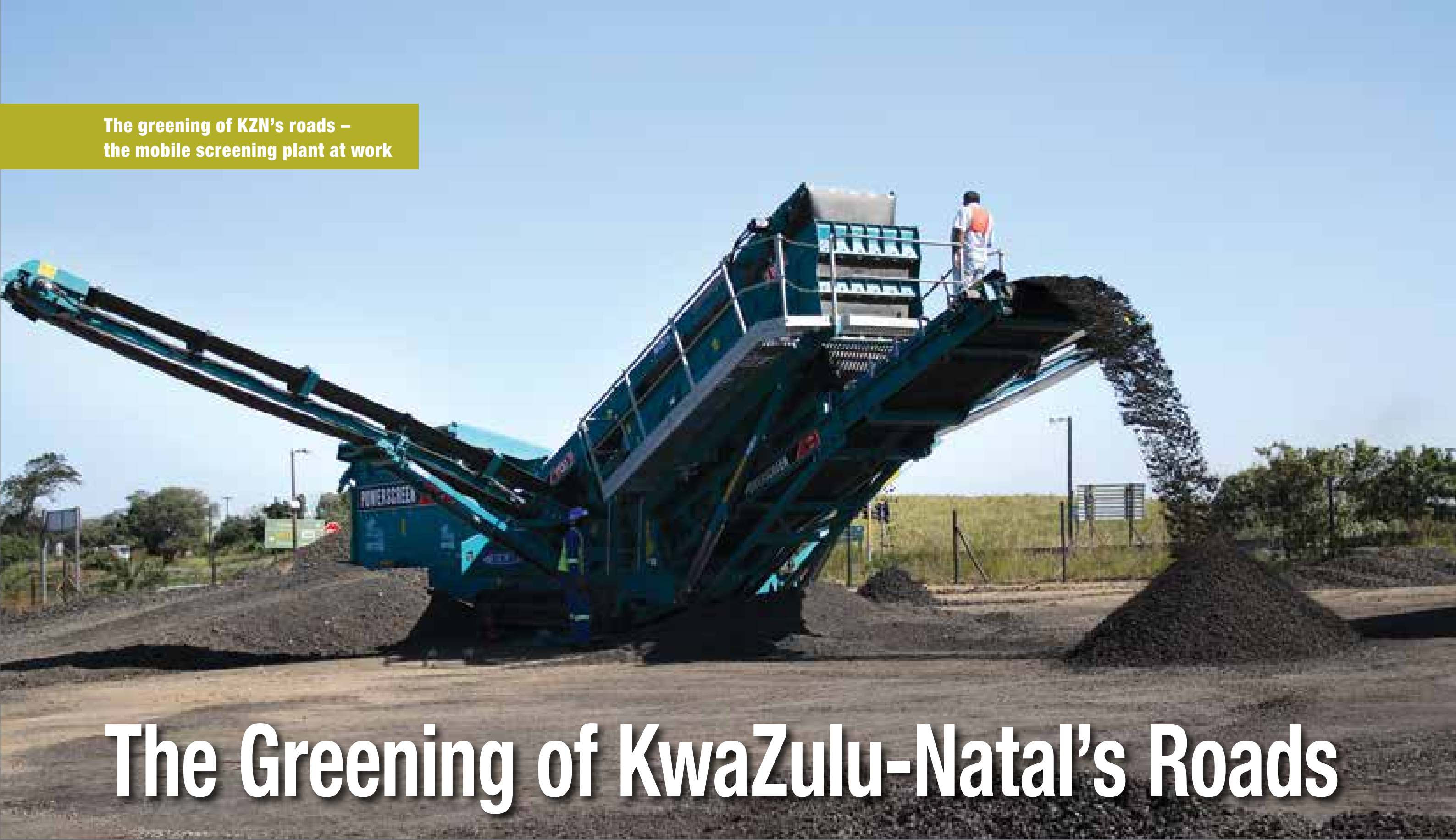
The greening of KZN's roads – the mobile screening plant at work



The Greening of KwaZulu-Natal's Roads

OVERVIEW

There is an urgent need for a total rethink in the way we treat our planet. As an organisation which puts out numerous plant and material-intensive contracts, all unavoidably producing vast quantities of greenhouse gases, the KwaZulu-Natal Department of Transport is fully aware of its responsibility to reduce its carbon footprint.

