

ADDITIVES USED IN CRUSHED ROCK

INTRODUCTION

This Technical Note provides guidance on the requirements for use of fine additive material for crushed rock. These additives are used solely to modify or improve the grading, plasticity and permeability characteristics of the final product as an unbound material.

REASONS FOR ADDITIVE USE

Some source rocks, due to hardness or because of mineralogical texture, produce limited amounts of fine and cohesive during normal crushing processes. The as-crushed product does not satisfy VicRoads performance requirements for flexible pavements. VicRoads Standard Specification Section 812 - Crushed Rock for Base and Subbase Pavement therefore permits fine material with suitable characteristics to be added to the crushed rock to provide:

- a suitable grading in the fine sizes;
- improved cohesion and workability of the material; and
- a reduction in the permeability of the compacted product.

These characteristics are particularly important for crushed rock used on heavily trafficked roads that are to be surfaced with a sprayed seal or an asphalt less than 60mm thick.

The introduction of an additive can lower the permeability of some crushed rocks from values in the range 10^{-6} - 10^{-7} m/sec, without additive, to comply with the maximum permeability value of 5×10^{-8} m/sec normally specified for Class 1 crushed rock.

TYPES OF ADDITIVES

Additives commonly used are fine clayey sand, fine clayey filler materials and crusher fines produced from other rock sources.

(a) Fine Clayey Sand

Fine clayey sand such as colluvial granitic sand has been specified and used successfully as an additive to crushed rock base and subbase to enhance the cohesion, workability and permeability properties of the product. The amount of

sand added has generally been limited to between 5% and 12% by mass. The combined product must meet the grading and plasticity requirements given in VicRoads Standard Specification Section 812. If the requirements are not met, variation to the amount of additive used and/or the characteristics of the additive may be required.

Typical test property limits for granitic sand additive are given in Table 1:

Table 1 Typical properties for granitic sand additive

Sieve Analysis % Passing by Mass					Plasticity Index	
AS Sieve Size (mm)						
9.50	4.75	2.36	0.425	0.075	Min	Max
100	90-100	75-95	45-65	30-50	10	20

(b) Fine Clayey Filler Material

Fine clayey fillers have been used successfully as an additive to crushed rock base to enhance cohesion and permeability of the product. These fillers may be industrial by-products or processed natural materials. These fillers are used only in small percentages (< 4% of the total product mass).

Typical test property limits for clayey filler additives are given in Table 2:

Table 2 Typical properties for clayey filler additives

Sieve Analysis % Passing by Mass					Plasticity Index	
AS Sieve Size (mm)						
9.5	4.75	2.36	0.425	0.075	Min	Max
100	100	95-100	70-100	50-100	30	85
Emerson Class Number (Max) (AS 1289.3.8.1)						6

(b) Crusher Fines

Where it is intended that crusher fines produced from an igneous or metamorphic source rock are to be used as a crushed rock additive, it is important that the quality of the fine aggregate components of such fines be known. If the crusher fines have been produced from a quarry, or a location within a quarry different from that which the crushed rock has been produced, it is usual to specify that the fine aggregate be assessed in accordance with the Degradation Factor - Crusher Fines test (VicRoads Test Method RC 370.05). This test allows an assessment to be made of the durability of the fine aggregate. The

Degradation Factor shall not be less than 60.



Crushed rock with clayey sand additive prior to pug-milling

Typically, up to 15% of imported crusher fines may be added to crushed rock, but in cases where the source rock is extremely harsh, approval has sometimes been given for the partial or almost total replacement of the quarry source rock fine aggregate with more cohesive and workable fine aggregate derived from a 'softer' source rock.

UNSUITABLE MATERIALS

Some readily available fine materials are cementitious and water soluble in nature. These materials are unsuitable for use as additives in crushed rock. These unsuitable materials include fly ash, flue dust and blast furnace slag.

Cementitious additives such as flue dust from cement works at Fyansford and Waurn Ponds or precipitator ash from Hazelwood Power Station should be avoided as a means of modifying the grading of crushed rock base or as a means of enhancing "setting up" properties when compacting over-wet material. An excessive cementing action can occur resulting in poor compaction and excessive deformation and shrinkage cracking of the pavement.

APPROVAL OF THE ADDITIVE

In all cases, the use of additives and/or fillers shall be subject to approval by the Superintendent as to the proposed source and nature of such materials, the proposed amounts to be added and the proposed method of incorporating such materials in the product.

REQUIREMENTS FOR USE OF ADDITIVES WITH CRUSHED ROCKS

Where a Contractor proposes to use an additive or where the use of an additive is specified, the additive shall:

- a) be derived from sound, inert and durable material;
- b) not be cementitious in nature;
- c) be free of vegetable matter, lumps and balls of clay and oversize particles of rock;
- d) be subject to processing such that it can be effectively and uniformly distributed throughout the crushed rock;
- e) be kept dry to ensure that a free-flowing additive is incorporated into the mixture; and
- f) not exceed 15% by mass of the total product unless approved otherwise in writing by the Superintendent.

IMPROVEMENT IN PERFORMANCE

The use of an appropriate additive to 'harsh' crushed rock results in:

- an improvement in the workability and cohesion of the compacted material due to an increase in plasticity;
- the provision of a tightly bonded and cohesive surface prior to the application of a bituminous chip seal;
- a base material which has a greater resistance to ravelling and potholing if the bituminous surfacing is cracking or deteriorating through ageing; and
- a reduction in the permeability of the pavement layers by minimising ingress of moisture into the subgrade.

REFERENCES

VicRoads Standard Specification Section 812 - Crushed Rock for Base and Sub-Base Pavement.

VicRoads Test Method RC370.05 - Degradation Factor-Crusher Fines Test.

AS1289.3.8.1 - Methods of testing soils for engineering purposes - Soil classification tests - Dispersion - Determination of Emerson class number of a soil.

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