RESEARCH

# Research Notes

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## Solar Powered Markers Not Up To Challenge

The Oregon Department of Transportation - Research Unit recently completed an evaluation of solar-powered raised pavement markers (SRPMs) to determine if this type of marker would operate more effectively than retroreflective raised pavement markers (RPMs) under certain climatic and roadway conditions.

Raised pavement markers (RPMs) have been in use in Oregon for many years. In the mid-1980's the ODOT Construction Section, through its Qualified Products Program, set up laboratory and field tests to determine which markers could be placed on state highways. Subsequently Standard Guidelines for Product Review were developed.

In some situations where the road curvature and terrain is such that headlights of approaching cars do not shine directly on the marker, RPMs are not effective. Fog and heavy rain also impact performance. Additionally the retroreflective qualities tend to degrade quickly. In response to the limitations of RPMs, manufacturers began investigating alternative devices. Solar-powered lights offer some advantages as has been demonstrated in products developed for airport lighting and marine situations. SRPMs typically use Light Emitting Diodes (LEDs) that are powered by solar cells. Solar cells convert sunlight directly into electricity. Some markers have retroreflective surfaces as well so that they essentially provide two different types of illumination, depending on the conditions.

ODOT performed preliminary tests on eight different models of solar powered raised pavement markers. These included environmental tests (extreme temperatures, immersion), optical performance tests, and observation tests. Federal Highway Administration's Photometric and Visibility Laboratory at the Turner-Fairbank Highway Research Center conducted additional tests on some of the markers to measure the LED signal and retroreflectivity at different distances and angles. The tests were designed to replicate what drivers would see on the road. It was found that each type of marker had significant shortcomings.

*A selection of solar raised pavement markers that were tested*

While the project was terminated prior to field trials being performed, weather tests were conducted. Markers were fixed to a display board and placed in an exposed fenced area where they were open to natural elements. After a period of eight months, less than half of the markers were operating satisfactory (they were either very dim or not lit at all).

*A selection of test markers waiting to be placed in the elements*

When all of the tests were completed a final report was written to document the testing process, provide detailed results, enumerate conclusions, and make recommendations.

Significant conclusions:

- None of the solar-powered raised pavement markers tested by FHWA met ODOT's retroreflectivity standards.
- The output of the LEDs was not sufficient to compensate for the low retroreflectivity values recorded.
- Most markers performed well in the environmental tests, which were more severe than those called for in the standards. Some showed damage after immersion. Weather tests indicated that prolonged exposure can result in failure after a short time period.
- Some markers did not stay lit long enough in laboratory testing to warrant the conclusion that they would stay on during the longest periods of darkness in Oregon (about 15 hours).

Recommendations:

- Due to performance concerns of the SRPMs tested in this research report, SRPMs should not be used in place of RRPMs that are currently approved for installation on highways in Oregon. It is expected that additional products will become available and that there will be improvements in the models tested. Before any markers are installed they should be tested to determine that minimum requirements are met. These include environmental tests, minimum retroreflectivity, and at least minimal observation tests.
- Models installed should be given conditional Qualified Products List (QPL) approval for a period of at least a year. If performance is satisfactory and markers can meet the basic requirements after a period of a year, they should be included on the QPL.
- ODOT should encourage and help financially support research on new types and new applications of traffic control devices through pooled fund projects or similar funding approaches. Undertaking this type of research independently is costly and can be more effectively accomplished by pooling resources with others.

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The final report for this project was published in January 2008 and is available on the Research Unit web page: http://www.oregon.gov/ODOT/TD/TP_RES/docs/Reports/2007/FHWA-OR-RD-08-07.pdf