Job Report Cold Recycling

WR 2500: Cold foam in place recycling, Ellerslie Road, Edmonton / Canada

Wirtgen Cold Recycling:

Cold foam in place recycling
Ellerslie Road, City of Edmonton, revisited

Mike Marshall, August 2001

1. Brief description

1.1 Background

On the 24th January 2001, Wirtgen opened discussions with the City of Edmonton, to explore the possibility of developing a Cold Foam In Place Recycling (CFIPR) project.

The City had identified a section of Ellerslie Road that was due for rehabilitation and suggested that this be a good candidate for a recycling project.

The current rehabilitation design strategy for the section would call for the reworking of the upper base layer with the addition of gravel and emulsion.

The initial benefits of CFIPR were identified as:

- Structural integrity: The process produces a thick bound layer.
- Subgrade is not disturbed.
- Shorter construction window required than full reconstruction.
- All of the pulverized existing AC and aggregate base would be recycled, thereby saving considerable “virgin” aggregate from being hauled to the site.

In order to progress the project it was agreed that Wirtgen would employ the expertise of A.A.Loudon & Partners to carry out initial site investigations to establish if the proposed section was suitable for CFIPR and if so to determine a mix design compatible with the existing materials and the City design requirements.

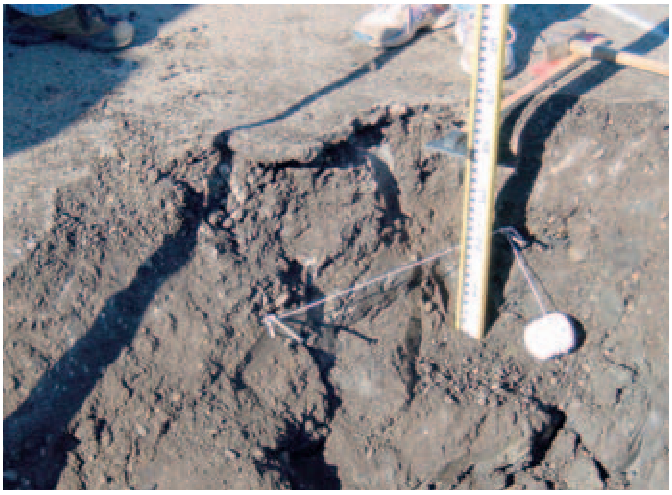
1.2 Site investigation / mix design

Pavement investigation concerns the gathering of available information, traffic analysis and the implementation of appropriate methods of investigation in order to provide sufficient data to carry out the pavement design. These include:

- Study of available information.
  In this instance the City was able to provide, as built data, traffic estimates, pavement deflection data and core samples from the existing pavement.

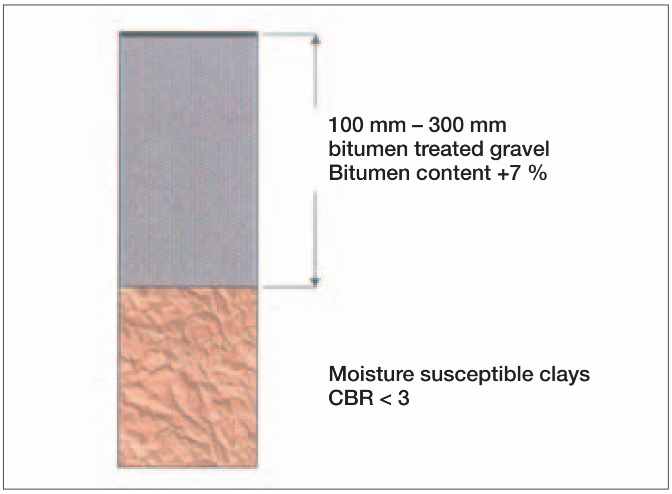
- Analysis of design traffic.
  For the section on Ellerslie road a recent traffic count showed:
  - 9,000 ESAL’s per year
  with an anticipated heavy traffic growth of 4 % per annum.

