Resurfacing a Trail in Oregon Using Volcanic Ash

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In the latest instance of taking research to practice, researchers at Oregon Tech have completed a pilot section of trail using a NITC-developed sustainable paving method. A quarter-mile section of the Klamath Geo Trail, just east and up the hill from the Oregon Tech Klamath Falls campus, has been successfully resurfaced using volcanic ash from Mount Mazama. The researchers explain and demonstrate the process in this NITC research video: Applying a Mt. Mazama Volcanic Ash Treatment as a Trail Accessibility Improvement.

USING MAZAMA ASH TO INCREASE ACCESSIBILITY

Substituted for portland cement, Mazama ash can be used as a more sustainable, locally sourced pozzolan to firm up gravel roadways and trail surfaces. Building on previous work by Matthew Sleep and Damien Matzen of Oregon Tech, researchers C.J. Riley and Ashton Greer employed a Mt. Mazama volcanic ash soil amendment to improve the surface stability and firmness of one quarter mile of Oregon Tech's Geo trail, in partnership with the Klamath Trails Alliance, to meet the requirements of the Americans with Disabilities Act (ADA). The trail treatment was successful, resulting in a firmer surface that wheels wouldn't sink into.

As demonstrated in the video above, the research team conducted before-and-after tests using wheelchairs and other wheeled devices, to evaluate the firmness of the trail surface. After the treatments, the surface was significantly more firm and stable, meaning that people who use mobility devices could now enjoy improved access to the natural area. The quarter-mile segment of trail the team chose for the pilot implementation is close to the trailhead, which has accessible parking spaces.

WHAT MAKES MAZAMA ASH A MORE SUSTAINABLE MATERIAL?

Most pavement projects use portland cement, which takes an excessive amount of energy to create: mining minerals, transporting them, and super-heating them. Such complex chemical reactions, similar to those needed to artificially create portland cement, took place naturally when the volcano erupted. Today, orange-colored deposits of Mazama ash are plentiful throughout southern Oregon and much of the Pacific Northwest, and are already being mined for other purposes.

This work was initiated by Sleep in 2017 through a NITC Small Starts grant: The Use of Mt. Mazama Volcanic Ash as Natural Pozzolans for Sustainable Soil and Unpaved Road Improvement. That first project demonstrated that Mazama ash had some properties of a natural pozzolan, and had the potential to be used for gravel roadway dust abatement. A sustainability analysis concluded that replacing portland cement with Mt. Mazama volcanic ash would reduce carbon dioxide emissions and embodied energy consumed during the construction process. In the second phase of research, ADA Accessible Trail Improvement with Naturally Occurring, Sustainable Materials, Sleep and Oregon Tech graduate student Damien Matzen conducted an extensive laboratory and field study to determine the effectiveness of using volcanic ash to increase the firmness and stability of unpaved trail surfaces. The team also did field-scale testing, with 12 lots of applied treatment testing different mixes.

The results of these tests showed long-term strength gains from Mazama ash that don't happen with portland cement alone, suggesting that aside from being more sustainable to use, the ash might actually work better than portland cement.

WHY ISN'T THIS BEING DONE MORE?

With such readily apparent advantages, why aren't natural pozzolans being used more widely throughout the construction industry? In short, it's a question of scale. The two earlier projects led by Sleep were both very small-scale efforts, with testing on small samples and in controlled environments. The current project, led by Riley and Greer, was a first stab at scaling up the process: with new difficulties discovered along the way.

"The process of scaling up from laboratory work to full-scale work on a trail was a really big step. I think it made it challenging for everybody involved to think about the scale that we had to move material on, the degree that we had to stage material, and be prepared to mix at a certain size batch and think about how much area a certain amount of material would cover. It felt a lot like baking; you're just kind of adjusting ingredients and amounts to make sure that your cake rises," Riley said.

The work done by the Oregon Tech team during this phase of the project paves the way for further development of their process and technique, which could eventually lead to natural pozzolans like Mazama ash being used more widely throughout the industry. Other communities with access to ash deposits could potentially follow suit. Anyone interested in observing the end result of this project can visit the Klamath Geo trail, and experience this unique surface for themselves.

EXPERIENTIAL LEARNING

Oregon Tech engineering students were involved in every phase of this project, giving them hands-on experience with the lab and fieldwork involved. During the course of the project, students groups tackled various engineering challenges, including:

- Designing and constructing a prototype to apply the material to the ground;
- Evaluating the strength of the material, in different ratios, over time;
- Developing processes for the logistics of transporting and handling the material;
- Evaluating the feasibility of solar lighting along the trail;
- Collecting and testing soil samples;
- Identifying potential strategies for stormwater drainage along the trail;
- Developing a sensor to measure the vibrations of a wheelchair on different surfaces.

"The ENGR 102 course is part of our introduction to engineering sequence, so all of our first year students take this course. Each year we try to turn it into really project-based experience, and this past term our Mazama ash trail resurfacing project turned into the project that this course was based around. So it was really neat to be able to kind of introduce them to this sort of project from beginning to end," Greer said.

ABOUT THE AUTHORS

The research team consisted of Charles (C.J.) Riley, Ashton Greer, Matthew Sleep, Damien Matzen, and students in Oregon Tech's engineering program.

ABOUT THE FUNDERS

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THE REPORT and RESOURCES

For more details about the study, download the full report "Applying a Mt. Mazama Volcanic Ash Treatment as a Trail Accessibility Improvement" at nitc.trec.pdx.edu/research/project/1529

Photo by C.J. Riley

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