Oregon Department of Transportation

Stage 1 Research Problem Statement

Number*: 25-48*

Proposed Title: Implementation of Increased Asphalt Recycling by Revising Plant Production Processes

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

Increasing asphalt recycling has the potential to significantly reduce the overall cost of paving and material production emissions. Although increasing the recycled asphalt pavement (RAP) content in asphalt mixtures is beneficial in many aspects, the primary concern when using high RAP mixes lies in the altered long-term durability properties of asphalt mixtures. Aged and oxidized binder in RAP is less ductile than a virgin binder and gives rise to failure under repeated high axle loads and thermal effects. For this reason, in Oregon, the use of RAP in asphalt mixes is currently limited to about 30% by weight of the mix for medium to high-traffic locations (Level 3 asphalt mixtures) and 20% for locations with heavy truck traffic (Level 4 asphalt mixtures).

In an ongoing ODOT research project (SPR862), different types of additives and virgin asphalt binder combinations were mixed with different aggregate size distributions to achieve high RAP (around 40%) asphalt mixtures that perform equal or better than the current lower RAP alternatives. According to the results of the research study, by using the most suitable mixture combinations, it may even be possible to increase the RAP content to 50% in the long term. It was also determined that significant cost and greenhouse gas (GHG) savings could be created by implementing high RAP asphalt mixtures at 40% and eventually at the 50% level.

Although the production of high RAP asphalt mixtures with high durability is possible according to the laboratory results, increasing RAP content at the production stage has several other challenges related to the operational capabilities of the asphalt plants and the inadequacy of the current standard plant procedures for high RAP asphalt mixture production. For instance, in a laboratory study, it is always possible to bring different constituents of the asphalt mixtures to ideal temperatures by using multiple calibrated ovens. However, heating systems at the asphalt plants are not always structured to directly control the temperature of different components in the mixture due to the several orders of magnitude larger size of the plant production compared to the laboratory. In Oregon, RAP material is indirectly heated by mixing it with the superheated aggregates. Thus, increasing the RAP content to higher levels may require even higher aggregate temperatures (since the virgin aggregate volume will be reduced), which may significantly increase plant emissions. Not heating the aggregates to the required temperature levels may result in lower RAP temperatures that will significantly reduce the blending of the RAP and virgin binders and the overall performance of the mixture. For this reason, alternative heating processes and new technologies for heating and processing RAP should be evaluated in a research study. This example was just related to the heating issues expected during the production of asphalt mixtures with high RAP contents. There are also other potential issues that need to be addressed at the production level for successful implementation (protecting RAP and aggregates from moisture, addressing the RAP stockpile variability effect, mixing additives at different stages for increased durability, etc.). Increasing RAP content without addressing the potential production challenges may reduce the blending between the RAP and virgin binder and result in a mixture with reduced durability. For all these technical reasons, a production-level research study should be conducted in collaboration with the asphalt industry in Oregon to complement the findings of ODOT research project SPR862 and achieve a seamless implementation of high RAP asphalt mixtures with high long-term performance in Oregon.

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

According to the 2022 ODOT Pavement Condition Report, the current ODOT pavement program is significantly underfunded, which is expected to result in a significant decline in pavement conditions in Oregon within the next couple of years. The current annual funding needed in Oregon for maintenance, rehabilitation, and reconstruction is about $280M, while the expected 2024-2027 and 2027-2030 STIP funding levels are $110M/year and $65M/year, respectively (almost 2.5 to 4 times less than the needed amount). According to the report, *"Preservation resurfacing mileage programmed in the STIP through 2027 only provides an equivalent resurfacing cycle time in excess of 50 years, which is more than twice as long as pavement lasts…… Historically, pavement funding has allowed for maintaining pavement on most of the system but rising costs are eroding the number of miles that can be preserved for the same dollar."* Since these funding projections did not consider the future increases in oil prices (which directly controls asphalt paving costs) and inflation rates, it is expected that the condition of the Oregon roadway network will even get worse than the 2022 predictions. For this reason, innovations that can be implemented to reduce paving costs are important in avoiding any significant reductions in pavement conditions on roads managed by ODOT.

House Bill 4139 required forming a technical advisory committee (TAC) to develop different strategies to reduce ODOT's greenhouse gas (GHG) emissions. By following the directives of the House Bill, a committee was formed by ODOT in 2023 to address several needs for reducing the GHG emissions of ODOT. ODOT will report the progress of the TAC annually to the Oregon Transportation Commission and an interim committee of the Legislative Assembly related to transportation. One major item in the TAC objectives is to implement an Environmental Product Declarations (EPD) program that will require measuring and evaluating the GHG emissions released during the material acquisition, transportation, and production of the paving materials. According to a recently published ODOT research report (Proudfoot et al., 2021), about 50% of ODOT's annual emissions are from the production of paving materials. According to an ongoing ODOT research project (FHWA Climate Challenge), a 15% reduction in asphalt production emissions is possible by increasing paving materials' recycled asphalt (RAP) content from 20% to 40%. This significant reduction, combined with renewable fuel use for asphalt concrete production, has the potential to result in a 16% reduction in the overall annual GHG emissions of ODOT.

Due to the economic and environmental benefits of increased asphalt recycling, this proposed research study is expected to provide a significant return for ODOT. It also directly addresses the *"Economic and Community Vitality"*, *"Stewardship of Public Resources"*, and *"Sustainability and Climate Action"* goals of the Oregon Transportation Plan (OTP). It also directly addresses the *"Climate"*, *"Process, material, or equipment improvements"*, and *"Cost reductions or savings to construction, operations, or asset maintenance"* research focus areas of ODOT.

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

This proposed research study would produce a revised asphalt mixture production process for mixtures with high RAP contents (about 40%-50%) to achieve mixtures with high long-term performance. The revised process is going to be developed after testing and evaluating the impact of the following factors at the asphalt mix plant level:

- Milling process to remove asphalt from the pavement for recycling;
- Impact of crushing and screening of the RAP at the plant before production;
- Fractionation option (separating RAP into different size groups and heating and mixing each size group separately to increase binder blending);
- RAP stockpiling and storage methods to reduce moisture and achieve a higher level of uniformity;
- Methods to reduce RAP segregation;
- Different methods to heat RAP without superheating the virgin aggregates to reduce production emissions and improve RAP blending and performance;
- Testing the option of mixing the rejuvenator additives with the RAP material first rather than mixing them with the binder first;
- Methods to reduce the agglomeration of RAP particles in asphalt mixtures to improve the blending of the RAP and virgin asphalt binders;

After implementing the revised production process for high RAP asphalt mixtures, the need for sublot RAP testing (not currently done in Oregon) for consistency will also be checked. A pavement life-cycle assessment (LCA) will also be conducted to determine the emission savings that can be created by implementing the revised production process.

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) HB4139 (2023) Relating to reductions of greenhouse gas emissions in the state's transportation system https://olis.oregonlegislature.gov/liz/2022R1/Downloads/MeasureDocument/HB4139/Enrolled

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

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