- Methods of Investigation, include
  - Visual assessment
  - Dynamic Cone Penetrometer survey
  - Testpits
  - Core sampling
  - Deflection measurements
  - Laboratory testing



A backhoe was used to excavate the existing pavement.

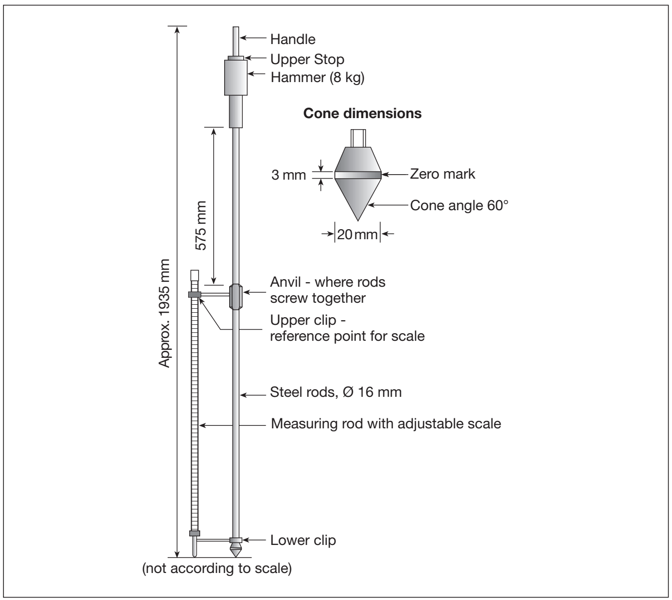
From this initial test pit it was possible to visually examine the makeup of the existing structure.



The existing pavement consisted of 100 mm to 300 mm of emulsion treated gravels over clays.

The emulsion stabilized base was shown to be rich in bitumen, which would result in low stabilities.

Samples, representative of the material to a depth of 100 mm were taken for the foam mix design.



DCP probings were carried out in order to determine the in situ strength of the existing pavement materials.

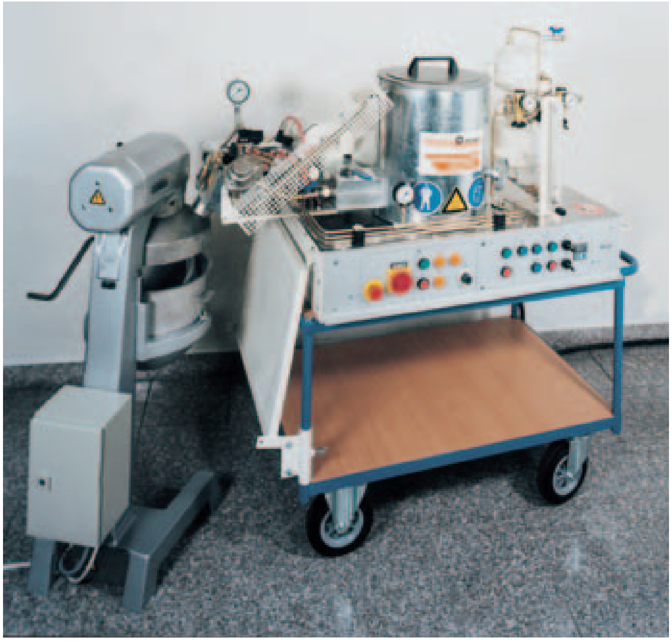
The results showed:

- An upper pavement layer of between 100 mm and 350 mm in thickness with an average modulus of 150 MPa.
- Underlying material with moduli ranging from 20 MPa to 30 MPa to a depth of 800 mm.

Samples from the testpits were subjected to laboratory testing, to establish the quality of the materials in the existing pavement layers, and in the underlying subgrade.

Typical tests include, sieve analysis, plasticity and CBR. The results from these tests together with samples of the materials were used to formulate the mix design.

Using a Wirtgen WLB 10, foamed bitumen laboratory portions of the samples were prepared by mixing them with various percentages of foamed bitumen to determine the optimum percentage of foamed bitumen to be added to meet the desired design requirement.



