AustStab Construction Tips

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Two-pass Mixing

Introduction

The successful application of cementitious binders with the existing pavement material is based on uniformly spreading and mixing the binder during insitu stabilisation. Work carried out by the RTA in the early 1990s with the then new generation of large reclaimers/stabilisers indicated that single pass mixing for cementitious binders does not sufficiently mix the binder into the pavement material, and yet similar acceptable uniformity was measured with two and three passes of mixing.

A lack of uniform mixing, such as in a single-pass mixing, can lead to long-term maintenance costs to the road authority when the stabilised pavement material has variable strengths in depth and width due to lack of binder sufficiently mixed into the existing pavement material. Basically some sections of road will have insufficient or excessive strength leading to either block cracking or rutting.

This construction tip aims to outline best practice in mixing cementitious binders with pavement materials for insitu road construction. This document should also be read in conjunction with other AustStab Construction Tips.

Equipment

The last ten years has seen many advances in road stabilisation construction, such as the:

- Introduction of the dual purpose stabiliser and reclaimer,
- Application of binder by mechanised spreading or indirect injection, and
- Heavy compaction equipment, up to 28 tonnes.

The new generation reclaimer/stabiliser as shown in Figure 1 has a single rotor to pulverise the existing material and mix the binder uniformly within the mixing chamber. However, prior to the introduction of these machines it was common to tyne the existing material with an attachment to a grader (see Figure 2) and mix the binder using a triple rotor system, such as shown in Figure 3. The triple rotor system was well known to mix the binder and pavement material efficiently, but lacked the capacity to work at depths exceeding 250 mm.

Figure 1 A RS500 reclaimer/stabiliser with a 325kW engine and single rotor system.

Figure 2 Tyning an existing road with a grader attachment.

Figure 3 A P & H machine with a triple rotor system (CIRCA 1978)

A single rotor system, as shown in Figure 4, provides a good compromise to manage depth control and delivery of power to the rotor. These machines also have well

designed mixing chambers where water and bitumen are added to the stabilisation operation. It is agreed that a single-pass operation with either the CMIRA500 or RS650 and the Wirtgen WR2500 can be achieved in the field to depths of 400 mm to meet high production levels, but reclaimer power does not contribute to uniformity of mix. Neither will direct-fee reclaimers be sufficient to provide uniformity of mix in a single pass!

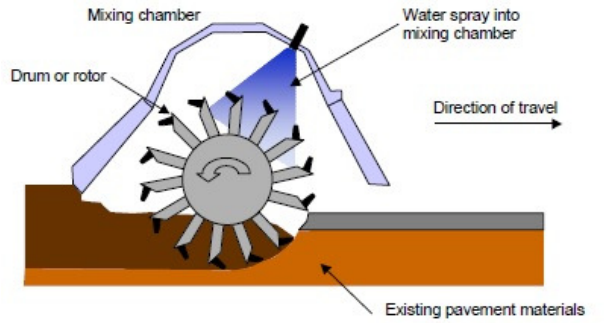

Figure 4 Single rotor system of reclaimer/stabiliser with designed mixing chamber.

Two-passing mixing procedure

The minimum procedure adopted by AustStab members for stabilising pavements at any depth is defined as two-pass mixing. It is emphasised that three or more passes may be required in some instances if subgrade material is incorporated into the stabilised material or binder application rates exceed 40 kg/m^2 or the pavement depth exceeds 350 mm.

The outline of procedure is as follows:

1. Binder shall be spread upon the prepared pavement (see Figure 5)
   (i) where a conventional stabiliser is used for the mixing, the pavement needs to be pretyned to the depth of stabilising prior to spreading the binder (see Figure 2). This tyning should not exceed the depth of the stabilising. Where pre-pulverising ahs been used in conjunction with level alterations pre-tyning may not be required
   (ii) where a reclaimer/stabiliser is used for the mixing there is no need for pre-tyning prior to spreading the binder. The binder is spread directly on the pavement as long as the levels are correct.

2. The binder and soil is then mixed to achieve the compacted depth and degree of pulverisation specified (see Figure 6). This stage allows for the binder to mix with the soil in the mixing chamber with the materials relatively dry.

