Stockpile Moisture Management & Plant Energy Efficiency

Stockpile Moisture Management

A report by the National Asphalt Pavement Association (NAPA) states for every 1% of moisture increase in aggregate stockpiles, energy use increases by 10% and production speed decreases by 10 – 20%.[1] Thus, at a nominal moisture content of 5%, aggregate moisture accounts for almost 50% of the energy required to dry and heat aggregates for asphalt mix production.[2] Depending on the type of energy or fuel being used at the production plant, this may lead to significant greenhouse gas (GHG) emissions. Managing moisture in the stockpiles is an effective way to lower fuel costs, increase production time and product quality, while lowering climate impacts.

The impacts of moisture will vary across Oregon with plant operations, number and size of aggregate piles, regional climate, seasonal change, and annual precipitation differences. There is no one-size-fits-all for this best practice, but since it is a simple and cost-effective management technique – like energy conservation in buildings – the opportunity should be exhausted before more expensive or operationally challenging climate actions are considered.

Best practices from NAPA include the following:

- Slope the surface beneath the stockpiles away from the face used to feed the plant.
- Pave the surface beneath the piles to accelerate drainage.
- Install permanent structures to prevent moisture, especially for fine aggregate and reclaimed asphalt pavement (which do not drain as well as coarse materials).
- Keep the loader bucket elevated into the pile and remove aggregates from the pile above ground level.
- Maintain as few piles as possible and avoid intermediate piles.[3]

Many parties in the supply chain have a role to play in stockpile management including material suppliers; delivery; loader and plant operators; and quality control personnel. Asphalt product customers like ODOT also have a role to play by limiting the number of mixes being requested, which, in turn, reduces the number of stockpiles to be managed.[4]

Moisture management is being highlighted here as one opportunity for plant-level energy efficiency, but there are a variety of energy efficiency and conservation opportunities within the industry.

Other Energy Efficiency Measures

EPA's EnergyStar Challenge for Industry provides a variety of resources for industries and asks participants to set a 10% reduction goal over five years. The program is currently piloting a project specific to asphalt plants.[5] Companies serving Oregon are already participating and have achieved reductions. CalPortland achieved the EnergyStar Challenge for Industry at four (4) concrete plants in Oregon reducing energy use by between 10 – 53%. EPA EnergyStar currently has a focus program, in partnership with NAPA, on energy efficiency in asphalt

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[1] National Asphalt Pavement Association. Management of Aggregate Stockpiles. Report online at https://www.asphaltpavement.org/uploads/documents/M2M/M2M%20Aggregate%20Stockpiles.pdf.
[2] Email exchange with staff at Asphaltpavement.org.
[3] Asphalt magazine. Maintaining proper aggregate stockpiles. Available online at http://asphaltmagazine.com/stockpiles/.
[4] Ibid
[5] For details visit https://www.energystar.gov/industrial_plants/industrialfocus/asphalt_pavement_production

production plants.[6] CalPortland, CRH Americas Materials, Lakeside Materials, and Riverbend Materials are participants.

Other Alternatives

Process controls and monitoring beyond moisture, include oxygen levels, temperature settings, and air flow control. Modern monitoring sensors and control system reduce energy use, in addition to improving productivity, quality and efficiency of the production line.[7]

Current Conditions & GHG Inventory Results

Current Conditions

ODOT purchases between 1 – 1.9 million short tons of asphalt concrete pavement (ACP) annually for use in construction and maintenance projects. Between Fiscal Years (FY) 2016 – 2019 construction projects used an average of 900,000 short tons annually while maintenance used an average of 400,000 short tons. ODOT reports using between 20 – 30% reclaimed asphalt pavement (RAP) in all mixes.

GHG Inventory Results

Oregon asphalt producers currently lead the nation in public environmental product disclosures (EPDs) for ACP (i.e., 17 available at the time of this report). Using an average of available EPDs from Oregon vendors result in an estimated factor of 47.5 kg CO_2e/short ton (with a range of 43.6 – 51.4). Multiplying this factor by the aforementioned quantities, ODOT's estimated GHG emissions from the production of asphalt pavement averages between 54,000 and 72,000 MT CO_2e annually.

Figure 1, on the following page, produced by the Federal Highway Administration, provides a summary of all lifecycle stages for ACP: production, use and disposal.[8] Moisture management is a best practiced aimed at reducing fossil fuel use needed for the heating in the asphalt mixing portion of the produce system (identified in red box within Figure 1).

