The Quieter Pavement test sites on I-5, SR 520 and I-405 were three of the most tested and documented quieter pavements in the world. WSDOT received an award for excellence in Quieter Pavements Research from the Rubber Pavements Association (RPA) in recognition of WSDOT’s contribution to the understanding of acoustics and performance of quieter pavements. RPA is a non-profit industry association of manufacturers, contractors, consultants, testing laboratories, suppliers, government organizations and individuals that encourage the use of asphalt pavements containing recycled tire rubber.

**What other pavement designs were evaluated for the potential to reduce noise?**

In October 2010 a new diamond grinding technique called the Next Generation Concrete Surface (NGCS) was used on I-82 near Sunnyside. The NGCS grinding is done in two stages. First, the pavement is ground to a very smooth profile. Second, done in two stages. First, the pavement is ground to a very smooth profile. Second, the pavement is ground to a very smooth profile. Approximately 30 months later the NGCS was 2 decibels quieter than the concrete prior to grinding and 1 decibel quieter than the adjacent lane of CDG, neither difference audible. The increase in noise was attributed to an increase in roughness of the pavement caused by studded tires. While other states have reported NGCS surfaces to be quieter than conventional diamond grinding, WSDOT did not measure a long-lasting noise reduction from this test section.

**What new things are being tried to combat noise?**

Open Graded Friction Course (OGFC) asphalt pavements have been successfully used by other states to reduce tire/pavement noise and were installed on three projects in the Seattle area. The OGFC projects were constructed between 2006 and 2009 on I-5 in Lynnwood, SR 520 in Medina, and I-405 in Bellevue. Each project included one section modified with curb rubber from recycled tires and one section modified with a synthetic polymer similar to natural rubber. Sections of conventional asphalt pavement were built alongside the OGFC pavements to compare noise characteristics and pavement performance. The test sections were designed to answer questions about the longevity of the noise reduction benefits and the long-term durability of OGFC pavements.

For concrete pavements, a new surface texture called Next Generation Concrete Surface (NGCS) was tried on I-82 near Sunnyside. The NGCS has produced low noise readings in other states. Noise levels for this new texture were compared to an adjacent section of conventional diamond grinding and the existing pavement prior to grinding. The goal was to determine the longevity of any noise reductions.

**What was discovered?**

Acoustic experts agree that noise or sound levels must differ by at least 3 decibels to be noticeable by most people (audibly quieter). Immediately after construction, the OGFC pavements were audibly quieter than the conventional pavements on all three projects. The longevity of the noise reduction varied from 1 to 14 months. Over all, the OGFC test sections were audibly quieter than conventional asphalt for an average of seven months.
OGFC-polymer design as recommended by the aggregate gradation for the OGFC-rubber content of the OGFC-Rubber and designs for the aggregate gradation for the OGFCs built on I-5, including pavement to reduce traffic noise. ADOT (ADOT) pioneered the use of OGFC pavements, which are more conductive to the construction of OGFCs with rubber, which requires higher surface temperatures during paving. These states also have low-studded tire usage.

How did WSDOT design the OGFC pavements?

The Arizona Department of Transportation (ADOT) pioneered the use of OGFC pavement to reduce traffic noise. ADOT provided WSDOT with the mix design for the OGFCs built on I-5, including designs for the aggregate gradation and rubber content of the OGFC-Rubber and the aggregate gradation for the OGFC-Polymer. WSDOT used styrene butadiene styrene (SBS) as synthetic polymer for the OGFC-Polymer design as recommended by the National Center for Asphalt Technology (NCAT). The SR 520 and I-405 projects used similar mix designs and material with some minor changes to improve performance.

What are the challenges to using OGFC pavements?

Climate and studded tires are the biggest challenges to using OGFC pavements in Washington. Most of the states successfully using OGFC pavements (Arizona, California, Texas, and Florida) are in the southern US and have warmer climates than Washington that 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.

How is the noise being measured?

Noise from the tire/pavement interaction is measured using the On-Board Sound Intensity (OBSI) method. OBSI uses two microphones mounted three inches off the pavement. The proximity of the microphones to the pavement ensures that only the tire/pavement noise is being measured and avoids measurements contaminated by nearby vehicles. OBSI is the standard for measuring tire/pavement noise in the US.

I-5 Lynnwood noise measurements

Four southbound lanes of 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 rubber
- MP 181.8 – MP 182.5 – OGFC modified with polymer
- MP 182.5 – MP 183.0 – conventional asphalt (control section)

OBSI measurements began immediately after construction in August 2006 and were taken monthly, weather permitting, through August 2010. Bar charts show initial and final average OBSI levels for all lanes of each pavement type.

Initially, there was an audibly difference of 4 decibels between the conventional asphalt control section and the OGFC-Rubber section. The OGFC-Polymer section was 3 decibels quieter than the conventional asphalt, which was also audible. The final readings in August 2010 showed no audible difference between the conventional and OGFC pavements. The OGFC-Rubber was 1 decibel quieter and the OGFC-Polymer 2 decibels quieter.

Final readings showed the OGFC-Rubber was 4 decibels quieter than the conventional pavement and the OGFC-Polymer 1 decibel quieter, neither difference audible.

SR 520 Medina noise measurements

The SR 520 project began just east of the Evergreen Point Floating Bridge at MP 4.2 and ended at MP 5.8. There were 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
- MP 5.2 – MP 5.8 – OGFC modified with polymer

OBSI measurements began immediately after construction in July 2009, and were taken monthly, weather permitting, through July 2011. Bar charts show the initial and final average OBSI levels for all lanes of the project.

Initially both the OGFC-Rubber and OGFC-Polymer were 4 decibles quieter than the conventional pavement section. However, within four months neither OGFC’s were audible quieter than the conventional pavement. The final readings showed the OGFC-Rubber was equal to the conventional pavement and the OGFC-Polymer 1 decibel quieter, neither difference audible.

I-5 Lynnwood rutting measurements

Rutting measurements made in May 2010 showed that the OGFC-Rubber section was losing aggregate from the surface of the pavement and rutting in the wheel tracks. The outside lane of the OGFC-Rubber section had the most aggregate loss with an average of 3/8 inch (9.5 mm) of rutting on a pavement that is only 3/4 inches (19 mm) thick. There were areas in wheel paths of the OGFC-Rubber section that were worn through to the underlying pavement. The rutting was attributed to raveling from studded tires.

SR 520 Medina rutting measurements

Rutting measurements made on the SR 520 sections in July 2011 were 1/2 inch (12.5 mm) on the most rutted lane of the OGFC-Rubber section, 3/8 inch (9.5 mm) on the OGFC-Polymer and 7/32 inch (5.5 mm) for the OGFC-Rubber lane, 7/32 inch (5.2 mm) for the OGFC-Polymer, and 7/32 inch (5.2 mm) for the conventional asphalt control section. The OGFC-Polymer was 1 decibel quieter than the conventional pavement and the OGFC-Polymer 1 decibel quieter, neither difference audible.

I-5 Lynnwood initial and current noise levels

<table>
<thead>
<tr>
<th>Noise Level, Decibels</th>
<th>New HMA</th>
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<th>OGFC-Polymer</th>
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<tr>
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I-405 Bellevue initial and current noise levels

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<th>Noise Level, Decibels</th>
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<td>Final/July 2011</td>
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The simplified term “decibels” is used in the document to represent an A-weighted decibel scale.