Oregon Department of Transportation

Research Stage 1 Problem Statement

Number 26-21 – "Implementation of Emulsified Asphalt Concrete Pavements with High RAP Contents to Reduce A1-A3 Emissions"

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

With rising paving costs driven by the escalating prices of asphalt binder and inflation, Emulsified Asphalt Concrete (EAC) with high Recycled Asphalt Pavement (RAP) content (approximately 60-80% RAP) emerges as a cost-effective strategy for pavement construction in Oregon. EAC production offers further advantages as it does not require the excessive heating of aggregates and binders typical of Hot-Mix Asphalt (HMA) and Warm-Mix Asphalt (WMA) production, making it significantly less carbon-intensive. Additionally, using mobile asphalt plants for EAC production helps lower greenhouse gas (GHG) emissions by reducing hauling distances.

EAC aligns well with the goals of House Bill 4139, which seeks to reduce ODOT's GHG emissions. By increasing recycled asphalt content, decreasing the demand for virgin binders, and lowering production emissions, EAC directly addresses these objectives and supports a more sustainable approach to pavement construction.

Emulsified Asphalt Concrete (EAC) has been utilized in Oregon for road construction, particularly in colder regions. However, while ODOT currently applies comprehensive design and performance testing methods for Hot-Mix Asphalt (HMA), Warm-Mix Asphalt (WMA), and chip seals, no performance testing methods specific to EAC are yet available in Oregon. Given that the material properties of EAC mixtures differ significantly from other paving materials, there is a need to develop unique tests, rapid quality assurance methods, specifications, and new strategies to ensure high-performance EAC mixtures, particularly those with high RAP content. A recently awarded ODOT research project (SPR 887, initiated in October 2024) aims to address this gap by developing laboratory test methods and associated specifications that accurately characterize EAC performance for effective mixture design and implementation.

This proposed research study will focus on Accelerated Pavement Testing (APT) and field implementation of the proposed mix types, designs, and test methods with the corresponding Environmental Product Declarations (EPDs). In addition, field test methods and specifications will be developed and used for in-situ quality assurance of the constructed EAC roadways. The major components of this research effort would be:

- A comprehensive literature review and assessment of the results and findings from the previous Oregon research study on EAC mix design process development.
- Developing laboratory EAC mix designs with high RAP contents and different emulsion and additive types for APT section construction using the test methods developed in the current ODOT Research Project (SPR 887).
- APT section construction with the proposed EAC designs and testing to determine the most promising design strategies for field implementation.
- Conduct upfront cost calculations, Life Cycle Cost Analysis (LCCA), and Life Cycle Assessment (LCA) to determine the cost-effectiveness and environmental impact of the most promising EAC mixture design options.

- Selecting and using the most promising mix design strategies for EAC mix production and field construction (pilot sections) based on the findings from the laboratory and APT tests, cost analysis, and the corresponding EPDs.
- Long-term performance monitoring of the constructed field pilot sections by Automated Pavement Condition Surveys (APCS) to validate the long-term performance effectiveness of the selected strategies compared to conventional Hot-Mix and Warm-Mix asphalt options commonly used in Oregon.

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

The major products from this proposed research project would be:

- Information and guidelines for ODOT to implement in EAC mix design.
- Potential EAC mix designs and production strategies that will create the highest level of reduction in GHG emissions with the highest possible cost savings.
- EPDs for the selected mix designs.
- The additive and emulsion types and properties for EAC mix production that should be included in ODOT's Qualified Products List (QPL).
- Specification development for a seamless EAC mix design process implementation.
- A comprehensive research report with a literature review, all research components and results, and major conclusions.

3. (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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Chris Duman	Pavement Quality & Materials Eng.	Christopher.L.DUMAN@odot.oregon.gov	(503) 559-4994
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4. Decision making lenses

Please complete the following three sections. Your answers to these questions will be applied on a programmatic basis to support agency decisions. Answering yes to the questions below is not required. Resolving a narrowly focused technical research problem may meet agency needs without answering yes to any of the following questions. The ODOT Research Section will seek a balanced portfolio some projects will answer yes to one of the three categories below (e.g. climate, equity, and/ or safety) and other projects in a different category.

We are looking for an overall program balance and no one project is expected to balance all categories. Generally, a research problem statement is expected to be able to answer yes with clear and verifiable information in only one of the three categories below, some projects may be able to answer yes in two or

even three categories. Some projects (i.e. needs focused on specific elements of infrastructure design), may have no yes answers but may still be high value research need.

Climate

Oregon recognizes the climate crisis and makes systemic changes to reduce emissions caused by travel. Every mile driven in Oregon is powered by a clean source of fuel. We seek research that supports construction and maintenance operations are carbon neutral and investments in mobility that support travel by low and no emission modes. While every research project may not result in a reduction in emissions, transportation investments overall support emission reductions to achieve state goals. Oregon envisions a transportation system that is resilient in the face of seismic and climate events and impacts to the degradation of the natural environment are reduced. Our vision includes a transportation infrastructure is built in a way that avoids impacts on key habitat and results in better environmental conditions for wildlife and native vegetation. For definitions and details please review the equity vision, goals, and objectives of the ODOT Strategic Action Plan and Oregon Transportation Plan.

