FACT SHEET

USE OF RECYCLED GLASS IN ROAD CONSTRUCTION: SUMMARY OF A CASE STUDY IN CHANDLER, GASPÉSIE

Éco Entreprises Québec

THE PROJECT AT A GLANCE

From October, 2017 to January, 2019, the city of Chandler, in the Gaspésie region, took part in a project that demonstrated the added value of recycled glass as an insulating barrier in road infrastructures. By using recycled glass instead of traditional quarry materials, the ground is less affected by temperature variations and ensuing impacts, namely road subsidence and cracking.

PROJECT PARTNERS	ROLE
Ville de Chandler	Road development
Centre de tri de la Gaspésie (RITMRG)	Recycled glass provider
École de technologie supérieure	Data acquisition and technical analysis
Éco Entreprises Québec	Coordination and technical analysis

CONTEXT AND OBJECTIVES

The project is the result of an association between **a research program** at École de technologie supérieure (ÉTS) on the incorporation of recycled glass in road works and Éco Entreprises Québec's (ÉEQ) ***Innovative Glassworks* Plan**, a test project that aims, among other things, to equip sorting centres with the means to recycle 100% of the glass collected via curbside recycling.

The use of glass in road works is widespread in several countries, including the United States (e.g. Minnesota, New Hampshire), in remote or isolated regions, such as certain islands (e.g. Saint-Pierre-et-Miquelon archipelago, Prince-Edward-Island). Laboratory work done at ÉTS has shown that glass has a superior insulating power over the generally-used limestone. As for ÉEQ's Innovative Glassworks, it has shown that it is possible to obtain quality recycled glass with a purity rate and particle size suitable for its use in road works as per the Ministère des Transport's specifications.

As regards the **goal to verify in situ the insulating power of recycled glass in roadworks**, the city of Chandler enabled the execution of a test to use glass collected from its citizens and sorted in the regional centre (RITMRG) in a section of road on its territory.

INNOVATIVE GLASSWORKS

EXECUTION OF WORK

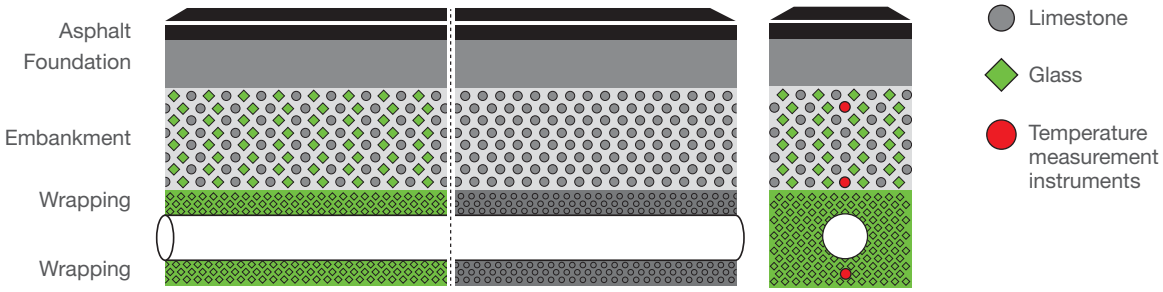
A road is made up of several layers of aggregates, from asphalt on the surface, to water pipes deep below. The work included adding glass in two of the layers, as illustrated in Figure 1 on the next page:

1. In the **pipe wrapping** buried at an approximate depth of two metres (100% glass);
2. In the **embankment** located above the wrapping (50/50 mixture of glass and limestone).

Temperature measurement instruments were installed at various depths in a section where the glass was incorporated and, in order to compare, in a section where traditional aggregates were used.

Temperature data were collected from October, 2017 to January, 2019, enabling researchers to measure ground temperature at various depths and over several seasons.

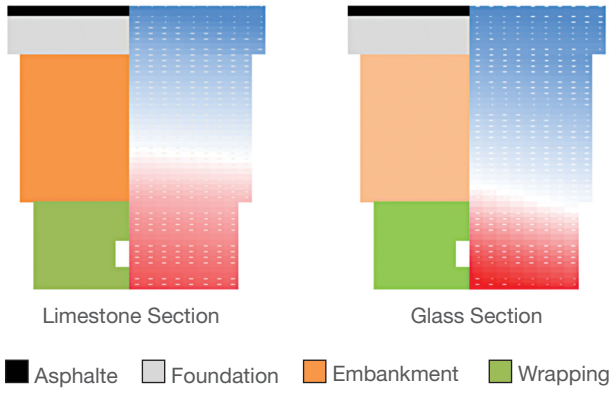
Figure 1 – Illustration of the various layers of the road in sections with and without glass



RESULTS AND CONCLUSIONS

Figure 2 indicates temperatures in various layers of the road, according to sections during winter. The colour gradient shows cold penetration (dark blue) downwards, as well as heat diffusion (dark red) towards the surface.

