Similar to the I-5 test section at Lynnwood, the OGFCs on SR 520 had lower initial noise levels, but these reductions were lost after a short period of time (2.5 years for I-5 and 1.5 years for SR 520).

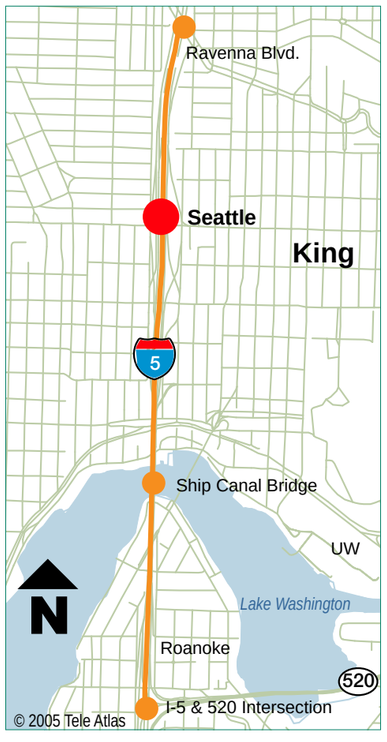
SR 520 Medina Rutting Measurements

Rutting measurements made on the SR 520 sections in January 2009 showed a loss of aggregate in the wheel tracks of two lanes of the OGFC-Rubber section of 7.3 and 8.3 mm (about 1/4 and 5/16 inches). In contrast, the OGFC-Polymer and the conventional asphalt sections are not rutting.

What are the next steps in the search for quieter pavements?

Testing of the existing OGFCs continues with one additional test section planned for I-405 in south Bellevue in 2009. We will continue to measure the OGFC pavements until the end of their useful life, which could be ten years or more.

In addition to the testing of the OGFC pavements, a test area of a new diamond grinding technique called the Next Generation Concrete Surface (NGCS), which promises a quieter concrete pavement, will be tried on I-5 between the Lake Washington Ship Canal Bridge and the Ravenna Boulevard Overcrossing in 2009.



NGCS Test Section Location

NGCS at the top, old diamond grinding technique at the bottom. Photo courtesy of L. Scofield, ACPA.

For More Information Visit the Quieter Pavements Web Site

www.wsdot.wa.gov/projects/quieterpavement

Contacts

Tom Baker, PE
State Materials Engineer
(360) 709-5401
bakert@wsdot.wa.gov

Jeff Uhlmeyer, PE
State Pavement Engineer
(360) 709-5485
uhlmeyj@wsdot.wa.gov

Tim Sexton, AICP
Air Quality, Noise and Energy
(206) 440-4549
sextont@wsdot.wa.gov

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Quieter Pavement Tests: The Story So Far

March 2009

Traffic noise is a concern for many residents living along state highways. The Washington State Department of Transportation (WSDOT) is studying ways to reduce the noise generated from our highway facilities and its effects on nearby residents.

Historically, noise barriers have been the most effective method for reducing traffic noise. Noise barriers include noise walls and earthen berms that separate traffic noise from adjacent properties. Typical noise reduction is 5 to 10 decibels, with 10 decibels being about half the perceived noise level. While noise barriers can be effective, they can also be expensive to install and are not constructible or effective in all locations.

Typical noise barrier wall that can reduce noise by 5 to 10 decibels.

What new things are being tried to combat noise?

WSDOT has been evaluating new types of pavements that might reduce freeway noise at the source. These new pavements, called Open Graded Friction Courses (OGFC) have the potential to reduce noise that comes from tires as they roll across the pavement surface.

Two projects have been built with OGFC test sections, one on I-5 in Lynnwood and one on SR 520 in Medina. Both test areas have one section of OGFC modified with rubber and one section modified with polymer. The test pavements were built alongside new conventional asphalt pavement so the noise characteristics and pavement performance could be accurately compared.

What has been discovered to date?

