Use of Geotextiles in Asphalt Road Construction

M. Kronig & S. Hollnsteiner
Consultest AG, Ohringen, Switzerland

ABSTRACT: The use of geotextiles as a waterproofing and stress - absorbing membrane interlayer (SAMI) is a proven and increasingly often - employed construction technique. Successful use of this system greatly depends upon the properties of the solids in the special binder and upon the quality of the geotextile used. Not every product comes up to the requirements in respect of recyclability and millability. PET-nonwovens and geo-grids caused difficulties, whereas the characteristic values for a recycled asphalt mix with and without PP-nonwoven showed no differences.
In Switzerland it was found that the nonwoven interlayer prevented any recurrence of random crocodile cracking. Advanced reflective cracking originating from cement-stabilized base layers was retarded only by 2 - 3 years. However, the permeability of overlays containing nonwovens is very much less than without interlayers. For construction of new roads nonwovens allow the combination of high stability base courses with thin wearing courses.

1. INTRODUCTION

Despite the advanced level of asphalt overlay technology, there is still no way in which damage in the form of cracking or deformation can be prevented altogether. Cracks, for example, may be caused by vertical and horizontal movements resulting from repetitive loading, by thermally induced changes in volume, or by shrinkage of cement-stabilized base layers. Where the asphalt overlay no longer has sufficient relaxation properties and has lost cohesion and adhesion due to the ageing of the bitumen, it is no longer able to absorb the stresses acting upon it.

In selecting which reconstruction method to use, the maximum possible use must be made of all possibilities for maintaining and re-using existing sub-bases, for both economical and environmental reasons. In evaluating the cost-effectiveness of a particular resurfacing system, attention should be paid both to its long-term performance and the desired service life. The construction systems and materials used must be such that all materials can easily be excavated and, where appropriate, recycled. For this reason, economical maintenance techniques which provide enhanced weather-resistance and help to preserve the fabric of road surfacings are becoming increasingly important.

In this connection, the use of geotextiles as a water proofing and stress-absorbing membrane interlayer (SAMI) is a proven and increasingly often-employed construction technique which fulfils the very varied requirements made here.

2. FINDINGS AND EXPERIENCE

In Switzerland, the SAMI technique has been used on high-capacity roads on a large scale since 1989, primarily as a repair method for cracked asphalt surfaces. The main findings that have resulted are as follows:

- The actual condition of the damaged surface must be carefully determined by appropriate technical analysis and taken into account in the choice of the method to be used.
- Structures which do not have sufficient bearing capacity or which are affected by vertical movements in the sub-base cannot be successfuly repaired using the SAMI system.
- Stress-absorbing interlayers can be used with all known overlay systems, from thin-layer construction methods all the way up to conventional thicknesses.

Successful use of the SAMI system greatly depends upon the properties of the solids in the special binder and upon the quality of the geotextile used.

Not every nonwoven comes up to the requirements made here in respect of recyclability and millability. Alongside its weather resistance, strength, and force distribution, requirements such as its binder absorption capacity and how well it can adapt itself to the sub-base are also extremely important.

Polyester geo-grids, for example, are unsuitable for meeting these requirements. Interlayers such as these have always been a "foreign body" in an asphalt surface. Where they were used, the overlayer had to be at least 4 - 5 cm thick in order to prevent cracks from occurring immediately. They were unable to function either as a waterproofing or as a crack-absorption interlayer. It has still not been proved, either by practical experience or by performing test measurements, whether the use of geo-grids in various resurfacing methods actually results in any constructional reinforcement or not.

In 1987, an investigation was carried out on an asphalt overlay containing various different nonwoven interlayers, in order to observe its behaviour when cold-milled and to determine the recyclability of the milled-out material.

In the trial fields containing PP-based endless filament geotextile interlayers, there were no problems with milling, nor was the recycling of the milled material in a mixing plant in any way impaired by the presence of shredded nonwoven remnants.

In contrast, the geo-grid interlayers could only be milled with the very greatest difficulty - in fact, the milling operation bore more resemblance to a demolition job!

