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Technical Note

STABILISATION - CEMENTITIOUS BLENDS INCORPORARING GGBFS

1. INTRODUCTION

Cement and cementitious blended additives are the main stabilisation agents in use in contemporary road rehabilitation.

A disadvantage of stabilisation additives containing Type GP (General Purpose) cement is the limited time to trim and compact the material once mixed with the additive. Laboratory based research undertaken in 1995/96 by GeoPave examined the physical properties of a Class 3 Fine Crushed Rock (FCR) and Class CC3 Crushed Concrete stabilised with a range of cementitious materials incorporating Ground Granulated Blast Furnace Slag (GGBFS). Of particular interest in this study was the effect of delaying the compaction process following the mixing of the additive.

This Note provides some general information on the properties of blended cementitious binders for stabilisation of pavement materials and reports key findings of this research.

2. USE OF BLENDED SLOW SETTING CEMENTITIOUS BINDERS

Current Specifications, which provide for the use of Type GB (blended) cement incorporating a blend of cement (GP) and supplementary cementitious materials such as GGBFS and Flyash, require compaction to commence within two hours and finish within three hours of mixing. This is because of the relatively rapid setting time of cement.

Supplementary cementitious materials such as Flyash and Ground Granulated Blast Furnace Slag (GGBFS) have been used extensively in the production of structural concrete to limit the heat of hydration, reduce shrinkage, improve the workability and retard the set of the concrete.

This latter characteristic is of significance to pavement stabilisation work, especially where construction occurs under traffic. These work sites tend to be confined, which limits plant operation and therefore more time is needed to achieve specified compaction. A further issue is the workability of the material, over time, to rectify any surface defects in preparing the surface for bituminous sealing. Some stabilising agents can substantially extend the workability time and assist in achieving the specified density, lower permeability and ultimate ride quality.

3. FINDINGS OF RESEARCH WORK

Two separate research projects were undertaken to investigate the effect of delaying compaction following the mixing of cementitious additives (3% by mass) on the Maximum Dry Density (MDD) and the Unconfined Compressive Strength (UCS).

In the first project, undertaken in 1995, a range of blends were added to the Class 3 crushed rock with compaction being delayed for up to 6 hours. The blends were as follows:

Blend A.	100% GP cement (control blend).
Blend B.	70/30% GP cement/GGBFS (GB Cement).
Blend C.	50/50% GP cement/GGBFS (GB Cement).
Blend D.	85/15% GGBFS/Lime.

Key findings were:

- The rate of density decrease (density decay) for blends A, B and C was almost linear.
- The average 28 day unconfined compressive strength (UCS) reduction, per hour delay in compaction, for blends A, B, C and D was 4.8%, 4.4%, 4.0% and 2.4% respectively.
- The 7 day UCS, after a one hour delay in compaction, in order of highest to lowest was A, B, C, D and for the 28 day UCS the order was C, A, B, D.
- The 7 day UCS, after 6 hours delay in compaction, from highest to lowest was D, B, C, A and for the 28 day UCS the order was D, C, B, A.
- Laboratory testing can be effectively used to determine an appropriate cementitious blend to maximise the strength of the stabilised material.
- The ratio of 7 day to 28 day UCS values generally ranged from 0.7 to 0.8 which is consistent with cement concrete. The ratio for the 50/50 cement/slag blend was only 0.53.

- If pavement material to be stabilised has dried out, water needs to be added to the material to bring the moisture content up to 1 to 1.5% below Optimum Moisture Content (OMC). The material should be allowed to cure for at least 8 hours or overnight. This is particularly applicable for natural gravel, or ripped sedimentary rock materials, where considerable time is required for the moisture to be thoroughly absorbed into the material. Any additional moisture required can be added at the time of mixing.

- Addition of water, within two hours of compaction, in excess of that required to achieve specified density requirements, can result in internal pore pressure, material instability or segregation of the fines and cementitious additive.

The second project, undertaken in 1996, was to use the same cementitious binders as in the first project but to add these to Class CC3 Crushed Concrete with delays to compaction extending to 24 hours.

In addition to the findings from the first project the key findings of the second project were:

- For Mixes A, B and C, the density reduced by 0.7%, 0.5% and 0.4% per hour respectively for the first 8 hours delay before compaction. For Mix D, there was no reduction in density for the first 8 hours with a decrease of only 0.25% per hour thereafter.

- The 28 day strength reduced for mixes A, B, C and D by 11%, 14%, 11% and 3% respectively due to the delay in compaction from 2 to 8 hours.

- The 90 day strength of Mix D was 50% higher than Mix A after an 8 hour delay in compaction.

4. AVAILABILITY AND RELATIVE COST OF BLENDED CEMENTITIOUS BINDERS

Blended cements are readily available to job sites throughout the State. Slag/lime blends are now also available in bags for routine maintenance pavement patching using insitu stabilisation techniques. The cost of cementitious binders is dependent on the quantity used, market forces and job location. Generally, the higher the content of GGBFS in the blend the lower the unit cost of the cementitious binder.

5. REFERENCES

FOLEY G. (1995) — Report on the Evaluation of Fine Crushed Rock with Cementitious Binders.
VicRoads Report GR 95-10.

YEO R and FOLEY (1997) — Recycled Crushed Concrete Stabilised with Cementitious Binders.
VicRoads Report GR 97-11.

Preparation of Cement Stabilised Materials to Establish the DryDensity-Moisture Relationship.
VicRoads Test Method RC 301.06 (1994).

Further reading;

Austroads APRG Technical Note No. 5 — Insitu Deep Lift Recycling of Pavements Using Cementitious Binders, November 1996.

Austroads APRG Technical Note No. 9 — Insitu Stabilisation of Marginal Pavement Material, July 1999.

Austroads — Guide to Stabilisation in Roadworks (1998).

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