The WLB 10 is used to:

- Determine the foaming properties of different bitumen types.
- Producing samples by injecting foamed bitumen directly into the laboratory mixer.
- The quality of mixtures to be produced in the field can be defined exactly.
- Information on the material properties such as load bearing capacity can be obtained before the construction work starts.

As described, the existing base material had a high percentage of bitumen and was not suitable for foamed bitumen stabilization without the addition of new material.

Treatment with a foamed bitumen stabilizing agent requires a minimum of 5 % fines (passing 0.075 mm sieve) for effective dispersion of the foamed bitumen. As little or no fines would be available from the existing base material, a suitable material with a high fines content was sourced.

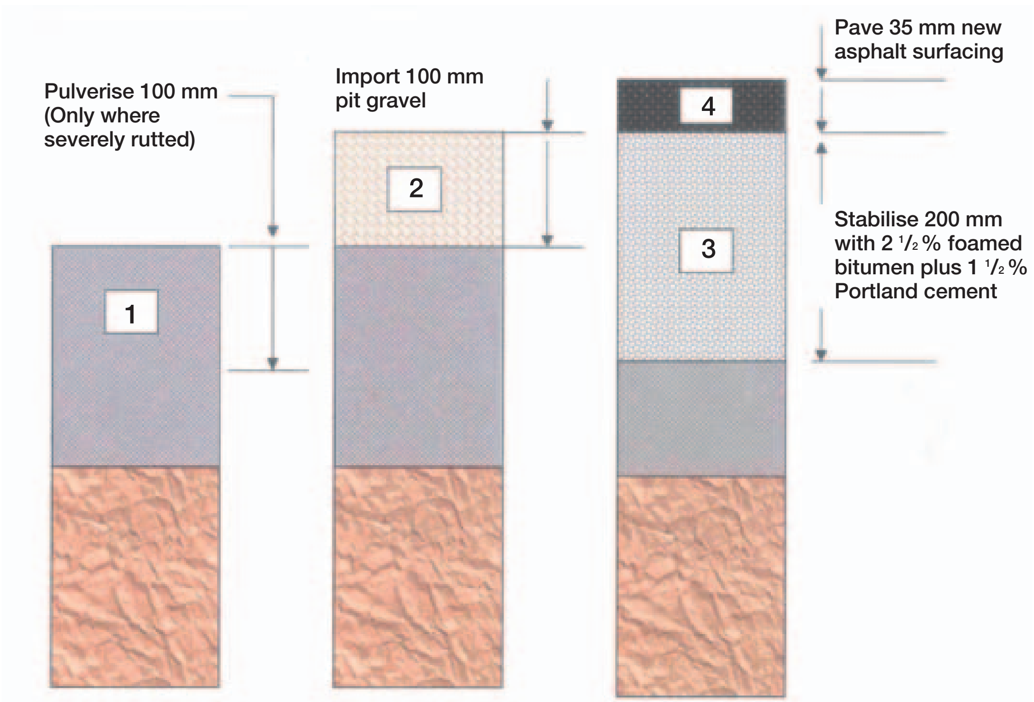
The most suitable material for addition to the base layer was a crushed rock product, this was sourced from a local pit, with a fines content in excess of 10 %.

The bitumen used for the mix design was 150/200 pen grade. The blended samples of material from the existing pavement were stabilized with foamed bitumen, contents ranging from 2.0 % to 3.5 %, in 0.5% increments, together with 1.5 % cement.

Briquettes manufactures using the WLB 10 at the different foamed bitumen contents were cured and then tested for indirect tensile strength, under dry and soaked conditions.

The final mix design for the CFIPR project was determined to be:

- Addition of 100 mm imported gravel
- Add 1.5 % cement by mass
- Add foamed bitumen to the pulverized material at a rate of 2.5 % by mass
- Recycle the existing pavement with the imported gravel to a depth of 8" (200 mm)



2. Road condition prior to recycling

Ellerslie Road, Edmonton.

View from 156th Street looking East towards 142nd Street.