The milling out of existing asphalt layers during road rehabilitation projects produces large quantities of crushed aggregate and bitumen. This has traditionally been used as gravel wearing course. During the construction of a 5 km section of the R102 near Darnall on the KwaZulu-Natal North Coast, 100% of reclaimed asphalt (RA) was used in the bitumen stabilised material (BSM) base-course layer.

The section begins at New Gelderland, north of KwaDukuza and ends near to the Darnall/Zinkwazi link road, whilst the second, the source of the RA, begins about 5 km north of Darnall and ends a few kilometres before the Tugela River.

The use of 100% reclaimed asphalt provides the following environmental and cost benefits:

- Massively reduced heat generation between the cold mixes and conventional asphalt
- Obviating transportation from the nearest batch plant, being some 60 km away
- Reuse of crushed aggregate and thus no need for dumping or quarrying of new aggregate
- Half the cost of a conventional asphalt base.

In addition, the sub-base layer also comprised 100% RA recycled in situ, using a nominal percentage of foamed bitumen, once again saving on using diminishing quarry sources and long haulage.

The use of 100% RA in the BSM with a static recycling plant has now been thoroughly proven on a major provincial road.

INNOVATIVE DESIGN PHILOSOPHY

The R102 is over 100 years old and the section was in bad condition, with significant rutting and other failures. With the current heavy traffic loading, the pavement required significant rehabilitation. However, being an important feeder route, it had to be kept open to traffic at all times, necessitating construction in half-widths. The most practical solution therefore was to build up the layers, rather than create deep excavations.

Stabilised layers were considered, as crushed gravel pavement layers would have been too thick, especially when constructing in half-widths. Using the TG2 (2009) manual guidelines, the design was as follows:

- Mill to pulverise and recycle the top 200 mm of in situ asphalt base wearing course to construct a 200 mm thick BSM1 sub-base layer.
- Use the KMA mixing plant with RA salvaged from Contract 2 and placed in stockpile, mix foamed bitumen and pave a 150 mm BSM1 base layer to achieve a six million equivalent axle loading.
- Overlay with 45 mm asphalt wearing course with an A-E2 modified binder and pre-coated chips. The modifier was specified to allow for flexibility in case of any minor settlement of the relatively weak underlying layers.

FINALIST
Technical Excellence Category

KEY PLAYERS

Client
KwaZulu-Natal Department of Transport

Professional team
Naidu Consulting (Pty) Ltd

Main contractor
Ubunye Plant Hire

Sub-contractors
Aqua Transport and Plant Hire (Pty) Ltd

ENVIRONMENTAL MANAGEMENT

The massive savings to the environment included:

- No crushing or transporting fresh rock from quarry to batch plant, as for conventional asphalt
- No hauling of asphalt from the batch plant, 60 km away

- Significantly reduced damage to the provincial road system, reduced carbon emissions from asphalt trucks and reduced traffic congestion on a narrow road
- With the BSM foam, the aggregate was cold-mixed – asphalt is pre-heated to 160°C
- Only 2.2% bitumen was required, compared with 5% to 6% for asphalt
- Instead of polluting the countryside, this valuable resource was utilised
- A significantly reduced construction site, with just one stockpile, kept to an absolute minimum.

PROJECT MANAGEMENT

This project was a steep learning curve for all parties concerned. Due to the two separate contracts, each with a main contractor and sub-contractors, regular communication meetings were required to resolve any logistical problems. Each operation was linked to the other and proper coordination was important, especially regarding the RA stockpile.

