FOAMED BITUMEN STABILISATION PROJECT – WARWICK, QLD

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Stabilised Pavements of Australia

1 INTRODUCTION

The Department of Main Roads, Queensland, has for some time been looking at using bitumen in stabilisation works to overcome some of their problems. They have been using cements in their stabilisation to rehabilitate pavements successfully for many years and they have just recently successfully recommenced the use of lime in subgrades.

Due to the fact that many of their highways in Queensland have thin pavement depths over very plastic subgrades, the use of deep lift cementitious pavement rehabilitation has been more limited than in other States.

In the early nineties, the QDMR carried out a number of trial projects using combinations of bitumen emulsions and cement with only moderate results. However, with the reappearance of foamed bitumen stabilisation with a higher level of technology in both the understanding of the procedures and the machinery used, the QDMR has begun to undertake a number of foamed bitumen stabilisation projects.

2 INITIAL QDMR EXPERIENCE

2.1 Warwick Trial (Gladfield)

With a high input from Wirtgen, (through A.A. Loudon & Partners) Stabilised Pavements of Australia (S.P.A.) completed a trial for Warwick Main Roads on the Cunningham Highway approximately 21km east of Warwick towards Brisbane (see Figure 1).

This foamed bitumen stabilisation trial –

- was approximately 1.6km long by 10m wide,
- to depths of 200 with 250mm in the outer wheel paths, and
- consisted of the mix design of 3.5% bitumen and 2% cement by weight.

This trial was a great success in its execution and its initial performance.

As it comes up to 2 years life, the pavement which was only designed for 5 years life expectancy, is showing some signs of distress in limited areas, basically due to discrepancies in some of the initial design parameters (i.e. the design gravel pavement thickness does not seem to exist in all areas and the 30% truck traffic has been found to have 12% overloading – 3% of which is over 50% overloaded!)

2.2 Gympie Trial

After the initial success with foamed bitumen stabilisation the QDMR contracted out some more trial work on Rainbow Beach Road west of Gympie (approx. 170km north of Brisbane).

SPA successfully won and completed these trial works in early June, 1998.

These trials consisted of incorporating different combinations of Bitumen Emulsion and Foamed Bitumen with different percentages of the supplementary additives lime and cement to 200mm depth, e.g.
- 2% and 3% residual bitumen from emulsion with 1% and 2% cement
- 3%, 4% and 5% foamed bitumen with 2% lime
- a control section of conventional granular construction.

The results of these trials confirmed the advantages of foamed bitumen stabilisation with regards to relative cost, early stability and superior long-term moduli results.

![Figure 1](location-of-the-three-projects-south-of-toowoomba-queensland-projects-a-gladfield-b-inglewood-and-c-warwick.png)

**Figure 1** Location of the three projects south of Toowoomba, Queensland. Projects: A – Gladfield, B – Inglewood and C – Warwick.

### 2.3 Inglewood Project

In late June 1998, SPA again successfully won and completed another foamed bitumen stabilisation job for QDMR Warwick on the Cunningham Highway just east of Inglewood (approx. 105km west of Warwick).

The job consisted

- approx. 1.5km of highway to 9.3m width
- 200mm depth
- 4% bitumen and 1.5% quicklime by weight

Following the success of the execution of these works and of the resultant pavement performances the QDMR have recognised the advantages of foamed bitumen stabilisation of relatively heavily trafficked roads with thin pavements where cementitious stabilisation is difficult to use.
They have purchased their own foamed bitumen testing kit from Wirtgen and have a laboratory set up in Brisbane.

The QDMR has now let out the contract for a major foamed bitumen stabilisation project out of the Warwick Office on the New England Highway.

3 FOAM STABILISATION PROJECT

3.1 Works Parameters

- New England Highway north of Warwick towards Toowoomba
- 17km total length in 2 sections (approx. 134,000 m$^2$)
- 200mm depth in central pavement and 250mm depth in outer wheel paths (2.4m widths)
- tendered on 4% bitumen and 1.5% quicklime
- 100% standard compaction
- roughness maximum 60 counts per kilometre
- deductions for greater than 60 counts
- bonus for less than 60 (but not at same parity as deductions)
- Practical completion within 80 days of letter of acceptance
- Work to be completed under partnering relationship.

3.2 Contract

Stabilised Pavements of Australia Pty. Ltd., as the successful tenderer, was contracted to –

- supply, spread and slake the quicklime
- transport the bitumen to site
- supply and incorporate the correct type and quantity of foaming agents to foam the bitumen the required 15 times its volume for a minimum 10 seconds
- mix the lime and the foamed bitumen into the pavement to the designated depths using a tightly specified item of mixing equipment
- compact and trim
- provide testing for depth control, additives controls, compaction and roughness.