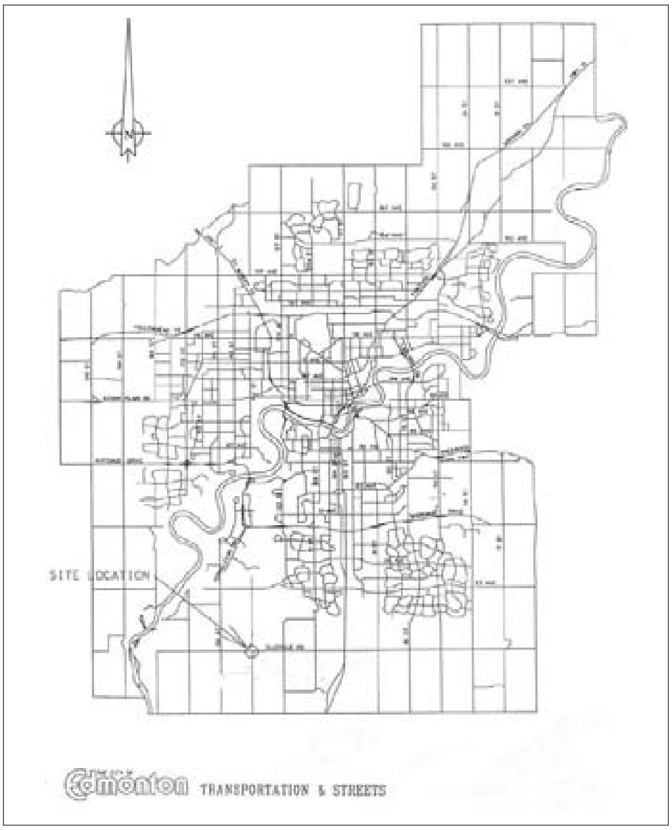
The distress found was mainly severe crocodile cracking and deformation.

The cracks are evidence of fatigue failure of the upper pavements layers due to lack of subgrade support, especially when the subgrade is excessively moist.

The deformation evident is also due to the movement of the subgrade and in some instances excessive bitumen in the base layer.

3. Location / project

3.1 Location map, City of Edmonton



Project Ellerslie Road:

Recycle full road width from Junction 156th St, East to Junction 142nd St, approx. 1.4 miles

Recycle full road width from Junction 140th St, West, approx. 0.3 mile.

Road Width, 25 ft (8 m).

4. Construction plan

- Pre-pulverise existing pavement where required
- Add 4" (100 mm) pit gravel by means of a paver
- Compact to accommodate traffic
- Spread 1 ½ % cement
- Recycle entire road width, 4 passes with WR 2500, addition of foam bitumen 2.5 %
- Compact and finish
- Seal with 35 mm new asphalt wearing surface.

5. Pavement preparation

5.1 Addition of pit gravel with paver

Locally sourced pit gravel, delivered to site by dump trucks.

The pit gravel was laid using a conventional paver at thickness of 4” (100 mm).

The layer was roughly compacted to accommodate traffic.

5.2 Addition of cement

Cement, 1.5 % by mass was added to the surface of the compacted new material.

The cement was spread in sections, no longer than 450 m in front of recycling train.

5.3 Pre-pulverisation

It was necessary to pre-pulverise certain sections of the pavement.

Rutting in excess of 6” (150 mm) West of 140th St.

Pre-pulverising the Crossroad radius.

Crossroad, Ellerslie road and 140th St.

6. Cold Foam In-Place Recycling (CFIPR) process

6.1 Recycling train

The WR 2500 recycler was coupled with:

- Bitumen supply tanker, in front, bitumen heated to a temperature of 350 deg F. The supply tanker is pushed by the WR 2500 recycler.
- Water cart, in rear. The water cart is pulled by the WR 2500 recycler.

The road width to be recycled is 25ft (8m), the number of passes with the recycler is four:

Pass 1. East Bound Lane
8 ft (2.5 m) full cutter width, with full foam spray bar open.
Direction West to East

Pass 2. East Bound Lane
5.5 ft (1.7 m), from edge Pass 1. to center of roadway (allowing for 6” overlap each edge)
Outer foam jets switched off to avoid double dosing with bitumen.
Direction West to East

Pass 3. West Bound lane
8 ft (2.5 m) full cutter width, with full foam spray bar open.
Direction East to West

Pass 4. West Bound Lane
5.5 ft (1.7 m), from edge Pass 1. to center of roadway (allowing for 6” overlap each edge)
Outer foam jets switched off to avoid double dosing with bitumen.
Direction East to West

Average recycling speed 44 ft/min (14 m/min).