Noise experts agree that sound levels must differ by at least three decibels to be noticeable to the human ear. Immediately after construction, the OGFC pavements were audibly quieter than the conventional pavements. Today, the OGFC test sections are not audibly quieter than the conventional asphalt pavement. Additionally, these OGFC test sections are showing signs of failure due to raveling: the small rocks are coming out of the pavement. This loss of rock results in rutting and it has accelerated over this winter. Ruts now measure as deep as 8 mm (5/16 inches).

OGFC Test Section Locations.

Are additional OGFC test sections planned?

One additional OGFC project is planned on I-405 in south Bellevue in 2009. While the I-5 and SR 520 test sections installed OGFC pavement on top of conventional asphalt, the I-405 test section will install OGFC pavement on top of a concrete base.

WSDOT will measure noise levels and pavement wear on all three projects until the pavements are replaced, which could be ten years or more.

Close-up of an open graded friction course pavement showing the tiny air holes.

Close-up of a dense graded pavement showing no visible air holes.

On Board Sound Intensity (OBSI) test apparatus.

Why are OGFCs potentially quieter than conventional asphalt pavement?

OGFCs are designed to have tiny air holes or voids throughout their entire depth. The air voids absorb and dissipate the sound generated by the tires on the pavement surface. Conventional asphalt pavements have fewer voids, which gives them better durability than OGFC pavements, but also tends to make them slightly noisier.

How did WSDOT design the OGFC pavements?

The Arizona Department of Transportation (ADOT) has been a pioneer in using OGFC pavement to reduce traffic noise. ADOT provided WSDOT with the mix design for the OGFCs, including the design for the aggregate gradation and rubber content of the OGFC-Rubber and the aggregate gradation for the OGFC-Polymer. The National Center for Asphalt Technology (NCAT) provided the recommendation to use styrene butadiene styrene (SBS), a synthetic rubber, for the OGFC-Polymer design.

All three projects will use the same designs for the OGFC-Rubber and OGFC-Polymer pavements.

What are the challenges?

Durability, climate and studded tires are the biggest challenges to the use of OGFC pavements in Washington State. Most of the states successfully using OGFC pavements (Arizona, California, Texas, and Florida) are in the southern US and have warmer climates than Washington. Warmer climates are more conducive to the construction of OGFCs with rubber, which requires higher surface temperatures during paving. These states also have low studded tire usage. OGFC pavements have less resistance to wear from studded tires due to the air holes or voids which decreases the strength of the pavements.

Many durability questions remain, including how long any noise reduction might last and how long the pavement might last.

How is the noise being measured?

Noise attributable to the tire/pavement interaction is measured using the On Board Sound Intensity (OBSI) method. This method uses a pair of microphones mounted on the right rear tire, three inches off the pavement, to ensure that only the tire/pavement noise is being measured. OBSI is becoming the standard for measuring tire/pavement noise, both in the US and internationally.

I-5 Lynnwood Noise Measurements

Four southbound lanes on I-5 through Lynnwood were paved with OGFC pavements between Milepost (MP) 180.0 and 182.5.

- MP 180.8 – MP 181.8 – OGFC modified with polymer
- MP 181.8 – MP 182.5 – OGFC modified with rubber
- MP 182.5 – MP 183.0 – conventional asphalt (control section)

OBSI measurements began immediately after construction in August 2006 and have been taken monthly, weather permitting, through January 2009. Bar charts show the initial and current average sound intensity level measurements for all lanes of each pavement type.

Initially, there was a 4 dBA difference between the conventional asphalt control section and the OGFC-Rubber section, which was an audible decrease. The OGFC-Polymer section was 3 dBA decibels less than the conventional asphalt, which was not audible. Currently the OGFC-Polymer is 1 dBA quieter and the OGFC-Rubber is 1 dBA noisier than the conventional asphalt; neither of these differences is audible to the human ear.

