Cleaning Open Grade Asphalt to Improve Safety

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ABSTRACT

The presentation will examine the following issue from a practical perspective: Why do we use Open Graded Asphalts ("OGPA") particularly on high-speed multi lane roads?

There are a number of answers to this question. The most relevant are

- Reduced collision risk due to the reduction in spray
- Reduced surface reflections from wet pavements both day and night
- A reduction in noise levels
- Improved skid resistance due to rapid removal of water from the aggregate tyre interface.

The paper includes a summary of the make up of OGPA, its expected life cycle, and how the water draining characteristics of the material function.

Two major changes happen over time when the OGPA becomes clogged. The first is the build up of detritus, which from stereoscopic photography looks like cement. This physically clogs the voids and reduces the effectiveness of the OGPA attributes.

The second is the oily material that accumulates in the voids and comes to the surface during rain. This material may contribute to loss of control accidents as evidenced by the fourfold increase in autumnal accidents

The paper then moves on to discuss the OGPA Cleaning Trial Contract CA2445 and the methodology used for the cleaning process, the test methods, and the environmental considerations. It includes all the test results for each site compared with the age of the OGPA. The water testing results and the level of contaminants removed from the seal are particularly interesting.

Finally: What were the outcomes from this trial and where do we go from here?

1. INTRODUCTION

Open-graded porous asphalt (OGPA) has been used since the 1950's and was originally designed for use on runways in the United Kingdom. It has been widely used on motorways to improve the surface frictional resistance of asphalt pavements.

OGPA improves wet weather driving conditions by allowing the water to drain through its porous structure away from the roadway. The improved surface drainage reduces hydroplaning, reduces splash and spray behind vehicles, improves wet pavement friction, improves surface reflectivity and reduces traffic noise.

2. BENEFITS OF USING OPEN GRADED POROUS ASPHALT

The open structure of OGPA drains rainwater effectively, thus eliminating the backsplash and hydroplaning typical associated with smooth asphalt. This helps to reduce the collision risk due to the reduction in spray.

Reduced surface reflections from wet pavements both day and night mean that light reflection and glare are decreased and night visibility of pavement markings are improved

There is a reduction in noise levels due to the ability of the OGPA to attenuate noise within the spaces in the pavement.

There is improved skid resistance due to the rapid removal of water from the aggregate tyre interface. This open texture allows for the absence of surface water. In addition the rough surface texture of the mix improves skid resistance at high speeds, especially during wet weather

3. WHAT HAPPENS WHEN THE OGPA BECOMES CLOGGED?

After two to three years the surface voids of the OGPA start to become chocked with debris or dust which reduces the pavement's ability to drain water. Once this happens the effectiveness of the OGPA reduces. This coincides with increases in vehicle spray, reductions in permeability, a decrease in skid resistance and ultimately an increase in accidents.

Eventually the performance characteristics of the OGPA are compromised. Traditionally the OGPA is resurfaced every seven to eight years. The problem that faces us is what to do between year three and the point of intervention to resurface the OGPA. How much do you allow the skid resistant characteristics and the other features of the OGPA to deteriorate before you intervene?

One method that is available to rejuvenate the skid resistance and other characteristics of OGPA is to use low pressure captive water blasting. Terry Boyle from the Transit New Zealand Auckland Regional office set out to determine the effectiveness of this method and put out a tender for an OGPA cleaning trail.

4. OGPA CLEANING TRIAL

The Transit New Zealand Tender for the OGPA cleaning trail was won by Pavement Treatments Ltd. A total of 13 sites were selected with pavement of varying ages to try and determine the best point of intervention.

Initial Test

The first test site was carried out on the Constellation Drive southbound on-ramp. As part of this test the same 100m section of road was cleaned and tested to determine:

- an optimum pressure for the water in the machine and
- if repeated cleaning had any negative impact on the surfacing.

The first two runs were carried out at 1,000psi water pressure. No real improvement was seen in the permeability of the OGPA. The pressure was then increased to 3,000psi for the next three runs. An immediate improvement in the permeability was noticed.

For the final run the pressure was increased to 5,000psi. Following this run there was actually an increase in the reading for permeability, possibly due to the fact that the matt was saturated with water at this point. More significantly some minor stone loss was apparent in the matt. From this the on-site conclusion was that 5,000psi was too high a pressure to use to clean OGPA. There was a real danger that the surface would be damaged at this pressure.

