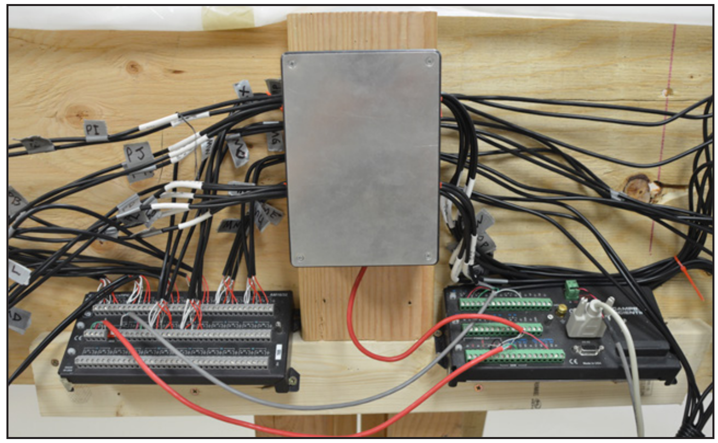
Two materials were used to represent the extreme conditions in which H2Ri might be used. The first material was a free-draining clean, uniform sand. This material provided an understanding of how well H2Ri works in permeable soil. The second material was an organic silt obtained from the CRREL Permafrost Tunnel near Fox, Alaska, just north of Fairbanks. Organic silt is essentially impervious, providing an understanding of the performance of H2Ri in impermeable soil. Based on the literature, we anticipated that H2Ri performs well in gravels, sands, and silts. However, when tested in organic silt with an organic content of 5%, the wicking fabric immediately ceased to perform. This result was confirmed by two methods. First, by supplying clear water at the upstream end of the fabric, it failed to remove any of the water. The fabric at the outlet of the flume remained completely dry throughout the test. Second,

A problematic section of road known as the Beaver Slide at milepost 110.5 on the Dalton Highway, May 12, 2010.

photomicrographs of the wicking bundles showed the fibers were coated with the organic clay contained in the silt.

As expected, H2Ri performed well in the flume containing the sand during all three test phases. In each case, the data indicated the fabric was capable of removing any water that was able to migrate to it.

Perhaps the most telling indicator of the effectiveness of the wicking fabric was shown in the wetting test for the sand (case 2), where H2Ri moved free water into the sand up to the splice. The data from all of the tests in the sand flume indicated that the splices in the fabric were inefficient. This finding was confirmed during disassembly of the flume. The soil beneath the



The data acquisition system composed of one CR1000 datalogger and one AM 16/32 multiplexer.

AUTC constructed a 73-foot long test flumes to evaluate the wicking effect of the fabric. All flumes were constructed on a level grade.

One set of sensors was put at each location, and 8 sets of sensors were put in one layer. The fabric was then saturated with water before another layer of soil was put into the testing flume.

The testing flume filled with 12 in. of saturated sand.

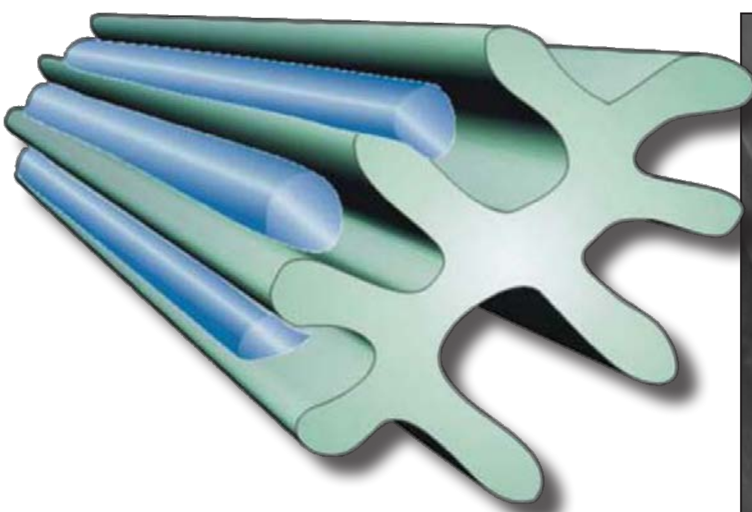
splice was fully saturated, and free water was visible on top of the fabric.

