BITUMEN RUBBER ASPHALT (DRY PROCESS)

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ABSTRACT

This paper describes the "Dry" process of manufacturing Bitumen Rubber Asphalt, the process of laying the asphalt in the field, the tests required for designing and controlling the mixes and general comments of advantages and field performance of the bitumen rubber asphalt laid over the past four years.

INTRODUCTION

The "Dry Process" being used in South Africa at present for the manufacture of Bitumen Rubber Asphalt is a direct follow on of the work done by John Rebbich of the County Road Board, Victoria, Australia, in Melbourne, as also that of the Research Board. The granulated rubber from tyres is introduced into the preheated aggregate prior to the introduction of the bituminous binder, no preblending of the rubber crumbs and the bitumen binder being required.

Hence the name "Dry Process".

1. MATERIALS

1.1 Rubber Crumbs

This material shall conform to the SANTA specification for rubber, viz: Grade 2, Type 3, having a natural rubber hydrocarbon content of 60 - 75% by mass.

1.2 Bitumen Binder shall consist of a 50/70 pen. bitumen.

1.3 Aggregate

The aggregate grading used will depend on the type of asphalt mix desired. We have used TPA fine, medium and coarse aggregate specifications for continuously graded mixes as well as the Australian grading having voids of 6 - 10%.

This process also lends itself more readily to the open graded asphalt than is the case with straight penetration bitumen.

2. METHODS OF TESTING AND SPECIFICATION

The Marshall Test method with slight modification and adaptation has been successfully used as follows:-

(a) Heat the aggregate to 180°C
(b) Add the rubber to the aggregate and mix.
(c) Heat the bitumen to 180°C and mix.
(d) Place the mixture in a closed container in the oven for one hour at 180°C.
(e) Allow the mixture to cool down to a compaction temperature of 160°C.
(f) 75 blows x 2 with the Marshall Hammer is the compaction effort.

Then proceed in the normal way to do the balance of the Marshall Test. It is essential to have an XY recorder plotter for interpreting the test results. The normal Marshall parameters will apply to the test results.

One of the problems encountered with the process is the control testing in the field. To establish the quantity of bitumen binder in the asphalt, samples of the rubberized bitumen asphalt are taken directly after the mixing of bitumen, rubber and aggregate has taken place.

The extraction test as described in THI Method C7(6) is carried out within two hours of taking the samples, and the bitumen content should not vary by more than plus/minus 0.3% of the specified bitumen content.

Composition of Bitumen Rubber Asphalt

In our work, 30% by mass of the bituminous binder was rubber. The total binder, i.e. bitumen plus rubber will vary according to the grading of the aggregate selected, the traffic count anticipated and the specification intended for use.

A typical composition could be as follows:-

Aggregate 91.0 %
Bitumen 60/70 pen. grade 6.75%
Rubber Crumbs 2.25%
Active mineral filler 0.0%

The normal Marshall Test parameters are applicable for the continuously graded asphalt. Creep Tests were done on the mixes and no problems were experienced in meeting the requirements laid down by the Department of Transport.

3. THE PROCESS OF MANUFACTURE

The process is ideally suited to batch mix plants with insulated storage bins. 384 sampling

The aggregate is preheated to 200 - 210°C. The rubber crumbs are added to each batch and mixed with the aggregate for 15 seconds. The bitumen binder is heated to 140 - 160°C, and introduced into the pupmill in the normal manner. Mixing continues for a further 15 seconds, ensuring a uniform mix which is then transferred to the insulated storage bins where it is stored for a minimum of one hour. The storage temperature should be in the range of 185 - 195°C.

4. THE PAVING PROCESS

After the "digestion" of one hour in the storage bins, the material is taken to the road at a temperature of 180 - 185°C and laid in the normal manner with a paver. Only flat-wheel steel tyred rollers should be used for the initial compaction. When the surface has cooled to 130°C the heavy pneumatic rollers can then be applied.
components are still functionally adequate they should be monitored to plan any remedial treatment timely, ie before significant disintegration of the surfacing begins.

= Turning circle

This area was in need of attention. The surfacing was particularly dry and brittle and there were already indications of structural distress.

= Apron

The apron was the area requiring the most attention. The pavement was generally in a poor condition with many defects in the form of warping and cracking. On further inspection it was established that fuel spillage was an important contributor to the localized disintegration of the asphalt.

STUDY RECOMMENDATIONS

From this assessment it was possible to show that the pavement network had undergone only a moderate degree of deterioration in the one year, but that there were certain areas needing specific attention. Accordingly surface treatments could be recommended where the surfacing was becoming brittle and areas where structural distress was beginning could be scheduled for detailed testing for possible rehabilitation. In the case of the apron, treatment with an epoxy tar coating could be recommended as a measure to protect the surfacing from the fuel spillage.

CONCLUSIONS

This brief overview of the application of a pavement management system on the airport on which sold serves to highlight some of the important principles, methods and advantages of the process.

= Regular monitoring of the network and graphical displays of the results provide an ongoing representation of the state of the network, the rate of deterioration and the areas in which attention is needed;

= drawing attention to the different functional components of the network focuses on the grouping of the pavement elements, their differing functional requirements, the possible causes of distress and appropriate remedial treatments;

= algorithms used in the PMS are useful for identifying the maintenance needs and their urgency from which preliminary maintenance schedules can be prepared; these have to be ratified by more detailed inspections before final programmes can be prepared;

= such inspections can lead to very specialized treatment recommendations such as oil resistant epoxies for refueling areas.