Strict quality control was essential for success, so pre-start checklists were drawn up for the recycling plant and paver respectively. These were approved and signed off daily by the contractor and consultant prior to starting any work.

The condition of the paver and the paver operator's experience were crucial, and all operators took training courses.

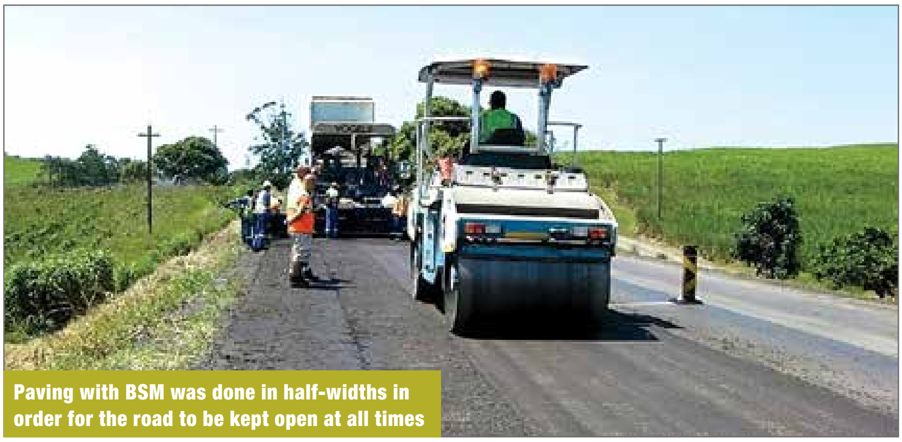
To ensure uniform moisture content, the stockpile was kept small enough to be fully covered with tarpaulins in the event of rain.

CONSTRUCTION

The BSM was mixed with a plant mixer and paved with a normal paver, rather than on the road, since:

- Achieving the required level tolerances of less than 10 mm calls for expertise and a highly skilled grader operator.
- Paving the layer in two thin lifts ensured that the high compaction requirements were achieved.
- Having the mixing plant, bitumen tanker and cement silo set up at a fixed location allowed for full control of the mix proportions.
- With in situ recycling, any variation in the material would reflect in the finished layer. Screening and stockpiling of the RA promoted uniformity of the input material, and the power-screen helped to produce the fines essential for disbursing the foamed bitumen. The stockpile was tested regularly and any variations were timeously picked up.

Mobile BSM screening an recycling plant



Paving with BSM was done in half-widths in order for the road to be kept open at all times

The two contracts were programmed such that there was never more than two days' supply of screened aggregate on the stockpile at any time.

TRAINING

All key site personnel were familiarised with the various steps in the TG2 (2009) Manual. The construction methodology was agreed upon upfront and a method statement subsequently drawn up.

Workshops were held prior to the start of work to ensure clear lines of communication and that the roles and responsibilities of all parties were defined in a site organogram.

Extensive use was made of the TG2 (2009) Manual with regard to quality control and daily checklists. The forms were modified where necessary to make them more user-friendly and these changes are being incorporated into the new manual.

CONCLUSION

Screening, mixing and paving techniques were all experimented with to achieve the most suitable methods. This was closely monitored by the compilers of the TG2 (2009) Manual, who were full of praise and intend using this project as an example of the correct design and construction of BSMs from start to finish. Permanent deformation measurements and FWD deflections are currently being carried out at three-monthly intervals, and the results sent to Stellenbosch University for analysis and further research on BSMs.

With proven cost savings, significant reductions in greenhouse emissions and a project completed on time and within budget, this is a worthy engineering achievement. □

FACTS BOX

- Road length: 5 km
- Road surface area: 110 000 m^2
- Bitumen stabilised base-course: 16 500 m^3
- Foamed bitumen sub-base: 22 000 m^3
- Cost savings in the region of over R7 million or R1.4 million/km over conventional construction methods
- The shallow depth of excavation enabled construction in half-widths in order for the road to be kept open at all times
- A high emphasis on safety throughout.