Based on the tests, H2Ri can be expected to work well in free-draining soil such as sands and sandy gravels and silts. However, H2Ri should not be used in organic silts. These soils represent extreme conditions. Unfortunately, no firm conclusions about clays or soils containing clay can be drawn from this data, since organic clays have properties that are not necessarily the same as other clays.

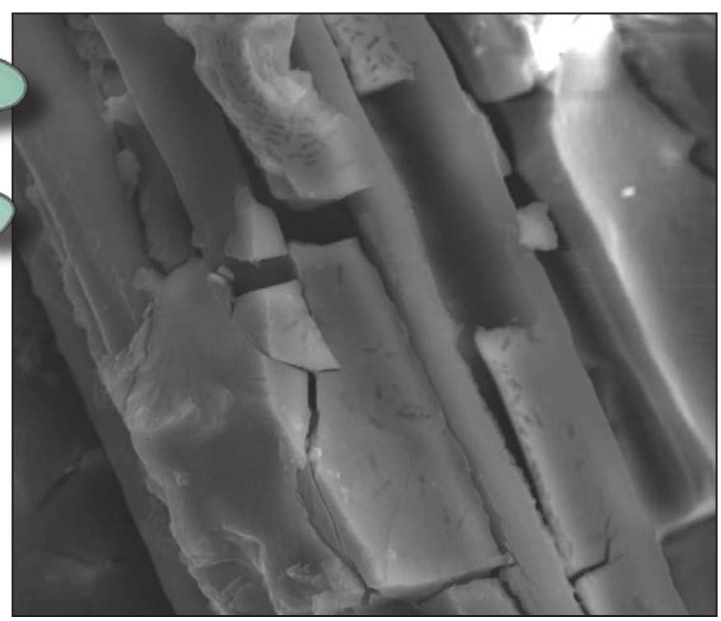
It is likely that H2Ri will not be effective in impermeable soils, since water cannot readily get to the fabric. The test as to whether a soil will benefit from H2Ri can be based on the soil suction. Once the soil suction exceeds 200k Pa, the H2Ri will no longer be effective. Therefore, if there is a question as to whether the H2Ri will work with a soil, it is suggested that a soil-water characteristic curve be developed for the soil to determine at what moisture content the soil suction exceeds 200 kPa.

Splices are a concern due to the inefficiencies observed. There are two basic alternatives for resolving this issue. The first is to consider weaving the wicking fibers in the longitudinal direction of the fabric rather than the transverse direction. This would eliminate the need for a splice. The second is to develop an effective splice. The three-foot simple overlap used in this experiment was not effective. It is doubtful that a sewn joint would be better. Tests in the 73-foot flume showed that H2Ri can wick over long distances, which makes it attractive for use in mulilane applications and for airports. However, as was shown in previous tests, the splices are inefficient and warrant improvement.

The development of the soil-water characteristic curve provides the basis for estimating the effectiveness of wicking fabric. The maximum usable soil suction generated by the fabric is 200 kPa. If the soil suction equals or exceeds that value, H2Ri will no longer be effective. Using a curve developed for dense-graded base courses, the fabric can reduce the soil moisture to about 2% below the optimum soil moisture content under ideal conditions. However, data from the flumes indicate that the practical soil moisture content for dense-graded materials is about 1% above optimum. This indicates that the moisture transfer from the soil to the fabric is somewhat less than 100% efficient, which does not reduce the value of the fabric significantly, but is important to recognize.



This illustration shows how the deeply grooved cross section of H2Ri fiber provides a larger surface area, thus ensuring that the channel holds and transfers larger amounts of water, even in unsaturated conditions.



A 1500x photomicrograph of wicking fiber bundle coated by organic silt.

Since ASTM C1559 is similar to the wicking tests devised by the project team and since it gives similar results, accepting the test as a standard for wicking fabrics is reasonable. Even though the tests performed by the project team were run well below the required 50% relative humidity, the test results are near the values specified by TenCate. Keep an eye on the T2 training calender for a related webinar in spring of 2017.