6.2 Compaction

Vibrating padfoot compactor follows immediately behind the recyclers for initial compaction of the recycled material.

Once compacted the recycled material is cut to level using a motor grader.

A double steel drum compactor follows the motor grader for final compaction.

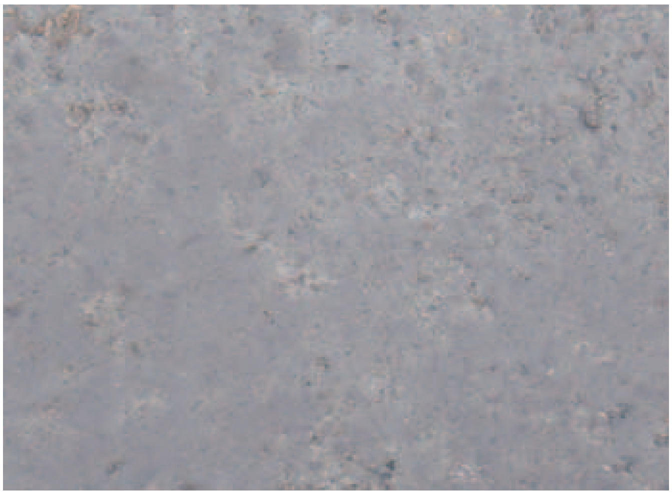
6.3 Water

The recycled material is watered to keep the surface moist.

6.4 Final compaction / surface finish

While the recycled surface is wet, the pneumatic tyred roller is used to create a surface slush effect, which knits together the finer particles at the surface.

This process locks the larger particles and avoids surface raveling.



The resulting finish provides an excellent smooth surface for traffic to run on.

7. Application shots

7.1 Site visit

During the recycling project, The City of Edmonton and Wirtgen held a foam bitumen seminar. After a presentation on foam bitumen stabilization the guests were invited to the job site. Some 66 engineers attended the job site, representing local government, private contractors and material consulting engineers.

7.2 Recycling on a 4 way crossroad

Junction Ellerslie Road and 156th Street, 4 way crossroad.

It was necessary to recycle this junction without closing off the traffic, therefore speed of operation was essential.

Firstly 4 passes were made West to East, full width of the road, then 4 passes North to South full width of the road. For the radius work, the bitumen supply tanker was unhooked and the radius material was pulverized only using the WR 2500, this material was then blended with the foam treated material.

Despite the best efforts of traffic control, (trying to stop traffic from 4 directions at once), it was necessary to work continually with traffic.

The radius material is blended with the foam treated material and then placed back into the radius ready for compaction and finishing.

8. Before and after views

8.1 View from project starting point looking East

19th August 2001

View from start of project looking East.

The distress found was mainly severe crocodile cracking and deformation.

The cracks were evidence of fatigue failure of the upper pavement layers due to lack of subgrade support, especially when the subgrade was excessively moist. The deformation evident also pointed to movement of the subgrade and in some instances excessive bitumen in the base layer.

26th August 2001

View from start of project looking East after recycling with foamed bitumen and before sealing with asphalt overlay.

13th June 2002

On the 13th June 2002 it was possible to revisit the Ellerslie Road site and determine how the recycled base using foamed bitumen had withstood nearly 12 months of traffic and ambient temperatures of down to minus 22 Deg F.

No evidence of any pavement failure or distress.

August 2001

Rutting in excess of 6” (150 mm) West of 140th St.

This rutting was after only 3 months of rehabilitation using cold mix.

June 2002

Above section, West of 140th St.

No evidence of any pavement rutting or failure.

8.2 View looking East approx 0.5 mile from starting point

19th August 2001

25th August 2001
Prior to final finishing with PTR

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