Most important of all though is the ability to detect areas of deterioration before they become too serious to be treated with relatively inexpensive measures. Under these particular circumstances this requirement was so important that monitoring at six-monthly intervals has been implemented.

ACKNOWLEDGEMENTS

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REFERENCES


3. The edges of the path crumbled as soon after as problems occur in cut, once it has cooled down, capacity must be available tenuous process of laying the aggregate. 

5. THE ADVANTAGES OF THE •

5.1 It is a simple adaptable to existing batch plant mixes. It is just a matter of plant manufacturers; it is not needed for drum mixers.

5.2 There are no problems due to blocked pipes in cold.

5.3 The coating of rubber with the 60/70 pen cement and-complete, the diaphragm after complete coagulation. The viscosity of the binder after a period of time.

5.4 By virtue of the continuous batching of the various a uniform control of the material.

5.5 With the various controlled during the past years where alternative or the "Dry" Process was some better than the "Hot" Process or pink.

5.6 No sophisticated for field control or design.

5.7 When a contractor of producing bitumen rubber essential to have the important product in all respects, ensures.

6. GENERAL COMMENTS ON RE

Bitumen rubber asphalt with or without bilinear membranes has overcome reflective crack bases. In Australia a coat with 30mm of bitumen rut was most successful with no at the joints in the traffic hair cracks on less than 5' however, were evident after 10

On the Lesotho Prinilised base was overlaid; tinnitus and a thin layer was evident laying. The runway was then men rubber asphalt and no has appeared after some but service.

By using the open graph asphalt (i.e. with 0· laboratory) portions of Johannesburg freeway have completed, reducing the traffic and the dangerous weather.
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of the network and graph
of the results provide an
imation of the state of the
rate of deterioration and the
attention is needed;
that the different function
of the network focuses on the
pavement elements, their
requirement, the
of distress and appropriate
nts;
the PHS are useful for
maintenance needs and their
which preliminary maintenance
prepared; these have to be
detailed inspections because
can lead to very special
recommendations such as oil
for resurfacing areas.

of all though is the ability
deterioration before they be
be treated with relatively
under these particular
requirement was so important
-monthly intervals has been

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Paper accepted for the
on Asphalt Pavements for

more recent evaluation

The edges of the paved area must be
"crushed" as soon after laying as possible
as problems occur in cutting the material
once it has cooled down. Adequate truck
capacity must be available to ensure a con-
tinuous process of laying the asphalt.

5. THE ADVANTAGES OF THE "DRY" PROCESS

5.1 It is a simple process easily ad-

corable to existing batch plants and storage
bins. It is just a matter of time before the
plant manufacturers will make adaptions
for drum mixers.

5.2 There are no problems with stoppages
due to blocked pipes in cold weather.

5.3 The coating of the aggregate and
erb with the 60/70 pen. bitumen is effi-
cient and complete, the digestion taking
place after complete coating of the aggregate.
The viscosity of the binder changes only
after a period of time.

5.4 By virtue of the process incorporating
batching of the various constituents,
a uniform control of the materials is obtain-
ed.

5.5 With the various contracts we have
controlled during the past three to four
years where alternative prices were invited,
the "Dry" Process was some 10 - 15% cheaper
than the "Hot" Process or premixed process.

5.6 No sophisticated tests are required
for field control or design testing.

5.7 When a contractor is in the process
of producing bitumen rubber asphalt, it is
essential to have the minimum number of
stoppages to ensure a uniform final economical
product in all respects, which this process
ensures.

6. GENERAL COMMENTS ON RESULTS IN THE FIELD

Bitumen rubber asphalt used in conjunc-
tion with or without bitumen rubber stress
relieving membranes has to date certainly
overcome reflective cracking on stabilised
bases. In Australia a concrete road stress
with 30mm of bitumen rubber asphalt proved
most successful with no reflective cracking
at the joints in the traffic lanes. Minor
hair cracks on less than 5% of the shoulders,
however, were evident after 4 years' service.

On the Leeshe Airport where the stabili-
sed base was overlaid with standard con-
Muously graded bitumen asphalt, 3mm reflective
cracking was evident only 3 days after
laying.

The runway was then overlaid with bitu-
men rubber asphalt and no reflective cracking
has appeared after some two to three years
of service.

By using the open graded bitumen rubber
asphalt (i.e., with 20 - 27% voids in the
laboratory) portions of the Jan Smuts-
Johannesburg freeway have been successfully
completed, reducing the noise level of the
traffic and the dangerous "splash" in wet
weather.

More total binder can be used without the mix
clashing up under traffic than normal open
grated mixes. The use of extra binder also
considerably reduces the problem of ravelling.

Field specimens taken from our first
section of road overlaid, with a 10% voids
bitumen Rubber Asphalt were tested in the
Instron apparatus for fatigue life. Tested
at 20°C with maximum deflections, the sample
withstood 500 000 cycles without showing any
signs of distress. This compares very
favourably with the gap-graded asphalt which
normally fails at 70 000 cycles.

Like all new processes, judgement on the
efficacy of the final product cannot be made
until at least 8 years of service life have
elapsed. However, from the field performance
of the various projects successfully completed
over the past 4 years, it would appear that
bitumen rubber asphalt is here to stay.

Some 200 000 tonnes of bitumen rubber
asphalt has been laid to date using the "Dry"
process.

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