PET continuous-filament nonwovens also caused difficulties in the milling and recycling trial. Connected sections of between 30 and 40 cm in length interfered with reprocessing, leading to a drop in quality and to discontinuity in the new mix.

The question of whether the quality characteristics of the asphalt mix or the properties of the binder are changed in any way at all by the presence of PP nonwovens in the milled asphalt material could only be answered by laboratory tests.

The many interference factors impinging upon a "field trial" mean that it would not otherwise be possible to make any generally valid assertions.

1 m2 of a 4 cm thick bituminous overlay weighs approx. 100 kg. The same area of PP nonwoven endless filament geotextile weighs only 140 g. These two components were thoroughly intermixed in a laboratory pug-mill mixer at temperatures of between 150 and 170°C to give a 0.14 % PP modified mix.

When the characteristic values determined for this asphalt mix were directly compared with those for the same type of mix without any PP component, no differences were found in either hot or cold asphalt behaviour (Table 1.).

Table 1. Brief characterisation of the recovered binder:

	w. nonwoven	w/o nonwoven
Softening point ring & ball) SN 671 743a [°C]	50.5	49.7
Penetration at 25 °C SN 671 740a [1/10 mm]	65	70
Fraas brittle point SN 671 755a [°C]	-17	-19
Ductility at 25 °C SN 671 746a [mm]	1150	1300

The minor differences in the physical properties of the binder have no effect upon the quality of the asphalt, and so may be disregarded.

As far as the effect of the nonwoven interlayer is concerned, it was found that it completely prevented any recurrence of random "crocodile" cracking. In the case of advanced reflective cracking originating from cement-stabilized base layers, however, it only retarded cracking by approx. 2 - 3 years in 30 mm hot rolled asphalt. The same was true of cracks resulting from vertical movements of the sub-base. Nevertheless, permeability tests on drill cores have shown that the nonwoven interlayer continues to have a waterproofing effect even where there is a recurrence of cracking in the overlay.

Direct comparison between continuously cracked overlays with and without a nonwoven interlayer shows that the binder/geotextile interlayer is not absolutely watertight in the area beneath the crack. However, this permeability is very much less than in overlays containing no nonwoven interlayer at all. Where there is no interlayer, water can flow through unhindered, whereas the amount flowing through the drill core (with interlayer) was about 1000 times less.

The interlayer fulfils its waterproofing function by preventing, or at least substantially restricting, any flow of water in the crack. The base layer beneath the interlayer is thus better protected against water penetration.

3. USING NONWOVENS IN THE CONSTRUCTION OF NEW ROADS

The channelled traffic caused by today's ever-narrower traffic lanes and constantly growing traffic volumes leads to much greater wear and tear on the bituminous surfacing layers. This means that these bituminous surfacings are subjected to enormous horizontal and vertical forces. The only way of counteracting this is to lay down highly stability bituminous base courses. Generally, very hard binders, and in some cases modified ones, are used for these base courses. The voids content of these surfacings should be between 4 and 8 % by volume.

High stability base courses are prone to cracking, and so need protecting from surface-water penetration and other atmospheric influences. The wearing courses used nowadays on such structures must also be formulated for high stability, and laid in thin layers. With these thin layers, it is obvious that it is neither possible to completely waterproof the sub-base, nor to prevent reflective cracking.

Construction methods incorporating a nonwoven interlayer protect the high stability hot-mixed base course. Any horizontal movements caused by resulting stresses are largely absorbed in the course of time by creep in the bituminous layers.

4. CONCLUSION

In view of the satisfactory results achieved to date, and in particular of the optimum scope it gives for preserving the fabric of existing bituminous structures, the use of asphalt non-wovens ("paving felts") can definitely be regarded as a forward-looking technology - and one which has progressed in the past few years from being a more "exotic" construction technique to become a widely used, tried-and-tested asphalt road construction method.

CONSULTEST AG
January 1994 / S. Hollnsteiner, M. Kronig