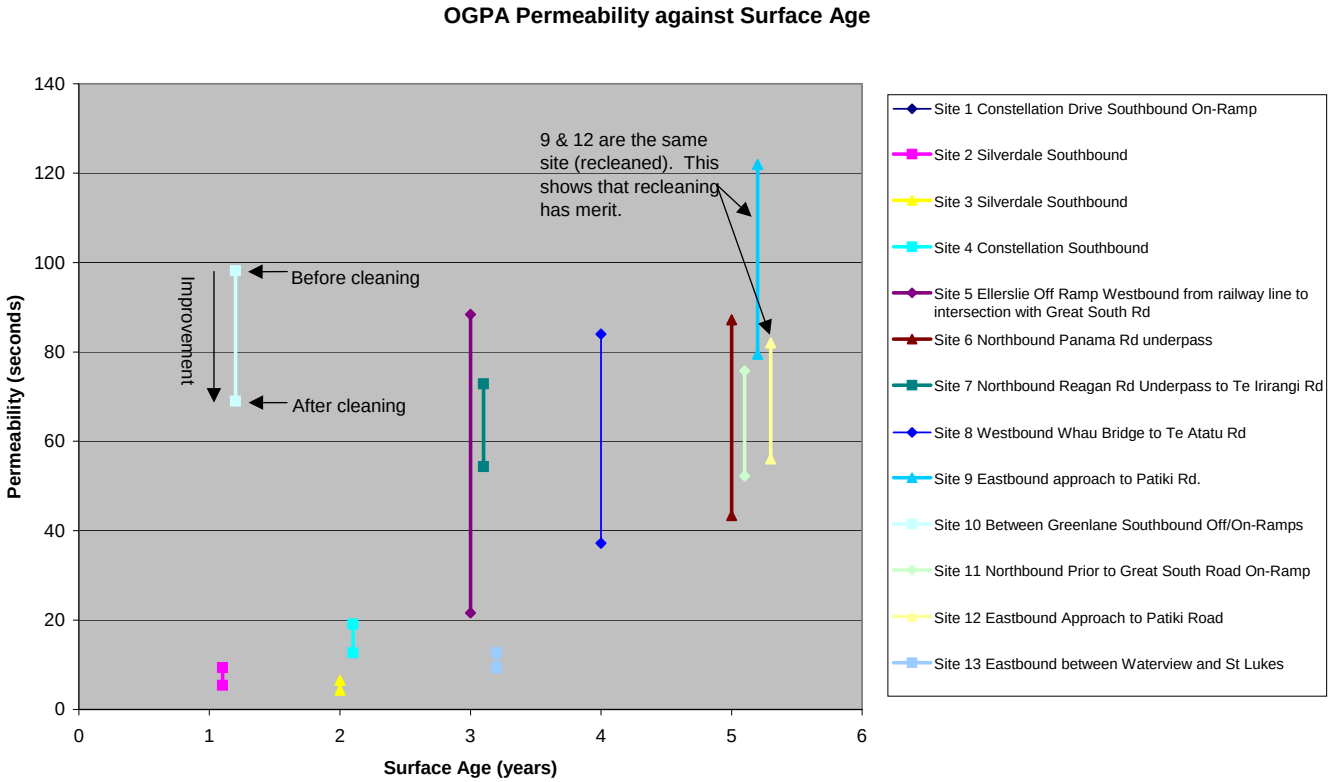
The decision was the made to clean the remaining sites at 3,000psi.

Although cleaning the same site six times in a row does not accurately model how a surface would react to repeated cleaning over a number of years it does at least give some guidance.

As no damage was observed to the OGPA after five runs at 1,000psi and 3,000psi it could tentatively be concluded that cleaning the OGPA had no serious impact on the life of the surface. However, there is no real way to confirm this conclusion for certain without monitoring a site for its full expected life.

Test Results

Figure 1 shows a summary graph of the average permeability readings plotted against surface age. This shows which sites improved more than others. The graph shows the average permeability reading of the OGPA before the site was cleaned and the permeability reading after cleaning was completed. The decrease in permeability time shows the improvement achieved in OGPA drainage. Site 10, between the Greenlane southbound off and on ramps, has been used an example to demonstrate how the chart should be interpreted.



The full set of results for each site are set out in in Appendix C and are summarised below: -

Site 1 – This was the initial test site and the results are described in the commentary in Section 3 on the initial results.

Sites 2 and 3 – These two sites were on SH1 southbound just after the Silverdale On-Ramp. They are both trial sites for the 'WhispA' surfacing which was laid in 2002 and 2003 respectively. Test readings prior to cleaning for these sites were very good, being generally under 12 seconds. Even so the post-cleaning results were even better, with improvements at all the test locations recorded.

Some of the percentage changes in the results table should be read with some caution however, as obviously a 50% improvement sounds very good but in reality is only a change in reading from 6 to 3 seconds.

