SPECIFICATIONS FOR BITUMEN-RUBBER - RECENT DEVELOPMENT IN THE RSA

P A MYBURGH

Executive Director, S A Bitumen & Tar Association

INTRODUCTION

At its meeting on 16 May 1983 the Bituminous Materials Liaison Committee recognised the urgent need for a national specification for bitumen-rubber. A generally applied specification did not exist and it was expected that increased use would be made of this binder in the maintenance of an ailing road network. Such a specification would of necessity also include less conventional test methods where such were necessary to define the special properties of this type of binder.

Although it was intended that the national standards body, the South African Bureau of Standards (SABS), would ultimately issue a national specification, it would be expedient for industry to convene a technical committee for the purpose of producing a preliminary specification within six months. The Southern African Bitumen and Tar Association (SABTA), being the body representing the asphalt industry was seen as the appropriate co-ordinator. Once a satisfactory specification had been agreed upon it would be submitted to the SABS for consideration as a national specification.

This paper briefly sketches the developments in compiling a specification for bitumen-rubber during the period May 1983 to May 1984.

Specifications for bitumen-rubber - recent developments in the RSA
OBJECTIVES

A committee with a very broad spectrum of representation was formed. Bodies represented on the committee are: The Directorate of Land Transport, Cape, OFS and Transvaal Provincial Roads Departments, National Institute for Transport and Road Research (NITRR), SABS, South African Air Force, South African Association of Consulting Engineers, Department of Co-operation and Development, Much Asphalt (Pty) Ltd, Protea Asphalt (Pty) Ltd, Roadmix (Pty) Ltd, Tosas (Pty) Ltd and SABTA. The terms of reference of the committee were to produce a specification for bitumen-rubber by the end of that year and to investigate the need for specifications for tar-rubber and modified binders and, if necessary, to compile specifications for these materials.

By the very nature of its composition this committee was an excellent forum where specifying authorities, research, industry and consulting engineers could co-operate for the purpose of producing realistic specifications which could be used as a fair basis to assess the suitability of products produced by organisations using distinct technologies in South Africa.

The most difficult task was to produce a workable specification within the six months target period set. Whereas a performance type specification was seen to be the ultimate goal, it was soon realised that it would not be possible to compile such a specification within a relatively short period. Judging from available overseas literature, it appeared that nowhere had sufficient progress been made for the adoption or adaptation of a performance type specification developed elsewhere. Consequently only performance studies on bitumen-rubber applications in South Africa would provide the answer. This would take time. First of all, no test sections of bitumen-rubber with proper pre-evaluation control had been constructed at the time. Secondly, the properties and suitable test methods to define the properties had not been generally agreed upon.

Specifications for bitumen-rubber - recent developments in the RSA
Consequently the committee had no option, but to accept that, in the first instance, it would aim at producing a recipe type specification based on information to be provided by industry. Also, since bitumen-rubber was being used largely in chip seals as stress absorbing membranes (SAM's) and stress absorbing membrane interlayers (SAMI's), a specification for the binder in spray applications was the first objective.

INTERIM RECIPE SPECIFICATION

Based on information supplied by industry regarding the composition and consistency of the products, a recipe specification was finalised in February 1984 and published by SABTA in March 1984 as an "Interim specification - Bitumen-rubber for spray application".

Briefly, the specification defines the component materials and consistency in terms of viscosity. The relevant content is reproduced in Appendix I.

The committee recognised the shortcomings of such a specification, these being:
- verification of the composition of the binder by testing would be extremely difficult, if not impossible.
- definition of composition alone cannot guarantee performance.
- recipe type specifications alone would not be acceptable to SABS as a national standard.

Nevertheless that specification is state-of-the-art in South Africa, and as far as is known, the only one of its kind. It attempts to overcome difficulties of composition determination by requiring the manufacturer to certify that the product complies with the specification. Variability is controlled by requiring the manufacturer to state the actual values within the range given in the specification. Tolerance limits would then be applied to the stated values. Most important, it satisfies the requirement of state buying,
whereby products complying with a specification and manufactured by a committed industry can be purchased on a tender basis.