[6] For additional details on EnergStar pilot program for Asphalt visit https://www.asphaltpavement.org/uploads/documents/Sustainability/EnergyStar_PilotProgram.pdf

[7] EPA Energy Efficiency Improvement and Cost Saving Opportunities for Cement Making at https://www.energystar.gov/sites/default/files/tools/ENERGY%20STAR%20Guide%20for%20the%20Cement%20Industry%2027_08_2013_Rev%20js%20reformat%2011192014.pdf?a8b0-3dfe

[8] https://issuu.com/calcontractor/docs/cam_enviro_2021_-_issuu?fr=sODVlYTQwMTYwMjg

Figure 1 - Lifecycle Stages of ACP Production

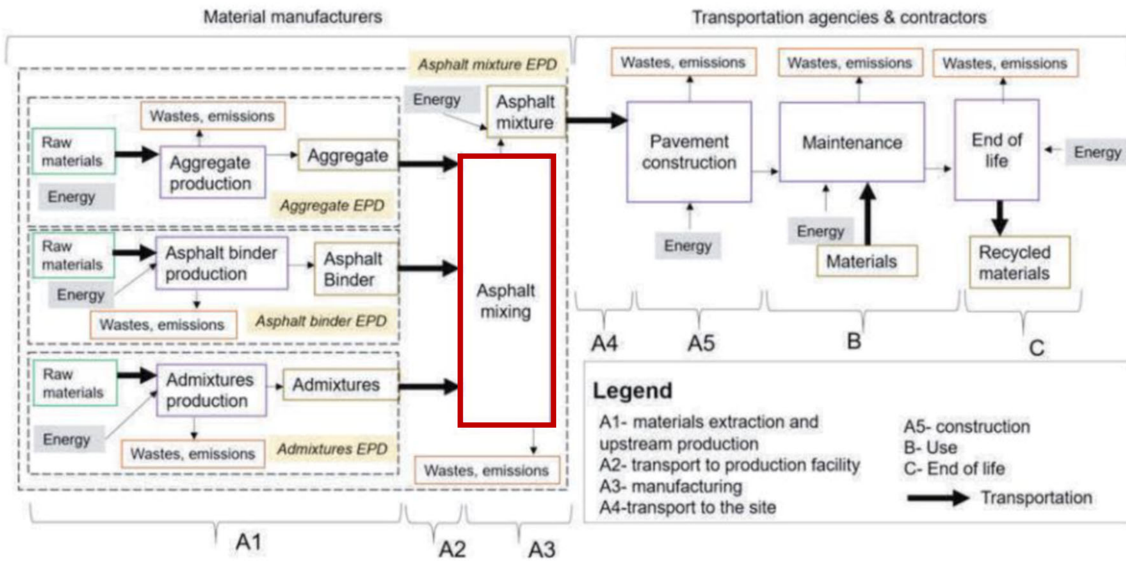
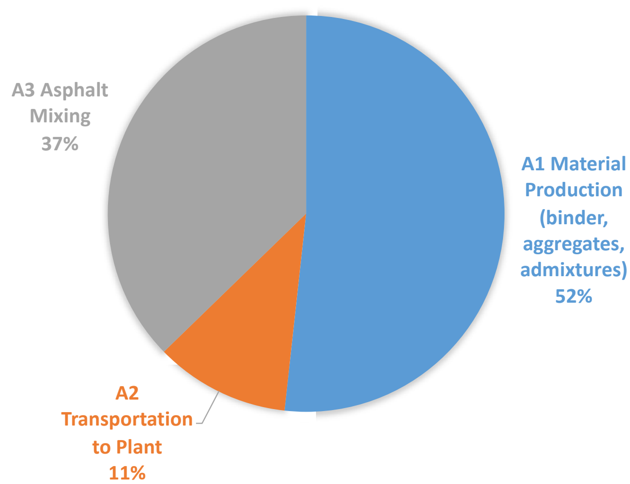


Figure 2 - ACP Emissions from Production



Furthermore, EPDs, which provide emissions for the upstream stages of production, are averaged in Figure 2 to depict a comparison between the impacts of A1 through A3. It is important to acknowledge the sample size for this comparison is small, 17 EPDs, and that EPD practice is an evolving field that will only improve over time. Ideally, this comparison would have a larger, regionally specific sample size. That said, this comparison uses the most regionally accurate data set currently available in Oregon.

Market Study

Availability and Access

Moisture management is best considered on a regional basis, particularly for states like Oregon with distinct climate regions. Stockpile moisture is not as much of a concern in drier parts of the state as it is in the Willamette Valley or on the Pacific Coast. Seasonal variation is also a factor in Oregon. Aggregate moisture reduction strategies outlined above might be difficult to implement for portable plants due to the temporary nature of their operations in any given location.

Figure 3, below, shows precipitation by geographic region. Purple and green on the map show the areas with the greatest precipitation while the areas in yellow and orange represent the least. Figure 4, also below, depicts estimated use of ACP in four regions of the state: Coast, Valley, Southern and east of the Cascades. As can be seen, roughly 70% of Oregon ACP use is in areas with average or above average annual precipitation. ACP plants in areas with greatest precipitation are the areas where moisture control will result in the greatest opportunities for fuel use and GHG emission reductions.