3. A second pass is then carried out with the required quantity of water (see Figure 7). This stage then enhances the mixed material and water to provide optimum uniformity of mixing of the materials.

Figure 5 The binder being spread in front of the reclaimer before first stage mixing.

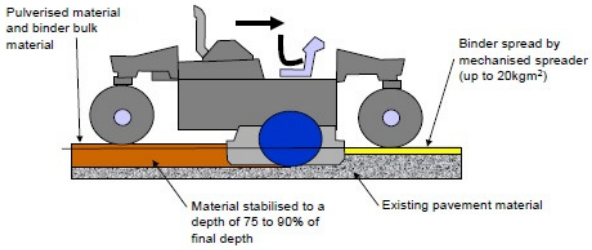

Figure 6 The reclaimer mixes the cementitious binder and existing pavement material with no water during the first stage mixing.

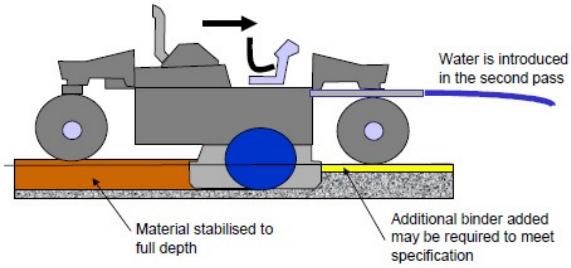

Figure 7 The reclaimer mixes again to the final stabilisation depth during the second stage mixing.

Where the binder spread rate exceeds 20 kg/m^2 the binder should also be spread to ensure uniformity of mixing. Water should not be added to the pavement until the second pass operation.

In the first pass the contractor will also reclaim to a depth of between 70 to 90% of the specified depth of stabilisation. In the second pass the contractor will then stabilise to the full depth including tolerance specified within the Quality Plan.

In some instances previously stabilised pavements may be quite strong and whilst modern reclaimers can pulverise these pavements materials, they are not efficient, and it is suggested that profilers are first used to pulverise the existing material. As a guide if the UCS of a core recovered from the site investigation exceeds 4 M Pa, it is suggested that a profiler be used to reclaim to the specified depth prior to stabilising. Caution is

required such that a minimum of 100 mm of "strong" pavement material is maintained in the pavement layers to avoid any potential thin layers that may be broken during compaction of the above layers.

In some instances where the existing granular pavement material is insufficient in depth, additional imported granular material may be used or alternatively, some of the subgrade material may be incorporated (required laboratory confirmation) in the final pavement material layer. In this instance, two-pass mixing is essential such that the lighter particles of the subgrade are thoroughly missed into the full-stabilised depth. If two-pass mixing is not carried out these particles are likely to cause thin lens near the surface that may inhibit long-term durability of the pavement.

Assessing Mixing Efficiency

Assessing mixing efficiency is not normally carried out on a project basis, and most of the work to assess mixing efficiency has been on ALF projects (refer to APRG Technical Notes 5 and 9). Mixing efficiency may be assessed using the following methods:

- Chemical analysis of the stabilised material.
- UCS test result comparisons across the width and depth of the stabilised layer.

Figure 8 Single pass mixing is likely to lead to streaks of binder in the pulverised material.

In the latter case, the UCS approach is based on samples extracted from behind the reclaimer after the final mixing pass and before compaction. These samples are compacted using standard compaction, and cured at normal curing conditions and tested at 28 days.

When using chemical analysis the background material will need to be tested to allow for any existing trace elements that may misrepresent the final results. Unfortunately this simple yet expensive method has not been reliable on major projects in Australia.

Assessing mixing efficiency may be justified on large projects and during the trial stabilisation stage with Hold Point.

Conclusion

The two-pass mixing procedure is a sound approach to the incorporation of a cementitious binder with the existing pavement material. If lime stabilisation is required for pavement material with a high PI prior to cement stabilisation, the number of passes, allowance for mellowing and the number of mixes may be needed to be established using a trial. For more information the designer should contact the Association or one of its contracting members.

AustStab has developed specifications that assist engineers incorporate best practice in road stabilisation construction and these specifications may be obtained from the Association.

Bibliography

Austroads Guide to Stabilisation in Roadworks Sydney, Dec 1998.

Web Sites

AustStab home page
http://www.auststab.com.au

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