4f. Will addressing the **transportation issue** identified as a need in Question 1 develop, or validate methods for the estimation, measurement, or monitoring of transportation generated greenhouse gasses (GHG)?

☐Yes ☒No ☐Unsure

4g. If climate or GHG is not the focus of this **transportation issue** identified in this problem statement, will the research apply a GHG analysis to transportation infrastructure, planning, operations, maintenance, or materials?

☒Yes ☐No ☐Unsure

4h. Will the addressing the **transportation issue** include development or testing of construction practices, methods, or materials to establish potential reductions in greenhouse gas emissions?

☒Yes ☐No ☐Unsure

4i. Will the solving the **transportation issue** in question 1 study or support the reduction of vehicle miles traveled and single occupancy vehicle travel or support transition to electric vehicles (or other types of zero emission vehicles) or low-carbon alternative fuels?

☐Yes ☒No ☐Unsure

4j. Will the solving the **transportation issue** in question 1 lead to work that will support, measure, monitor, transportation system resilience in response to expected climate events, effects, or natural disasters in general?

☐Yes ☒No ☐Unsure

4k. Will the solving the **transportation issue** in question 1 lead to work that may result in better environmental conditions for wildlife and native vegetation ?

☐Yes ☒No ☐Unsure

4l. If you answered yes to any of the climate questions above or can provide alternative details related to climate, please provide additional information:

The findings of this research will help ODOT improve the performance of the EAC mixtures in Oregon. With the potential performance improvement, more EAC mixtures can be constructed in various regions in Oregon. Since EAC mixtures can have significantly higher RAP, they can create a substantial reduction in plant emissions. In addition, since EAC production does not require excessive heating of aggregates and the binder at an asphalt plant, production of EAC is significantly less carbon intensive than its Hot-Mix Asphalt (HMA) and Warm-Mix Asphalt (WMA) counterparts. All these benefits will help ODOT reduce its GHG emissions and meet the objectives of House Bill 4139.

According to an ODOT/FHWA research study (FHWA Climate Challenge) recently completed by the OSU-Asphalt Materials and Pavements (AMaP) research group, the cost of fuel and tire wear that can be saved by reducing current pavement roughness levels by 20% is around $73 million/year for the road users. The associated annual emissions savings are around 193,000 MT CO2/year, while ODOT's total annual emissions from all operations were calculated to be 182,592 MT CO2/year (Proudfoot and Toneys 2022). This important result shows that low-cost paving materials and strategies, such as EAC with high RAP contents, are needed in this low paving budget environment to keep the roadway roughness and rolling resistance low to reduce GHG emissions and road user costs.

Equity

Equity can have many dimensions and impacts relating to communities, and transportation. It is important that problem statement proposals clearly explain in what capacities are equity dimensions or impacts being examined within problem statements. It is a goal of the OTP to "Improve access to safe and affordable transportation for all, recognizing the unmet mobility needs of people who have been systemically excluded and underserved. Create an equitable and transparent engagement and communications decision-making structure that builds public trust". Proposed research may have the intent of studying elements of this goal or apply analysis to specific transportation topics to ensure the resulting research recommendations is consistent with our equity goals. For definitions and details please review the equity vision, goals, and objectives of the ODOT Strategic Action Plan and Oregon Transportation Plan.

4a Is the **transportation issue** identified as a need in Question 1 specifically focused on transportation equity?

☐Yes ☒No ☐Unsure

4b If the **transportation issue** is not focused on transportation equity, will the primary topic be assessed for equity benefits or impacts within the research project?

☐Yes ☒No ☐Unsure

4c Is the implementation of potential findings from this research likely to directly involve participation from an identified group that would benefit from an equitable process or outcome?

☐Yes ☒No ☐Unsure

4d Is the intended final product or information expected to support ODOT's equity efforts (Including but not limited to supporting one of the equity related objectives of the ODOT's Strategic Action Plan or Oregon Transportation Plan) ?

☐Yes ☒No ☐Unsure

4e If you answered yes to any of the equity questions above or can provide alternative details related to equity, please provide additional information:

Safety

Research outcomes may include interventions and countermeasures to prevent or reduce the frequency of crashes or other causes of transportation-related injury or death; or may include measures to reduce severity of injury (including prevention of death) after a crash or other injurious event. For definitions and details please review the equity vision, goals, and objectives of the ODOT Strategic Action Plan, Oregon Transportation Safety Action Plan and Oregon Transportation Plan.

4m. Will solving the **transportation issue** in question 1 support improving **safety culture** for either transportation workers or the traveling public?

☐Yes ☒No ☐Unsure

4n. Will the solving the **transportation issue** support improving safety through **healthy and livable communities**?

☐Yes ☒No ☐Unsure

4o. Will solving the **transportation issue** support improving safety through using **best available technologies**?

☐Yes ☒No ☐Unsure

4p. Will solving the **transportation issue** support improving safety through **communication and collaboration**?

☐Yes ☒No ☐Unsure

4q. Will the solving the **transportation issue** support improving safety through **investing strategically**?

☐Yes ☒No ☐Unsure

4r. If you answered yes to any of the safety questions above or can provide alternative details related to safety, please provide additional information:

5. Other comments:

REFERENCES:

1) Proudfoot, J., and A. Toneys. 2022. *Oregon Department of Transportation Operational Greenhouse Gas Reductions: Best Practices & Recommendations*.

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