DISCUSSION

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Practical implications of the relation between the clay mineral content and the Plasticity Index of dolerite road construction material

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COMMENTS FROM E M DE VILLIERS (Pr Eng, Member SAICE)

The Technical Paper by E Kleyn et al provides some useful insights into the use of dolerites in road construction.

The conclusions and recommendations can be further augmented by the following comments and identified needs for further research:

The effect of particle size on the Plasticity Index to better quantify the nature of the matrix material, with further implications for durability, was acknowledged by the inclusion of the effect of PI on the minus

Table 1 Results of tests performed by various quarries producing high-quality basecourse material in South Africa (ASPASA, 1994)

Type of stone	Area	Sample No	PI on minus 0,425mm	PI on minus 0,075mm [5]
Dolerite[1]	SE Transvaal	1	1,7	7,9
	SE Transvaal	2	0,6	3,9
	OFS	3	3,1	9,1
Andesite[1]	S Transvaal	4	5,7	9,2
	PWV	5	SP	6,0
Norite[1]	N Transvaal	6	1,9	15,4
	N Transvaal	7	1,0	4,8
Granite[2]	PWV	8	1,3	6,6
	E Transvaal	9	NP	2,9
	NE Transvaal	10	1,4	5,5
Quartzite[3]	E Transvaal	11	2,5	7,7
	OFS (11tests)	12	0–4	7–13
	PWV	13	4,0	6,0
	PWV	14	SP	4,0
	N Transvaal	15	NP	12,0
	W Transvaal	16	SP	5,0
	Natal	17	SP	7,0
	Natal	18	SP	6,0
Dwyka tillite[4]	South Natal	19	5,0	10,0
Malmesbury hornfels[3]	W Cape	20	2,1	13,7
	W Cape	21	SP	10,4
	W Cape	22	3,1	11,0
	W Cape	23	SP	12,5
	W Cape	24	NP	3,0
(G2)	W Cape	25	3,0	8,0
(ROC)	W Cape	26	4,0	6,0
Felsite[2]	E Transvaal	27	SP	7,0

Notes:
1 Basic crystalline rocks
2. Acid crystalline rocks
3. High-silica rocks
4. Diamictites
6. COLTO requires chemical modification if the PI equals 12 or more, and the PI after modification is not to exceed 8.

0,075 mm fraction in SANS 1200M, Table 3A, together with Clause 3.3.6.1, and in COLTO Standard Specifications for Roads and Bridge Works, Table 3602/1, alike, by the relevant technical committees.

The criteria set for the PI, mandating the use of chemical modification, were based initially on experience with certain sources of hornfels in the Western Cape, further augmented by the results of tests performed by various quarries producing high-quality basecourse material in South Africa, as supplied by the Aggregate and Sand Producers' Association of South Africa (ASPASA, 1994) to the relevant technical committees involved in developing the specification requirements at the time. The latter information is reflected in Table 1.

It may well be that the criteria set at the time for the PI of the minus 0,075 mm fraction, including the limits set for chemical modification, may need to be revisited for certain material types following more specific research.

In addition, the effect of mixing time on the PI as described in this paper and the possible impact on certain materials, as also inferred from Note 5.1 of TMH1, Method A2, may require an increase in the mixing time, particularly for the minus 0,075 mm fraction, after further research has been done on the outcome of such an increase, especially in terms of the possible impact on durability.

Also, the specifications for durability testing, particularly for dolerites, should in the interim include a project specification mandating further assessment using the ethylene glycol soak test.

In this regard, C M Orr (1979) writing on rapid-weathering dolerites, offers useful guidance on two distinct test methods to determine in the laboratory the rapid-weathering properties of South African dolerites. The first of these, the ethylene glycol soak test, utilises the observation that this chemical reacts with the swelling clays of the smectite group, and is an extremely simple test method which could be undertaken in any field laboratory. Samples of unweathered dolerite known to exhibit no abnormal rates of weathering will remain unaffected after 30 days of immersion.

The second, the slake durability test, involves seven cycles of oven drying and wetting but using ethylene glycol as the slaking medium rather than water. Water as a slaking medium was found to have little or no effect on the degradation of smectite-bearing dolerites within the seven cycles of testing, as opposed to the use of ethylene glycol.

The authors conclude, among others, "… that for optimum durability all dolerite gravel with a barely measurable smectite content should be treated (with lime) when used for base and subbase layers, and similarly for crushed dolerite rock intended for crushed rock (G1) base."

It would be useful if such a statement by the authors could have been further justified after also having been quantified in terms of the stated ethylene glycol test procedures.

Reference

Orr, C M 1979. Rapid weathering dolerites. *The Civil Engineer in South Africa,* July: 161–167.

RESPONSE FROM THE AUTHORS

The authors would like to thank Mr De Villiers for his comments. The additional information regarding the identification of weathering dolerites is much appreciated.

The paper was mainly intended to draw attention to the fact that weathered dolerite gravel can be successfully used in the upper layers of pavement structures without summarily resorting to commercially crushed material, provided it is done with circumspection and the appropriate treatment. Hence, the ethylene glycol test procedures applicable to relatively unweathered material/aggregate were not mentioned directly but only in terms of the references.