Milepost 110.5 on the Dalton Highway on May 24, 2011, after installation of H2Ri wicking fabric.

Summary of conclusions:

- Efficiency of H2Ri is a function of soil suction. Maximum design suction for H2Ri is about 200 kPa.
- Soil can be dried to around optimum moisture content. Silt content appears to reduce the effectiveness slightly.
- H2Ri can wick moisture at least 73 feet. No reason to expect considerably more.
- H2Ri not effective in soils containing high organic clays.
- Overlap splices not as efficient as desired.
- Dissolved minerals retard rewetting of fibers.
- Specifications including wicking tests suggested by TenCate appear appropriate.
- H2Ri will move water back into the soil if the exposed ends are placed in water.

The full report can be found at:
http://www.dot.state.ak.us/stwddes/research/results_lib.cfm?keywords=Wicking&fields=All&mnuFORMAT=All&selectYear=&Submit=Submit+Search

Characterization of Alaska Hot-Mix Asphalt Containing Reclaimed Asphalt Pavement Material

Researchers: Jenny Liu, Ph.D., P.E., Sheng Zhao, Ph.D., and Lin Li, Ph.D., University of Alaska Fairbanks

Recycled asphalt pavement (RAP) has been used for several decades in hot-mix asphalt (HMA) as an economic way to reuse a portion of pavement materials in place during paving capital improvement projects. In Alaska, the newly established statewide HMA highway specification allows up to 15% RAP content in the wearing course of roadway pavement and up to 25% RAP content in the binder or base course layer(s). As a result, projects are expected to increase the use of these sustainable materials, but what is the upper percent threshold that still results in well-performing pavement? This project aimed to address exactly how well the current percentages perform as well as testing if the threshold could be increased as a way to further improve economic reuse of materials.

Project Setup

Traditionally, pavement engineers will develop design alternatives and then use life-cycle cost analysis to select the most cost-effective percent option per project. Mechanistic analysis procedures (e.g., Alaska Flexible Pavement Design software) require existing material engineering properties as an input source. Consequently, it is essential to properly establish the engineering properties of HMA mixtures containing the RAP material available for each project location.

A USDOT-sponsored study done by the Center for Environmentally Sustainable Transportation in Cold Climates at University of Alaska Fairbanks evaluated three asphalt binders commonly used in Alaska mixes in order to properly characterize and evaluate the majority of Alaska HMA materials containing RAP. These asphalt binders included one neat binder, PG 52-28, and two polymer-modified binders, PG 52-40 and PG 58-34. Eleven HMA control and RAP mixtures containing 25% or 35% RAP were produced in the lab or collected from field projects for performance evaluation, covering two mixture types and material sources from the Alaska DOT&PF Northern and Central regions.

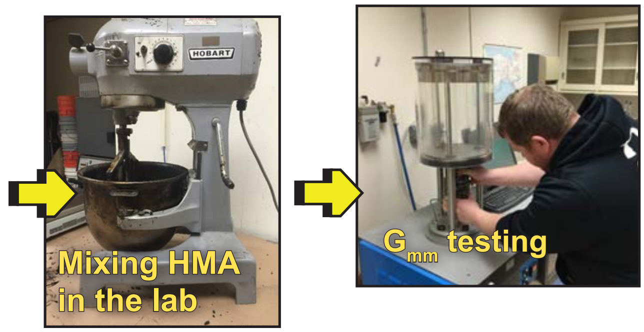
Testing

Testing included comparing preliminary material savings of using typical Alaska HMA containing 25% RAP with HMA without RAP. The incorporation of RAP into Alaska HMA increased the dynamic modulus and flow number of the mixtures, which indicates that the addition of RAP increased the rut resistance of the Alaska mixes tested. Typically, the higher the RAP content, the higher the improvement in rutting. Further, the addition of RAP increased the indirect tension (IDT) creep stiffness of the mixtures regardless of testing temperature, which could potentially result in lower resistance to low-temperature cracking. In general, the higher the RAP content the higher the creep stiffness. Some results were not as conclusive: adding certain amounts of RAP did not affect the low-temperature performance of some mixes, while it increased the low-temperature cracking temperature of other mixes. This indicates that RAP may not impair the low-temperature performance of some Alaska mixes, but these aren't conclusive results as not all grouped mixes showed comparable cracking temperatures. In addition, the parameters in RAP mix production and construction that significantly contribute to low-temperature cracking are still unknown.