Figure 2 – Temperature distribution in various layers of the road during winter



Source: Final Report – Test slab in Chandler, Gaspésie, ÉTS, 2019

In particular, the test data show the three following observations:

1. The cold from the outside penetrates deeper when the pipe wrapping is glass instead of limestone;
2. The cold stops clearly at the pipe when the wrapping is glass rather than limestone, even if the temperatures are lower;
3. Underground heat progresses more towards the surface when the wrapping is limestone rather than glass.

Conclusions of these results are as follows:

1. Glass does have a superior insulating power: the glass layer applied as wrapping acts as a thermal barrier that prevents underground heat from rising up to the surface and frost from reaching the pipes;
2. The ground above the glass layer freezes faster in winter compared to the ground above the limestone wrapping. By freezing faster, the ground accumulates less water and limits the formation of ice lenses that are a source of heaving and cracking on the roads during winter. Therefore, the layer of glass reduces the damage to roads.
3. Using a mixture of glass and limestone in the embankment layer does not provide any particular added value.

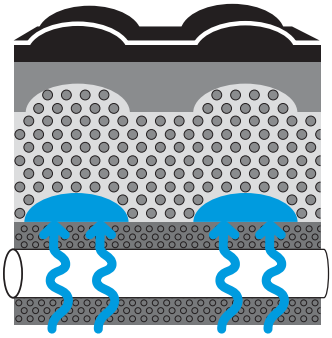
Why are ice lenses a source of road damage in the spring?

Underground water has a tendency to rise to the surface. In the winter, when the water comes into contact with the freezing front, ice lenses are formed and cause deformation of the road.

During the thaw, the ice melts, leaving behind a ground that is loose and has voids. When vehicles, especially heavy ones, drive on the road, the pressure they exert crushes the voids and causes subsidence of the ground.

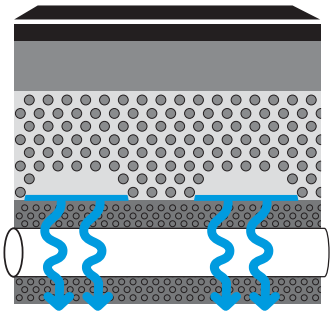
Figure 3 – Impact of ice lenses on road deformation

Winter – Negative temperatures

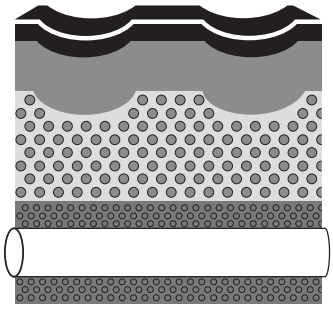


Ground heaves due to water infiltration and formation of ice lenses.

Spring- Positive temperatures



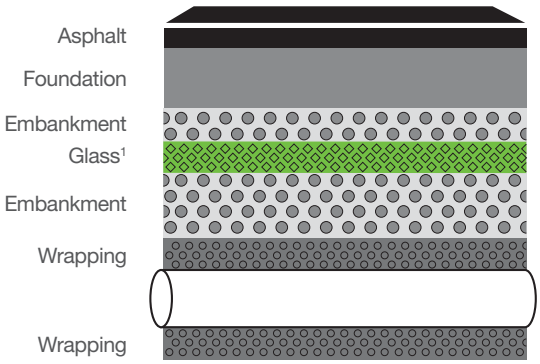
Water percolation and formation of cavities, loose soil and voids.



Ground subsidence.

RECOMMENDATIONS

Based on these results, it is recommended to place a 300-400 mm thick glass coating between 450 mm and 800 mm beneath the asphalt in order to meet the Ministère des Transports' requirements for pavement insulation.



1: 450 to 800 mm beneath the asphalt

PROJECT TECHNICAL DATA

- Aqueduct: 150 mm diametre
- Length: 49 m
- Depth of aqueduct: between 1.9 m and 2.2 m
- Wrapping thickness: 400 mm
- Cushion thickness: 300 mm
- Glass particle rate: 0-6 mm

Full report available only in French:
eeq.ca/wp-content/uploads/verre-infra-routes-RP-VF.pdf