PERFORMANCE TYPE SPECIFICATION

Whilst the recipe specification was being developed the committee set to work on a performance type specification for bitumen-rubber for spray application. This involved three stages:
- definition of engineering properties
- selection or development of suitable test methods to measure these properties
- determination of limits of values obtained on testing such that satisfactory performance can reasonably be expected.

Engineering properties defined were: adhesion to aggregate; temperature susceptibility of viscosity; flexibility at low temperatures; ductility-tenacity; elastic and plastic recovery; ageing/oxidation.

A sub-committee was set up for the purpose of selecting or devising suitable test methods. Through the co-operative efforts of research (NITRR), consulting engineers, Department of Land Transport and industry considerable progress has been made in this regard. At this stage it is possible to report that the following test methods have been tentatively proposed to measure the identified engineering properties:

<table>
<thead>
<tr>
<th>Property</th>
<th>Test method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adhesion to aggregate (only applicable in cases where pre-coating was not employed)</td>
<td>Riedel &amp; Weber</td>
</tr>
<tr>
<td>Temperature susceptibility of viscosity</td>
<td>Davidson modified flow test</td>
</tr>
<tr>
<td>Flexibility at low temperature</td>
<td>Mandrel test (low temperature fracture test)</td>
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</tbody>
</table>

Specifications for bitumen-rubber - recent developments in the RSA
Ductility-tenacity
- Variable force ductility test

Elastic and plastic recovery
- Modified McDonald recovery test
- Ball penetration and recovery test (ASTM D3407)

Ageing/oxidation
- Extended thin film oven test with ductility tenacity measurement on residue

For field measurement of viscosity the suitability of the Haake rotational viscometer is being investigated.

Since it is suspected that the handling and reheating of test samples may have a significant effect on test results, a method for sampling, storing and preparation of bitumen-rubber for testing is being investigated.

Trial sections on 20 km of road have been selected to monitor and evaluate the performance of available bitumen-rubber binders in spray applications. Set procedures have been established by the NITRR for monitoring of the trials by panels composed of members of the committee and NITRR personnel, where practically feasible.

It is expected that meaningful data which will enable one to assign appropriate limits to test results will be forthcoming in approximately two years' time. Only then would it be possible to compile a performance specification whereby available binders could be adjudged for a variety of uses in spray applications.

FUTURE OBJECTIVES

Future progress in developing specifications for bitumen-rubber will be largely determined by the research and development resources of the NITRR, consulting engineers and industry. Currently all resources are being fully utilised and consequently the scope is limited to producing a performance specification for bitumen-rubber for spray application.

Specifications for bitumen-rubber - recent developments in the RSA
It is, however, possible to commence preliminary investigations into the use of bitumen/rubber in hot-mix asphalt and members of industry involved in these operations have been requested to forward details regarding techniques applied in the manufacture thereof. Clearly this information will guide the activities of the committee in this respect.

The limited use of tar-rubber purchased on state tender board specification does not at this stage warrant spending resources in this field.

As far as modified (polymer) bitumen is concerned, it is hoped that a performance type specification for bitumen-rubber may be largely applicable to this type of binder. Consequently no work in this field is foreseen in the immediate future.

SUMMARY AND CONCLUSIONS

An interim recipe specification for bitumen-rubber for spray application, based on information supplied by the asphalt industry involved in the manufacture of the product, has been produced and distributed throughout South Africa. Although the limitations of the specification have been recognised by the technical committee on bitumen-rubber, it provides client bodies with the means of purchasing bitumen-rubber on a fair and equitable basis.

A performance type specification, based on performance studies on selected trial sections is being developed. It is expected that such a specification would be issued in two years' time.

Preliminary work is underway to establish the route to be taken with regard to hot-mix bitumen-rubber asphalt.

Regarding other types of modified binders, e.g. tar-rubbers and polymer bitumens, current resources do not make it possible to investigate suitable performance type specifications for these.

Specifications for bitumen-rubber - recent developments in the RSA
Rather, it is hoped, that a generalised performance type specification for bitumen-rubber may be adapted to encompass such materials.

The committee, composed, as it was of members representing client bodies, research, consultants, standards bodies and industry, proved to be a most productive one and illustrates that a forum such as this leads to realistic specifications without undue delay.