Samples before and after the flow number (FN) test. This procedure was derived from AASHTO TP 79-13. The FN test is used to evaluate the creep characteristics of HMA and results in permanent deformation of the test specimen.

Cost Analysis

According to a typical cost analysis of Alaska conditions, a rough estimate of $13.3/ton savings was reached if 25% RAP is used in an HMA paving job. The cost analysis along with the performance evaluation show that using 25% or 35% RAP in an Alaska HMA is very promising. Additional testing and cost comparisons of other Alaska jobs throughout the state need to be analyzed for further characterization and confidence in these recommendations.



Laboratory mixture production, material collection, material verification, mixing HMA in the lab, and testing.

The full report can be found at:
http://www.dot.state.ak.us/stwddes/research/results_lib.cfm?keywords=Characterization+of+Alaskan+Hot-Mix+Asphalt+Containing+Reclaimed+Asphalt+Pavement+Material&fields=All&mnuFORMAT=All&selectYear=&Submit=Submit+Search

Research, Development, & T2 Welcomes Jim Horn, P.E., as State Pavement Management/ Preservation Engineer

Jim Horn began work for Alaska DOT&PF as a college intern in Central Region highway construction. It was there that he decided to continue with a career involving pavements. He transitioned into full-time with highway construction after obtaining his degree in civil engineering from the University of Alaska Fairbanks. Years later he transferred to Public Facilities as a project engineer to experience vertical construction. After several more years working on Public Facilities projects he joined with Central Region Materials as a materials engineer. It was as a materials engineer that he became immersed in geotechnical pavement design in addition to asphalt evaluation technologies and data collection.

He became the state pavement management/ preservation engineer in 2009, under the chief of Maintenance & Operations. The pavement management/preservation engineer's position was recently reorganized as a component of the Asset Management section within Design & Engineering Services. Pavement data is collected yearly for the approximately 4,500 miles of paved highway system and the 56 asphalt-paved airports. That data is analyzed and prioritized for project recommendations to state planners, maintenance leaders, and legislators. Jim is located in Anchorage in the Tudor Complex. Welcome Jim!

Asset Management Update

Carolyn Morehouse, Chief of Research, Development & Technology Transfer

Anyone working on federal highway funded projects has heard about the Federal-Aid Highway Program moving toward performance management. This fits in nicely with Alaska DOT&PF's Results Based Alignment efforts that have been happening over the last 18 months. The new highway bill requires each state to have an asset management plan. Asset management is a way of doing business that manages our assets over their entire life cycle. Asset management assists mangers and leadership in making wise investment decisions to meet our performance management goals.

Asset Management Plan Final Regulations were published October 24, 2016. The Asset Management final rule requires FHWA to determine whether state DOTs have developed and implemented asset management plans consistent with the requirements. States must also establish national highway targets for bridges and pavements. Failure to do so means FHWA cannot approve any further projects using National Highway Performance Program funds. The majority of our FHWA funds fall into this category.

States have the flexibility to set their own targets and project selection. FHWA has the responsibility to ensure that states use the asset management process as described in their asset management plan and are making investments to meet these targets. This includes requiring states to have management systems for bridges and pavement.

The Asset Management section has been working on Agile Assets Pavement and Maintenance Management System implementation that meets the requirements of these new regulations. We are working to update a draft Transportation Asset Management Plan (TAMP) in accordance with the new regulations. The National Highway System final regulations on bridge and pavement condition performance measures and travel time, freight, and air quality performance measures were issued in January 2017.

This is an opportunity to define what is important for this state's highway transportation and match those desires with funding levels. The TAMP will show where gaps exist between what we need to do and the funding needed to do them. This data should help us communicate to our internal and external stakeholders.

Asset Management Plan Final Regulations can be found at: https://www.federalregister.gov/documents/2016/10/24/2016-25117/asset-management-plans-and-periodic-evaluations-of-facilities-repeatedly-requiring-repair-and

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Juneau Hosts the WASHTO Annual Meeting

Transportation professionals will gather in Juneau, Alaska, for the 2017 Western Association of State Highway and Transportation Officials (WASHTO) annual meeting on June 25–28, 2017.

