Ontario

RoadTalk

Spring 2017 • Ontario's Transportation Technology Transfer Digest • Ministry of Transportation

Ontario's First Pilot Project for Smog-Reducing Acrylic Noise Barriers

The Ontario Ministry of Transportation (MTO) installs noise barrier walls along its busiest provincial freeways to reduce highway noise in adjacent residential areas. Typically most ministry barrier walls have been constructed of concrete or a composite material, while acrylic barriers have been more recently introduced for special applications.

Early in the spring of 2017, the ministry arranged a pilot project to field test a pollution-reducing, acrylic noise barrier called SmogStop™ during a Highway 401 rehabilitation project in Toronto, near Bayview Avenue. A 15-metre section of photocatalyst-coated acrylic barrier was installed along the northern side of the highway, temporarily replacing a portion of the ministry's conventional concrete noise barrier. This is Ontario's first in-field test for photocatalyst-coated acrylic panels. The barrier installation provides the road-side conditions for comparing university laboratory test results of the barrier's ability to mitigate air pollution, specifically nitrogen oxides, against in-field data.

A 15-metre section of SmogStop™ acrylic noise barriers installed on the north side of Highway 401 during a rehabilitation project in 2017

Benefits of Acrylic Barriers

There are unique benefits of acrylic barriers that make their use ideal in some highway applications. Acrylic noise barriers are light weight and have been level four (TL-4) crash-tested for high impacts, making them ideal for use on overpasses. When used on the highway right-of-way, their transparency mitigates visibility barriers for businesses located adjacent to a highway. Acrylic also allows sunlight to pass through, reducing tall-wall shadows typically cast by concrete barrier walls on neighbouring properties. With an estimated 30-year life, acrylic barriers have a similar service life as their concrete counterparts; however they cost approximately three times more than conventional concrete barriers, making their use in traditional applications cost prohibitive.

New Photocatalyst-Coated Acrylic Barriers

The acrylic barriers installed at the Highway 401 site are two centimetres thick and conform to ministry structural specifications. The proprietary aerodynamic design of the barrier directs traffic emissions into an air channel within the barrier, where emissions come into contact with the photocatalyst coating. Sunlight-activated photocatalytic chemical reactions are then initiated, where nitrogen oxides (i.e., nitric oxide and nitrogen dioxide) are converted to harmless by-products, such as nitrogen gas and oxygen gas.

Laboratory Testing

Computational fluid dynamics (CFD) modelling and wind tunnel testing in university laboratories were performed on the photocatalyst-coated acrylic barrier to establish a baseline for its effectiveness in mitigating air pollution. Wind tunnel testing was conducted at the University of Western Ontario in London, Ontario, to confirm the results of the CFD modelling. The effectiveness of the photocatalyst coating in mitigating >

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nitrogen oxide emissions was then tested inside the University Of Ontario Institute Of Technology's wind tunnel. The state-of-the-art facility, which is located in Oshawa, Ontario, is capable of conducting wind tunnel tests under a wide range of climactic conditions.

Installation and Monitoring

Armtec LP, a barrier supplier for the ministry, along with partner Evonik, an international producer of specialized acrylic materials, supplied the acrylic barriers installed on the Highway 406/Glendale Avenue overpass in St. Catharines, in 2016. Also in 2016, a new partner was added, Envision SQ, a company specializing in air pollution reducing technology. Together the team presented the new lab-tested, photocatalyst-coated barriers to the ministry proposing the inclusion on the Highway 401 rehabilitation project as a pilot. The installation will compare laboratory results against in-field data as part of providing proof-of-concept for the barriers.

The University of Guelph has developed an air quality monitoring strategy that they will implement to assess the performance of the Highway 401 barrier installation site. The results of the pilot project monitoring will be compared to the university lab findings. The data will be available in 2018. •

