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TEXTURAL AND MICROSTRUCTURAL FEATURES OF ALKALI REACTIVE GRANITIC ROCKS

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ABSTRACT

The aggregates which had till recently been considered innocuous have now been proved to be reactive under field conditions and their reactivity has been attributed to the presence of strained quartz. However, petrographic studies on four granitic aggregates from different locations in India have revealed that, in addition to the presence of strained quartz, the textural and microstructural characteristics of aggregates have a profound influence on alkali silica reactivity (ASR). In this context the paper highlights the significance of textural and microstructural features of granitic aggregates in causing ASR.

INTRODUCTION

Ever since the alkali silica reaction was reported, continuous reserach work is being carried out employing different advanced analytical techniques. Out of these the petrographic method, based on the use of optical microscopy has gained considerable importance in characterising the aggregates for potential ASR. In the pressent study four granitic aggregate types from different locations and another extracted from a dam structure deteriorated due to ASR, were evaluated. And it is noticed that, besides strained quartz (1), the textural and microstructural features also play an important role in causing ASR. A correlation between textures and microstructures of the four granitic aggregates on the one hand and their mortar bar expansions, on the other, at 38°C and 60°C regime are presented in this paper.

CHARACTERISATION OF GRANITIC AGGREGATES

The granitic aggregates studied comprised Biotite gneiss (Sample ref.Gr1), Augen gneiss (Sample ref.Gr2), Biotite augen gneiss (Sample ref.Gr3), Banded gneiss (Sample ref.Gr4) and Mica granite (Sample ref.Gr5). The textural features observed in these aggregates are myrmekites and perthites; the common micro-structural features include transverse cracks, secondary mineral inclusions in quartz and feldspar porphyries and granulation of quartz.

The petrographic studies revealed that Gr1 showed much granulation of quartz with abundant myrmekites and perthites (Fig.1) while Gr4 showed no such textural features (Fig.2). Sample Gr5 which was extracted from a distressed dam structure

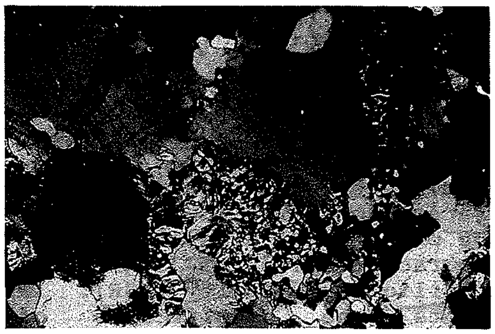

Fig.1 Granulation of quartz with myrmekites and perthites

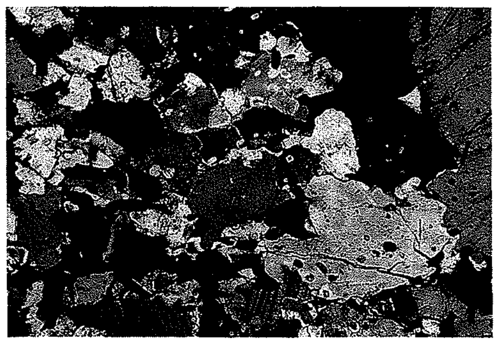

Fig.2 Simple gneissic texture

showed textural and microstructural characters similar to those of Gr1 (Fig.3). Samples Gr2 and Gr3 contain comparatively less granulation of quartz with little amount of myrmekites and perthites (Fig.4). The modal composition of the aggregates and

Fig.3 Granulation of quartz with myrmekites and perthites

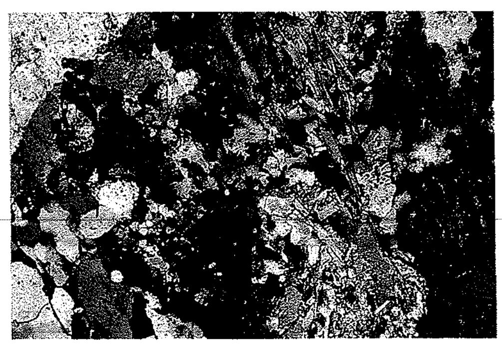

Fig.4 Less granulation of quartz, myrmekites & perthites

their corresponding mortar bar expansion test results are given in Table 1.

Table 1

Sample No.	Type of Aggregate	Modal Composition (%)						Mortar Bar* expansion at	
		Qz	Or	Pl	Bio	M	Ac	38°C	60°C
Gr-1	Biotite gneiss	54	21	11	7	3	4	0.0372	0.1078
Gr-2	Augen gneiss	58	22	12	5	3	-	0.0222	0.0800
Gr-3	Biotite augen gneiss	45	31	8	12	-	4	0.0350	0.0870
Gr-4	Banded gneiss	40	23	20	10	2	5	0.0248	0.0384
Gr-5	Mica granite	41	36	7	11	-	5	-	-

Abbreviations:

Qz: Quartz, Or: Orthoclase, Pl: Plagioclase, Bio: Biotite, M: Muscovite, Ac: Accessories

*test results with 1% Na_2O equivalent (expansion %) at 240 days

DISCUSSIONS

The above petrographic studies revealed that all the aggregates were almost mineralogically similar. The textural and microstructural features of these aggregates were entirely different and the aggregates with highly granulated quartz, myrmekites and perthites (Gr1) gave mortar bar expansions of the order of 0.1078% at 60°C in 240 days whereas the aggregate with simple gneissic texture (Gr4) showed only 0.0384% under similar conditions. Similarly, the granitic aggregate extracted from the distressed concrete (Gr5) showed highly granulated quartz with abundant myrmekites and perthites. Samples Gr2 & Gr3 showed less granulation of quartz with few myrmekites and perthites, and gave mortar bar expansions of the order of, 0.0800 and 0.0870% respectively.

The presence of abundant myrmekitic texture mostly in the crushed zone (Fig.1 & Fig.3) indicates that these are formed during later deformation, in which silica migrated along skeletal defects of plagioclase feldspar (2, 3). The formation of perthites in these aggregates is closely related to the shearing stress acting upon the rock involved. According to Chayes (1952), if quartz is undulant or granulated, perthite is commonly present in such granitic aggregates(4). The occurence of vermicular quartz in myrmekites and the blebs or tiny rods of alkali feldspar in perthites are easily susceptible to ASR, since they are structurally unstable and are developed, due to geological stress and strain, during later deformations. Thus the petrographic study of these textural and microstructural aspects can be adopted for evaluating granitic aggregates for alkali silica reactivity.

CONCLUSIONS

Textural and microstructural features are among the important parameters in evaluating a concrete aggregate for potential ASR studies, as these features are the indices of the geological processes which have been in operation. The experimental studies in NCB have revealed that the parameters influencing ASR in granitic aggregates with strained quartz is the combined effect of undulatory extinction (UE) angle and the textural and microstructural features. It is also established that the presence of alkali feldspar in granitic aggregates containing lower proportions of quartz than in quartzite also aggrevates the ASR (5).

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