

APRG TECHNICAL NOTE 14

Dry powdered polymer stabilising binder

1 Introduction

Dry powdered polymers (DPP) can be used as stabilising binder for the construction or rehabilitation of granular pavements. Polymer stabilising binders have the effect of potentially waterproofing materials which otherwise would lose significant strength if subjected to moisture ingress. This note provides guidance for evaluating the suitability of DPP as a stabilising binder and outlines application and construction methods.

Unlike other stabilising binders that contain cement, slag, fly ash/lime mixtures, DPP stabilisation does not result in the development of strong cementitious bonds. Shrinkage cracking or brittle fatigue of the stabilised pavement is unlikely to occur and the pavement functions as a flexible, low permeability protective barrier to the subgrade.

2 Dry powdered polymer stabilisation

DPP is a road stabilising binder consisting of an insoluble polymer that is thermally bound to a very fine carrier such as fly ash. The product, when mixed with hydrated lime has the effect of flocculating and coating clay particles within the pavement material. The fly ash, which is encapsulated by the polymer, is effectively inert and does not react chemically in the stabilisation process. Its only function is to facilitate the distribution of the polymer throughout the pavement material.

Some DPP products that are commercially available are:

- A blend of 2:1 polymer-coated fly ash/ hydrated lime;
- A blend of 1:1 polymer-coated fly ash/ hydrated lime.

The latter product is recommended for use with higher plasticity materials with a plasticity index (PI) in excess of 12 but less than 20.

Laboratory testing of marginal quality gravel, granitic sand, soft rock and ripped rock (PI range 5 to 7) stabilised with 2:1 blend has indicated the following to varying degrees [VicRoads, 2002]:

- A reduction in capillary rise and water absorption;
- An increase in the Californian Bearing Ratio (CBR) with the lower strength materials showing the greater increase;

- An increase in resilient modulus (increase in stiffness);
- A decrease in permanent deformation (more rut resistant).

The improvement to natural gravels and sands was more pronounced than for soft rock or ripped rock.

The use of DPP stabilising binder should not be expected to make up for inadequate pavement thickness or gross deficiencies in grading, cohesion or aggregate 'soundness'. Poorly graded and non-cohesive materials may require correction by addition of another granular material as part of the stabilisation work.

3 Spreading rates

The selection of DPP product type is based on the PI of the material to be stabilised. For highly plastic materials $PI > 20$, the lime content of the blend may need to be increased to reduce the plasticity of the material to a $PI < 8$.

Typical spreading rates are in the range of 1 to 2% by mass of treated material.

Laboratory testing has indicated that the ability of DPP to resist the ingress of water can be variable with coarse grained permeable gravels requiring a higher spreading rate. Further laboratory testing is required to confirm this addition rate.

4 Testing for suitability

To determine the suitability of DPP for the stabilisation of a granular pavement material, tests such as plasticity index, grading, maximum dry density and optimum moisture content should be undertaken.

To assess the water-proofing effect of the DPP on the stabilised material, AS 1141.53 – Absorption, swell and capillary rise of compacted materials, is used. The best approach for stabilised materials is to compare the capillary rise swell of samples with and without the binder.

If, after testing, it is found that the nominated type and quantity of DPP does not produce a material to a desired outcome, then an increased dosage rate or an alternative binder should be evaluated by further testing.

If required, testing for stiffness and deformation can be undertaken using the Repeated Load Triaxial test (RLT) of treated and untreated test specimens. This test has been found to clearly show whether or not DPP stabilisation will produce a significant improvement in the performance of the material.



Figure 1 Newell Highway (NSW) is typical of the roads being rehabilitated with DPPs.

5 Pavement design considerations

Stabilisation with DPP will, to varying degrees:

- Reduce susceptibility to moisture;
- Preserve the dry strength of plastic materials when wetted up;
- Produce a flexible base course layer with low permeability resulting in increased pavement life;
- Provide a strong cohesive surface for a sprayed seal treatment.

Pavement thickness is determined in exactly the same manner as for unbound flexible pavements.

RLT testing and layered elastic analysis can be used to evaluate the relative effects of using treated and untreated materials on the predicted pavement life.

6 Use in pavement rehabilitation

Stabilisation of pavement materials with DPP has been used for patching and rehabilitation of pavements constructed from marginal materials such as granitic sands and natural gravels particularly those with a high degree of moisture sensitivity. The surface of the stabilised layer is relatively resistant to abrasion and may be left unsurfaced for several days without excessive raveling.

7 Construction procedures

Pavement construction is carried out using the same specialised plant and equipment to that used for pavements stabilised with cementitious binders. DPP can be delivered either in 20 kg bags for small patches carried out as a routine maintenance activity or in bulk pneumatic tankers for larger rehabilitation or construction works.

When treating highly plastic materials, it is advantageous to pre-treat the material with lime to reduce the plasticity of the material to an acceptable level prior to the addition of DPP.

To achieve compaction water (if required) is best incorporated during the first mixing run. In practice, it has been found most important that the DPP stabilised layer is compacted at 2 to 3% dry of the OMC of the untreated material. As the hydrophobic effect of the binder repels moisture it is good practice to compact as close as practical behind the mixer before the material becomes too dry. It may also be remixed, reshaped or re-compacted without loss of dry strength.

Supervisors should refer to Material Data Safety Sheets for more information on the use of and precautions of handling DPPs.

References

AS 1141.53 (1996) *Methods for sampling and testing aggregates Method 53: Absorption, swell and capillary rise of compacted materials* Standards Australia, Sydney.

Bibliography

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