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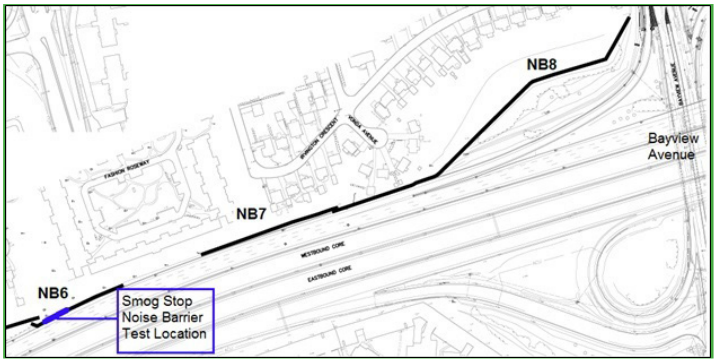
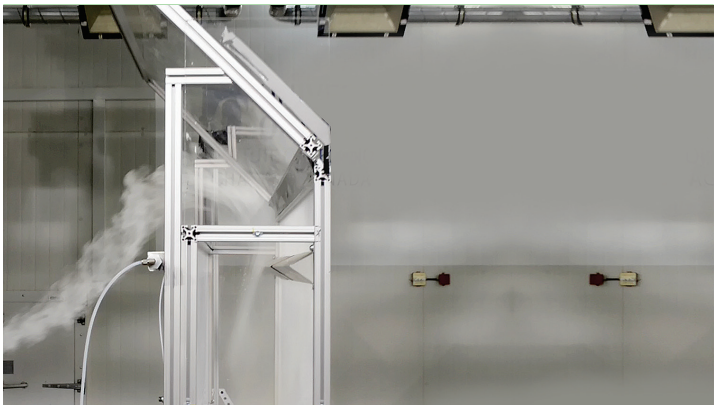
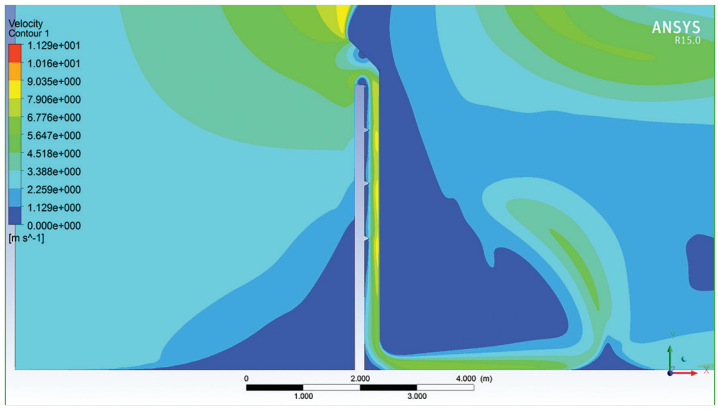


The location of the SmogStop™barrier installation show in blue; a small section of NB6.



SmogStop™ barrier in laboratory aerodynamics test using smoke



Computational fluid dynamics simulation displaying air velocities surrounding a SmogStop™ barrier

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Loader-Mounted Equipment Removes Snowpack and Ice from Ontario Highways

Ontario has among the safest roads in North America and keeping roads clear of snow and ice is a provincial priority. To that end, in January 2017, the Ontario Ministry of Transportation (MTO) began a field trial for an innovative piece of winter equipment manufactured by Snow Lion, headquartered in Harbin, China. The product, a loader-mounted ice breaker, removes pavement-bonded snow and ice in subzero conditions. The equipment is used to assist with the removal of ice and snowpack when other conventional approaches, for example salting and direct liquid applications, fail to prevent ice and snow from bonding to pavement surfaces. Snow Lion equipment is being tested on snow packed highways for improved friction and retention of winter sand.

Once the equipment is mounted to a loader it can be used throughout the winter season when necessary. The equipment does not have a dedicated motor. In operation, a cylinder comprised of rows of steel disks rotate with the motion of the loader, while actuators force downward pressure on the rotating cylinder to break up accumulated ice and snowpack. An auger system, located just behind the cylinder, conveys the removed material to the roadside. The loader used for the trial has also been fitted with Ontario's winter equipment conspicuity panels and lighting for visibility on the highway. The average speed of the Snow Lion equipped loader is 25 km/hr.

Figure 1: Snow Lion equipment mounted to a loader by EMCON Services, Ontario's Kenora Area Maintenance Contractor.

The field test for the equipment is being conducted in Dryden, with EMCON Services, the ministry's Kenora area maintenance contractor. EMCON mounted the equipment on a loader in early January and began testing its effectiveness on Highway 605, west of Dryden, and on Highway 601, north of Dryden. Highways 605 and 601 are designated as Ontario Class 5 and Class 3 highways, respectively. Highway 605 has a performance standard of 24 hours to achieve a well groomed snow packed condition and Highway 601 has a centre bare pavement standard of 24 hours.