The contract requires works to be carried out under SPA’s approved Q.A. system.

Principal to –

- initially set out
- supply traffic control
- supply bitumen ex BP works under their state contract
- apply bitumen surfacing

The bitumen supply not being a part of the contract has been a disappointment to SPA and since it has caused a few problems in the continuity of the works with the supplier not being directly under the contractor's control, this situation is to be reviewed for future contracts.
3.3  Mix Design

Initial limited mix design work was carried out by Mobil Bitumen Laboratory to determine the initial contract parameters.

Subsequent to the letting of the contract and the QDMR setting up their own foam bitumen testing laboratory, their Transport Technology Section undertook more thorough testing investigation.

This testing regime resulted in the following –

- confirmation that SPA’s foaming agents successfully foamed the bitumen to be used
- from testing various bitumen percentages, to obtain the required design resilient modulus of 1,500MPa the bitumen content was seen to be able to be lowered from the contract 4% to 3% initially and then 3.5% by weight. (See Figure 2)
- This resulted in a saving in bitumen of approx. $200,000.00 to the initial estimate
- the supplementary additive was determined to be 2% lime (1.5% quicklime)
- Results showed that this 2% lime gave the optimum strength results, with increasing lime to 3% and 3.5% actually reducing the strength by “absorbing” the bitumen.

![Figure 2: Modulus versus bitumen content in the laboratory trail.](image)

3.4  Partnering

The contract involves a Partnering Relationship between

- The Principal (Tony Platz, QDMR Warwick)
- The Principal’s Superintendent (Peter Evans, QDMR Warwick Infrastructure Delivery)
- The Principal’s staff involved in the project (i.e. the QDMR inspector, the surveyors, traffic control and bitumen sealing
- The Superintendent’s Representative – Bruce Baker from the consultants Baker Russow
- The Contractor (Stabilised Pavements of Australia Pty. Ltd.)
There has been a very effective pre-start meeting and mutual planning and communications by all parties. Thus the works have significantly benefited by the co-operation engendered under the Partnership relationship.

3.5 Works Methodology

One half of the road is stabilised at a time to allow one lane of traffic to pass during the works

- initially the area is pre-milled using a CMI RS500 large Reclaimer/Stabiliser (with in excess of 500hp) to a depth of 150mm
- this eliminates the possible effects of previously cement stabilised patches
- allows for shape correction without any resultant loss of pavement thickness as compared to when shaping after stabilising
- the milled material is quickly shaped with a grader and lightly rolled
- the 1.5% quicklime is spread using a purpose-built, low dust spreader
- traffic is halted while the quicklime is slaked using 2 water carts
- the slaked quicklime is mixed to the designated depth of 200 and 250mm using the CMI RS500 with an attached water cart to obtain the correct moisture content
- the bitumen is mixed into the pavement to the designated depth using the purpose-built Wirtgen WR2500 Reclaimer/Stabiliser (see Figure 3). The hot bitumen is pumped out of the attached bitumen push tanker and is injected into the mixing box of the WR2500. Water is sprayed into the bitumen at 2.5% by mass of the 3% bitumen, which causes the treated bitumen to foam to 15 times its initial volume. While the bitumen is in its expanded state it is mixed into the pavement material by the WR2500. All of the measuring functions of the WR2500 have highly accurate computer controls
- the stabilised material is then shaped, compacted and trimmed using another grader, a pad foot vibrating roller, a smooth drum vibrating roller and a rubber tyred roller
- the finished surface is often water sprayed while a number of days work is completed
- after approximately 4 days work has been completed the area is given a light cut with the grader, a water cart and roller prior to the testing with the roughness meter
- following the acceptance of the compaction and rideability testing the area has a bitumen seal wearing surface applied.

Figure 3 The bitumen tanker supplying hot bitumen to the Wirtgen WR2500 reclaimer during the foaming operation.
3.6 Productions

Works commenced on 24/3/99.

To date, all the procedures have been working well. All of the equipment and especially the key item, the Wirtgen WR2500, which actually carries out the foamed bitumen mixing, has performed as planned. Compactions test results have been in excess of the required 100%. The roughness rideability testing has been below the specified 60 counts per kilometre and has to date averaged just less than 40 counts.

Daily production has been in the range of approximately 3,500 to 4,000 $m^2$ per day.

To date the stabilised material is attaining the moduli results (in excess of the 1,500MPa) that has been designed for.

All parties are happy with the works.