I-5 Lynnwood Rutting Measurements

Rutting measurements made in January 2009 show that the OGFC-Rubber section is losing aggregate from the surface of the pavement in the wheel tracks. The outside lane is showing the most aggregate loss with a rut depth of 7.7 mm (between 1/4 and 5/16 inches), on a pavement that is only 19 mm (3/4 inches) thick. We start scheduling replacement when pavements reach 10 mm (3/8 inch) of rutting.

SR 520 Medina Noise Measurements

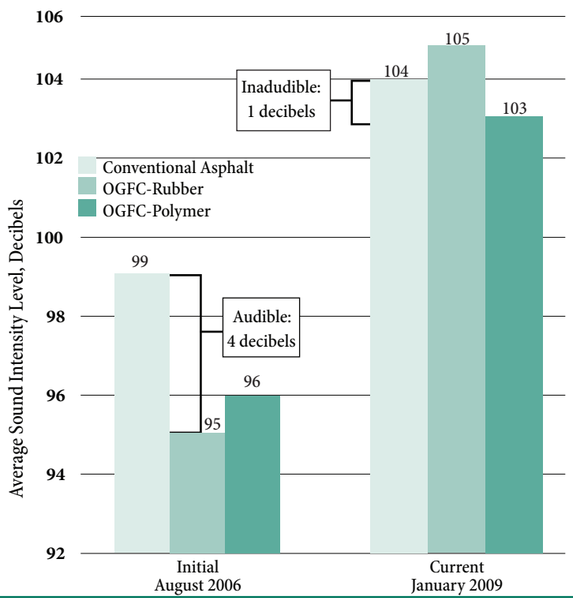
The SR 520 project begins just east of the Evergreen Floating Bridge at MP 4.2 and ends at MP 5.8. There are two general purpose lanes in each direction and an outside HOV lane in the westbound direction.

- MP 4.2 – MP 4.6 – OGFC modified with rubber
- MP 4.6 – MP 5.2 – conventional asphalt control section
- MP 5.2 – MP 5.8 – OGFC modified with polymer

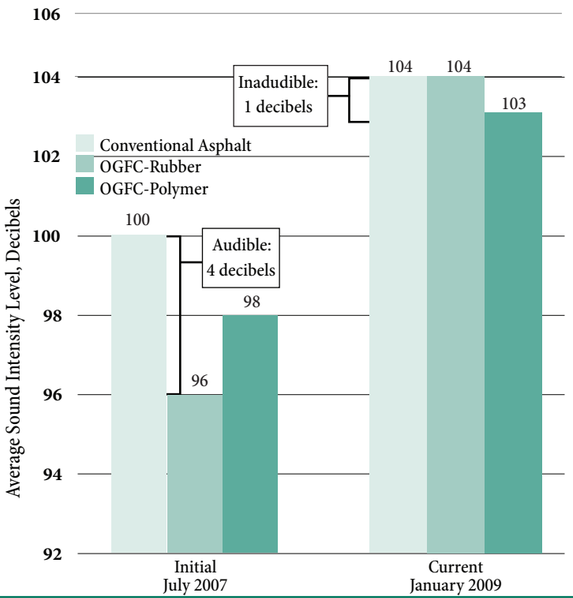
OBSI measurements began immediately after construction in July 2007 and have been taken monthly, weather permitting, through January 2009. Bar charts show the initial and current average sound intensity level measurements for all lanes of the project.

Initially, the noise level of the OGFC-Rubber was 4 dBA quieter than the control section, which would have been audible. The initial noise level for the OGFC-Polymer, at 2 dBA quieter than the control section, was not audible. Currently, the noise levels for all three sections are essentially the same: the OGFC-Rubber is equal to the conventional asphalt noise level and the OGFC-Polymer is approximately 1dBA quieter.

I-5 Lynnwood Initial and Current Noise Levels



SR 520 Medina Initial and Current Noise Levels



Sound Level Readings – The simplified term "Decibel" is used in the document to represent an A-weighted decibel scale. A-weighting, dBA, is used to better reflect the range of human hearing.