Highways 605 and 601 were selected because they provide a range of asphalt, chip seal surfaces, and pavement markings which will be monitored for any unfavorable caused by the equipment. The trial will also provide practical equipment experience while the safety, mechanical reliability, set-up and operating costs are monitored.

In addition, the trial will measure the equipment's performance when removing snowpack using a spectral camera and a friction trailer to document the state of snow cover before and after it is used. The University of Waterloo, under the ministry's Highway Infrastructure >

Loader-Mounted Equipment Removes Snowpack and Ice from Ontario Highways, continued

Figure 2: Snow Lion equipment prior to mounting

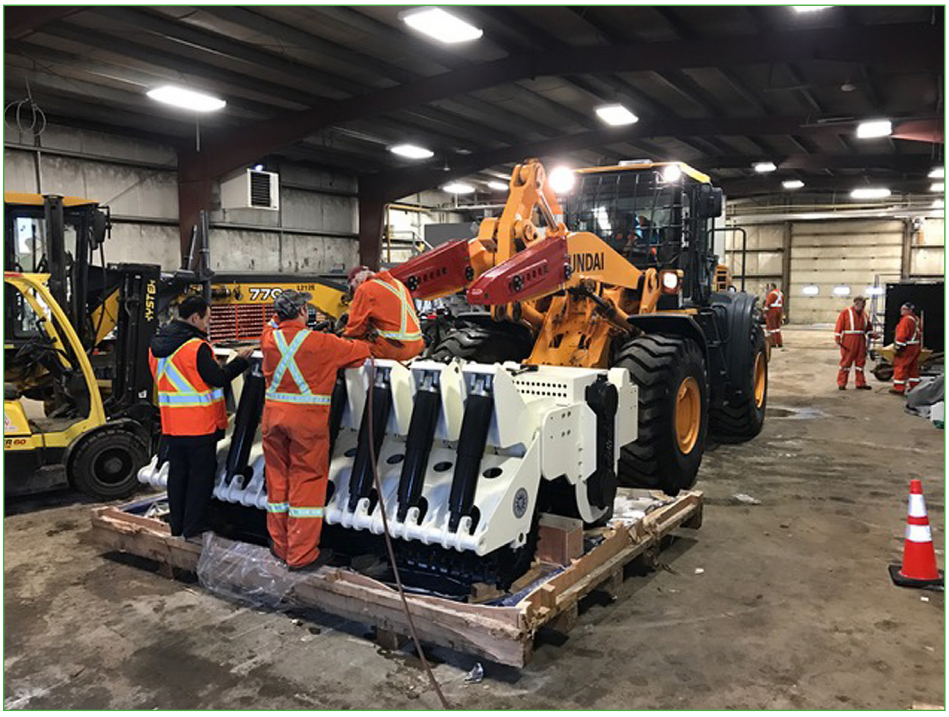

Figure 3: Mounting the Snow Lion equipment on a front loader

Innovation Funding Program (HIIFP), will coordinate data integration, analysis, model development, and reporting for the Snow Lion equipment trial.

To date, early testing of the equipment's use demonstrates the removal of highway snowpack to approximately one centimetre above the pavement, preventing damage to the pavement surface. In addition, the steel cylinder leaves divots in any remaining packed snow which assists in keeping salt and sand applications on the roadway. Overall, these early observations conclude that Snow Lion equipment exhibits faster and more efficient ice and snowpack removal than a traditional grader with ice blades.

Based on initial outcomes of the winter 2017 trial, the ministry is considering adding another truck-mounted unit for the continuation of the trial during the winter of 2017/18. Meanwhile, the California Department of Transportation (Caltrans) has also tested Snow Lion equipment and is sharing their results with Ontario. >

Figure 4: An example of a friction trailer

Loader-Mounted Equipment Removes Snowpack and Ice from Ontario Highways, continued

The testing of innovative products, like the Snow Lion equipment, demonstrates Ontario's commitment to investigating state-of-the-art technology to keep highways safe for winter driving. •

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Figure 5: The results of snow and ice cleared from an Ontario provincial highway using Snow Lion equipment. Divots are visible in the remaining one centimetre of snow. These divots assist in retaining salt and sand on the road.

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