ACKNOWLEDGEMENT

The author wishes to thank all the members of the committee for their unselfish efforts and valuable contributions to the deliberations.

The members are:


Specifications for bitumen-rubber - recent developments in the RSA
APPENDIX I

INTERIM SPECIFICATION

Bitumen-rubber for spray application

1. SCOPE

This specification covers a blend of bitumen and rubber, suitable for application by means of a binder distributor to road and airfield surfaces.

It is intended for determining the suitability of a product by defining its components, as well as reaction time and temperature.

Notes:

- Because of substantial differences in the rheological properties of bitumen-rubber as distinct from normal bitumens, the rates of application of this binder are significantly higher than for normal bitumens.

- Important notes to users of this product are contained in Appendix A.

2. REQUIREMENTS

2.1 General

The particular values within the limits of the specifications given below will depend on the specific application of the product and the technology employed by the manufacturer.

For each batch and its constituent materials, excluding the bitumen, the manufacturer shall issue a certificate stating:

*See note A.1 in Appendix A

Specifications for bitumen-rubber - recent developments in the RSA
2.1.1 That the processes have been controlled during manufacture and handling.

2.1.2 The actual values within the appropriate limits given in 2.2.2, 2.2.3 and 2.3 below**.

The actual value and range of penetration of bitumen shall also be stated on the certificate.

2.2 Component materials

2.2.1 Bitumen. The bitumen shall be a penetration grade bitumen which complies with the requirements of SABS 307 for either 60/70, 80/100 or 150/200, or which is a blend of any two or all three grades to provide for a product with particular penetration properties.

2.2.2 Rubber. The rubber shall be obtained by processing and recycling tyres. It shall be comminuted, free from fabric, steel cords and other contaminants except that up to 4 percent (by mass of rubber) calcium carbonate or talc may be added to prevent rubber particles from sticking together. The rubber shall be free-flowing and dry and shall comply with the following requirements:

- Natural rubber content as a percentage by mass of total hydrocarbon rubber 30 min
- Particle size distribution:
  - Minimum percentage by mass passing the 1,18 mm screen 95
  - Maximum percentage by mass passing the 0,075 mm screen 10
- Maximum fibre length, mm 6
- Relative density 1,10 - 1,25

**See note A.2 in Appendix A
2.2.3 Extender oil. The extender oil shall be a distillate of high aromaticity and shall comply with the following requirements:
- Flash point, °C 180 min
- Percentage saturates by mass 25 max
- Percentage aromatic/unsaturated hydrocarbons 50 min

2.2.4 Diluent. The diluent shall be a hydrocarbon distillate.

2.3 Bitumen-rubber blend

The bitumen-rubber blend, containing where necessary extender oil and/or diluent, shall comply with the following requirements:

- Percentage of rubber by mass of the total blend 18 - 27
- Percentage extender oil by mass of total blend 6 max
- Percentage diluent by mass of total blend 7 max
- Blending/reaction temperature °C 170 - 210
- Reaction time, hrs 0,5 - 4
A.1 It is recommended that a 'batch' be regarded as the quantity of bitumen-rubber in a single binder distributor.

A.2 The specific properties for which the manufacturer is required to state the actual values as well as the tolerances to be applied to these values will be a matter of agreement between the supplier and the purchaser.

A.3 This being a relatively new product it is recommended that, in addition to meeting the requirements of the specification, acceptance of the product be subject to the manufacturer having demonstrated his ability to blend, heat and spray bitumen-rubber which has given satisfactory in-service performance.

A.4 A binder distributor complying with the requirements of TMH 2 may have to be modified to spray the bitumen-rubber blend satisfactorily.

A.5 Spray temperatures vary depending on the particular bitumen-rubber product used. Recommendations for these values should be supplied by the manufacturer.

Retaining the blend at spraying temperature for prolonged periods is detrimental to the product. It will therefore be necessary to limit temperature during storage as well as the storage period. The above limits will also depend on the product used and should be supplied by the manufacturer.

Reprocessing after storage should be controlled and it is recommended that the manufacturer be required to demonstrate that after such reprocessing the product still complies with the specification.