Oregon Department of Transportation

Stage 1 Research Problem Statement

Number*: 25-46*

Proposed Title: High Friction Surface Treatments and Alternative Chip Seals to Reduce Accident Rates and Improve Network Level Roadway Performance

1. Concisely describe the **transportation issue** (including problems, improvements, or untested solutions) that Oregon needs to research.

According to the 2022 ODOT Pavement Condition Report, the current ODOT pavement program is significantly underfunded. This insufficient funding level, combined with the increasing cost of paving (due to the increasing asphalt and oil prices and high inflation) and increasing traffic levels, has necessitated the development of low-cost but effective alternative solutions for preserving and maintaining Oregon's roadway network. Chip seals are a low-cost pavement preservation solution that enables transportation authorities to pave more lane miles to improve the state's overall pavement quality and user comfort despite budgetary constraints. For this reason, according to the 2022 ODOT pavement condition report, although general paving in Oregon is expected to drop significantly within the next 2-3 years due to budgetary issues, the annual chip seal treated lane miles are expected to stay constant or may even increase. This plan shows the importance of chip seals in Oregon to combat the current high cost of road construction and to avoid any decline in the condition of the ODOT roadway network.

Although chip seals effectively preserve the condition of the Oregon roadway network, their life span is shorter than other alternatives (on average, 4 to 6 years), necessitating more frequent construction and disruptions to mobility. Since chip sealing is a critical cost-effective pavement preservation strategy for ODOT, any improvement in the performance of chip seals can result in significant cost and greenhouse gas (GHG) emission savings. For these reasons, alternative chip seal methods to improve the longevity of roadways need to be tested and implemented. In addition, ways to incorporate recycled asphalt pavements (RAP) into chip seals without sacrificing performance should be investigated to reduce cost and GHG emissions.

High Friction Surface Treatments (HFST) are another strategy for improving roadway conditions while significantly increasing road users' safety by increasing road surface friction. According to field performance studies conducted by Pennsylvania, Kentucky, and South Carolina DOTs (FHWA, 2014), total crash reductions in critical locations (mostly curves and areas with lower visibility) due to the application of HFSTs are 100%, 90%, and 57%, respectively. These significant reductions in accident rates for the three states point out the importance and effectiveness of HFST. However, the high cost of HFST (about $\$23/yd^2$) when compared to chip seals (about $\$4/yd^2$) appears to be the major reason blocking its widespread use in many states. Major components of this high cost are expensive liquid polymer resin and the special bauxite aggregates that are only available in a few states in the U.S. (Arkansas, Alabama, Georgia, and Virginia). Long transportation distances for the bauxite also increase the cost and carbon footprint of HFST. For all these reasons, the potential of using local materials to create a similar surface at a lower cost needs to be investigated. Heavy residue emulsions that are currently being produced in Oregon can be considered to replace expensive polymer resins, while locally available aggregates and recycled asphalt pavements (RAP) can be evaluated to replace bauxite in this proposed research study. The impact of aggregate gradation and nominal maximum aggregate size on pavement surface friction and safety should also be determined.

2. Document how this **transportation issue** is important to Oregon and will meet the Oregon Research Advisory Committee Priorities

Pavement surface texture and its friction response to rain events control a significant portion of the safety of road users. Due to the frequent heavy rain events in Oregon, surface friction and skid resistance of the roadways have immense importance. Although HFST applications are used on bridge decks in Oregon for sealing and protecting the

underlying concrete with reinforcement, their use on roadway construction is limited due to the high cost. The high cost of HFST is a result of the expensive polymer resin and the special aggregates used for construction. For this reason, developing innovative methods to use locally available aggregates and emulsions for HFST construction without sacrificing performance can significantly benefit ODOT and road users in Oregon. Construction of HFST sections at locations critical for accidents can significantly reduce accident rates (FHWA, 2014).

Since the cost of paving with asphalt concrete and concrete materials is continuously increasing, lower-cost options for pavement preservation, such as chip seals, are starting to become more critical. The major advantage of chip seal strategies, besides the high benefit-to-cost ratio, lies in the effectiveness of the process in sealing the surface cracks and improving the condition of the pavement surface by introducing a protective layer, which also improves ride quality and user comfort in many cases. However, the short lifespan of chip seals generally results in more frequent paving and more disruption to traffic on roadways in Oregon. Since the percentage of chip seals in the overall pavement maintenance and rehabilitation is not expected to decrease within the next 2-3 years, improving the long-term performance of chip seals can solve various budgetary issues, which is expected to result in better roadway network conditions for Oregonians. Using Recycled Asphalt Pavement (RAP) materials in chip seals can also reduce the environmental impact and the overall cost of the process. Other strategies to improve the performance of chip seals *[fiber reinforcement (about 12-year expected service life) and sandwich chip seals for fixing failed chip seal sections]* should also be investigated to increase the life span of this cost-effective paving method.

This proposed research study clearly addresses the *"Economic and community vitality"* and *"Safety"* goals of the Oregon Transportation Plan (OTP). The potential of using locally available materials with lower costs for HFST construction, which is currently about six times more expensive than chip seals, is expected to reduce not only the paving costs but also the GHG emissions by reducing hauling distances. Using recycled asphalt pavements (RAP) for chip seal and HFST construction can also potentially reduce the environmental impact and cost of both strategies. This aspect addresses the *"Stewardship of Public Resources"* and *"Sustainability and Climate Action"* priorities of the OTP.

The proposed research study also addresses the *"Safety"*, *"Climate"*, *"Process, material, or equipment improvements"*, and *"Cost reductions or savings to construction, operations, or asset maintenance"* priorities of the Oregon Research Advisory Committee.

3. What **final product or information** needs to be produced to enable this research to be implemented?

The following products and information will be developed in this research study: i) the quantified impact of HFST on roadway skid resistance and potential accident rates (by conducting locked wheel skid tester and dynamic friction tester on roads with and without HFST); ii) a more cost-effective and environmentally friendly process for HFST material production and construction to increase its widespread use in critical locations to reduce accident rates; iii) information regarding the effectiveness of fiber-reinforcement in improving the longevity of chip seals in Oregon; iv) information regarding the effectiveness of sandwich chip seals for fixing failed chip seals rather than completely replacing them (as an adaptation to heatwaves and climate change); and v) methods to incorporate RAP materials into chip seal and HFST construction to reduce cost and environmental impact and improve performance.

4. (Optional) Are there any individuals in Oregon who will be instrumental to the success of implementing any solution that is identified by this research? If so, please list them below.

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5. Other comments:

REFERENCES:

1) FHWA (2014) Frequently Asked Questions about High Friction Surface Treatments (HFST). www.fhwa.dot.gov/innovation/everydaycounts/edc-2/pdfs/fhwa-cai-14-019_faqs_hfst_mar2014_508.pdf

2) Coplantz (2023) 2022 ODOT Pavement Condition Report. www.oregon.gov/odot/Construction/Documents/Pavement/2022_condition_report_maps.pdf

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