WASHTO 2017 ALASKA will be attended by state department of transportation CEOs, chief engineers, and executive leadership from the 18 westernmost states in the country, as well as executives from the U.S. Department of Transportation and Federal Highways Administration. Other notable attendees are national transportation leaders from the private sector and academia.

The meeting will be held at the Centennial Hall Convention Center in downtown Juneau.

June 25–28, 2017, Juneau, Ak

More information at:
http://www.cvent.com/events/washto-2017-alaska/event-summary-694b2fe444e642d88acee8aa940c1091.aspx

T2 Sponsored Courses Planned in 2017

The following T2 sponsored courses are scheduled in 2017. These are planned courses and are not a guarantee of delivery. Please monitor our website as courses post for enrollment or subscribe to our training notification list for updates as courses post:

Training calendar at:
http://dot.alaska.ecatts.com/lmsTrainingCalendar

Training notification list at:
http://list.state.ak.us/mailman/listinfo/dot-training-notification

Northern Region

- 3R Safety Analysis
- Americans with Disabilities Act (ADA) Bike and Pedestrian Design
- Applying and Balancing Mass Haul Volumes
- American Traffic Safety Services Association (ATSSA) Flagger, Traffic Controls Technician (TCT), & Traffic Control Supervisor (TCS)
- Basic Hydraulic Principles of Embankment and Practical Highway Hydraulics
- Certified Erosion and Sediment Control Lead (CESCL) (two day & one day refresh)
- Communicating Effectively with the Contractor and Your Team
- Construction Spec Writing
- Fall Protection
- FHWA-NHI-131050: Asphalt Pavement In-Place Recycling Techniques
- FHWA-NHI-132012: Soils and Foundations Workshop
- Flexible Pavement Design
- Geosynthetic Engineering Principles
- GPS Surveying for Construction Inspectors
- Hazardous Paint Handler Certification
- Highway Capacity Manual 2010 - web-based course (WEB)
- Roundabout Design -WEB
- Gravel Road Maintenance for Borough Road Service Commissioners
- Gravel Road Maintenance Planning for Borough Road Service Commissioners
- Grader Operator

Central Region

- 3R Safety Analysis
- ADA Bike and Pedestrian Design
- ATSSA (Flagger, TCT, & TCS)
- Basic Hydraulic Principles of Embankment and Practical Highway Hydraulics
- CESCL (two day & one day refresh)
- Change Order Estimating
- FHWA-NHI-131050: Asphalt Pavement In-Place Recycling Techniques
- FHWA-NHI-132012: Soils and Foundations Workshop
- FHWA-NHI-142055: Advanced Seminar on Transportation Project Development: Navigating the NEPA Maze
- FHWA-NHI-380095: Geometric Design: Applying Flexibility and Risk Management
- Geosynthetic Engineering Principles
- GPS Surveying for Construction Inspectors
- Highway Capacity Manual 2010 -WEB
- Roundabout Design - WEB
- Gravel Road Maintenance for Borough Road Service Commissioners

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Training courses (continued)

- Gravel Road Maintenance Planning for Borough Road Service Commissioners
- Grader Operator

Southcoast Region

- 3R Safety Analysis
- ATSSA (Flagger, TCT, & TCS)
- Aviation Design Basics
- Blasting and Overbreak Control
- Communicating Effectively with the Contractor and Your Team
- Change Order Estimating
- CESCL (two day & one day refresh))
- FHWA-NHI-310110: Federal-Aid Highway 101 (State Version)
- FHWA-NHI-135046: Stream Stability and Scour at Highway Bridges for Bridge Inspectors
- FHWA-NHI-380032A: Roadside Safety Design
- FHWA-NHI-380095: Geometric Design: Applying Flexibility and Risk Management
- Highway Capacity Manual 2010 -WEB
- Grader Operator

For information about T2-sponsored training, contact:

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http://www.dot.state.ak.us
- select "Inside DOT&PF"
- select "Research & Technology"

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