Figure 4 - Regional Precipitation

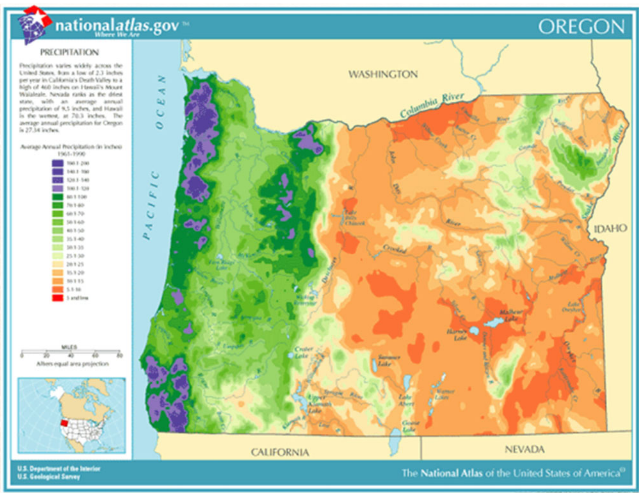
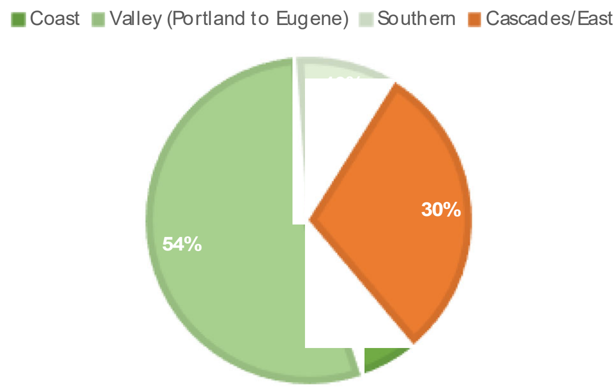


Figure 3 - ACP Use by Region



Cost

Costs associated with this action include installation of permanent structures and paving underneath stockpiles. Permanent structures must be engineered to meet local buildings codes for wind and seismic loads, with estimated total project costs at or above $100,000.[9] The size of stockpiles will vary from site to site, ranging from 1,000 to 20,000+ short tons with any given plant having between three and ten piles, even more in some cases. Costs will vary significantly depending on site-specific conditions. Once implemented, the practices should have minimal operating expenses and will save roughly 10% of fuel or electricity costs for every 1% of moisture reduction and an increase in production. Lastly, there might be opportunities to work with Energy Trust of Oregon (ETO), or directly with utilities to identify potential financial incentives (beyond fuel savings) incentives for asphalt plants to reduce fuel and electricity use through efficiency upgrades. Plant operators should contact ETO for support in identifying opportunities and available incentives. Any plant within ETO's service territory that uses natural gas is likely eligible to receive incentives.[10]

[9] Email exchange with staff at Asphlatpavement.org.
[10] For an Energy Trust of Oregon service territory map visit https://www.energytrust.org/wp-content/uploads/2016/11/GEN_ServiceTerritoryMap.pdf

Other Considerations

Lifecycle Considerations

- Energy efficiency upgrades, like moisture management techniques, typically have lifespans much longer than a single year, so these improvements will provide benefits well into the future.
- Avoided fuel use provides reduced emissions at the tailpipe as well as upstream emission for fuel production. (See info sheet on alternative fuels at ACP production plants.)

GHG Benefits

The following estimates are provided to illustrate a sense-of-scale for emission reductions. Note: baseline energy use conditions at all asphalt plants that serve ODOT are unknown. As previously shown, roughly 37% of ACP emissions are generated at the plant during production. ODOT's total annual average emissions from ACP production is about 65,000 MT CO_2e (plant emissions equal 37% of total, or 24,000 MT CO_2e). If all ACP plants that contract with ODOT participated in the EnergyStar Challenge for Industry (10% reduction over five years), the reduction potential at the end of year five is estimated at 2,400 MT CO2e / year. Research conducted for this project found some of ODOT's vendors/plants have already participated in the EnergyStar program, so a reasonable range of potential reductions for this practices is estimated at 1,000 – 3,000 MT CO2e per year (again, at year five of successfully completing the challenge).

Co-benefits

- Energy cost savings
- Air quality improvements beyond GHG emissions from reduced fuel use and tailpipe emissions

Recommendations

- Promote and encourage ODOT contractors to voluntarily participate in the EnergyStar Challenge for Industry with a primary focus on moisture reduction.
- Work with ETO for technical support and financial incentives.
- Seek financial support from USEPA, USDOE, etc. and state resources (Department of Energy, Department of Environmental Quality and Biz Oregon) for conversion costs through low interest loans, grants, or bond issuance.