Site 4 – This was another 2002 surfacing on SH1 southbound at Constellation Drive. Pre-test readings on this section were higher than for sites 2 and 3 indicating that the surfacing was more clogged. Again post-cleaning readings showed significant improvements with a number of results coming down to near or just under 12 seconds. This site offers some proof that a 2 year old surfacing can be showing signs of clogging but can be cleaned to return it to near new levels of permeability.

Site 5 – This site is another 'WhispA' site. There is some discrepancy as to the history of this surfacing, but it appears to have been laid in 2001. Although this was a short section of surfacing there were some very good results recorded in the post cleaning tests. One test had an improvement from 180s to 28s. At this

stage of the trial there were some good signs that cleaning the OGPA was having a very positive effect on the permeability of the surfacing.

Site 6 – This site was on a 1999 OGPA. The pre-cleaning tests showed that the surfacing had become clogged with detritus. Some of the readings were up to 180s prior to cleaning. Following cleaning improvements were again found, up to 70% or 80% in some places, although in general the results were still averaging between 30 and 40s. This site gives the first indication that OGPA that is five years old can be cleaned to improve the permeability. However, one run of cleaning is not enough to restore the surface to new.

Site 7 – Cleaning of this site did not occur until the end of June and by this time the weather had deteriorated and there had been a large amount of rain. On the night this site was cleaned the weather started off dry so it was decided that work should go ahead. During the evening the rain came on and some of the results started to become erratic.

In order to try and get more accurate results, the testing was re-done a couple of weeks later. Once again some of the results obtained showed widely varying figures. This site showed that testing when the road is wet can seriously affect the results for permeability. It would appear, that even if it has been dry for a few hours, there can still be enough water sitting in the OGPA matt to affect the results.

Site 8 – This site is a 2000 OGPA that was cleaned mid June when the weather was still dry. Pre-cleaning results were generally high showing the OGPA was reasonably clogged. Following cleaning the test results once again showed some significant improvements, although as with site 6 the values obtained were still generally well above 12s.

Site 9 and 12 – This was a section of 1999 OGPA that was found to be very clogged with detritus. Cleaning once showed that again the permeability could be improved but not to the levels expected of a new surfacing. It was decided to try cleaning this section again to see if this made any difference. This was done a week later and in general further improvements were found.

Interestingly the pre-cleaning results on the second run were not the same as the post-cleaning results on the first run. In some cases the results were lower and in others they were higher. This could possibly be due to the initial clean removing the top of the detritus layer and disturbing the remaining detritus which has then moved around due to rain and vehicle movement.

Sites 10 and 11 – These sites were again affected by rain. Therefore the results were erratic. Site 10 was re-tested a couple of weeks later and some improvements were found. Site 10 is a 2003 OGPA so that these improvements could be due to the fact that the surface is not that old and the detritus that has built up is easier to break down and remove.

Site 13 – This was the only site tested that had OGPA Mix 20 instead of Mix 14. It was a 2001 surfacing and the pre cleaning results were generally good. Improvements were still found following cleaning and in general results were under 12s. It would appear that OGPA of this stone size doesn't get as clogged up in the first instance and when it is slightly clogged it can be cleaned and restored to its original condition

In general it was found that following cleaning of the OGPA the permeability did improve (substantially in some cases). It appears that better results were found in surfacing up to 2-3 years old. Surfacings older than this were found to be more clogged and although the permeability could be improved it was not to the same state as new.

Figure 1 shows clearly that sites of three years or older can have significant improvements in permeability achieved. Sites 9 and 12 (which are in fact the same location) show that repeated cleaning has merit. It would be interesting to discover if further recleaning could achieve an even better permeability outcome.

When the results in detail are looked at it can be seen that some results appear slightly erratic. This can partly be explained due to the weather conditions which deteriorated towards the end of the trial. However, the test method itself has also got some drawbacks.

It is a fairly basic test and the timing is based on a visual inspection of when the water level drops. Care has to be taken when carrying out the test that water does not escape out of the side of the test equipment as opposed to permeating down into the matt.

A more accurate method may be to try and use the testing equipment described in TNZ T/11, however, carrying out this method would be more time consuming and hence would either make the whole cleaning process longer or would mean less tests could be carried out.

Environmental considerations

Some limited sampling of the water that was recovered during the process of the OGPA cleaning was done. This showed high levels of Copper, Nickel, Lead and Zinc as well as an oily sludge which would contribute to making the pavement slippery. All the waste water was recovered and recycled through the Pavement Treatments state of the art water recycling plant that was commissioned for this project.

4. WHERE TO FROM HERE

Transit New Zealand has committed to a further round of trials with a second tender planned. More emphasis should be placed on the relationship between permeability and improved skid resistance. It will also be worthwhile to review the accident statistics before and after the permeability and texture of the OGPA is improved.

Texture equals Skid resistance

Pavement Treatments providing safer roads thru innovation and environmentally sustainable methods