Slake durability and microscopic analysis of rocks used as aggregate for concrete

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ABSTRACT

The rocks are being used extensively as construction material from very early part of the human history as building stones, road metal, rail ballast and as aggregate for concrete. The concrete has become the most important construction material with reinforcement and is using almost 70-75 percent of coarse aggregate with fine aggregate, cement, water and recently different admixtures. As concrete is being made as mass concrete at batching plants, the quality control at raw material level is very important. The important physio-mechanical properties of rock aggregate include size, grading, shape, crushing strength, resistance to abrasion and attrition etc. The most common rocks in use as aggregate include quartzite and granite in north India, basalt and dolerite in central India, laterite and gneisses in peninsular India and mixed ones in hilly states of India depending upon its availability in nearby areas. The best in the lot are quartzite, granite and basalt owing to their strength and chemical stability. Due to restrictions on mining by Honorable Supreme Court of India, for ban on mining around Rajasthan bordering UP and Haryana due to environmental concerns, the good quality rock material is not available easily. Also, along many river stretches coming out of Uttrakhand and Himachal Pradesh, blanket restriction has been imposed to save river morphology. Due to this, aggregate suppliers are supplying crushed rocks from locations having poor quality rocks.

Keywords*: *Aggregate, concrete, microscopic analysis, rocks, slake durability, quality,

1. Introduction

The rocks exposed to the earth surface and buried close to the earth surface are mined at first instance to get used as construction material and also as aggregate. These rocks are amenable to chemical and mechanical degradation termed as weathering. The degree of weathering in general decreases with depth but, presence of joints, shear zones and faults can extend the effect of weathering to much deeper depths. The most important effect of weathering on rocks is alteration of minerals and their conversion in different types of clay minerals, detrimental to aggregate quality and increase deterioration with time.

We have tested the weatherability of aggregate by employing Slake Durability Test and have observed rocks under microscope, as per IS: 2386, Part VIII. We have three rock aggregate types from different mines in Rajasthan which includes different types of quartzite from Aravalli Hills and are invariably used in western UP. The aggregates are mostly sequestered from different parts of Rajasthan.

A simple test termed as Slake Durability Test, can be carried out to assess the performance of rocks and resistance offered to weakening and disintegration when subjected to standardized wetting and drying cycles as per the codal provisions in IS: 10050-1981.

The petrographic examination of rocks under petrological microscopes can be used to discern different properties such as texture of the rock in terms of mineral size, grading, presence of voids and composition and petrographic analysis as per IS: 2386, Part VIII, respectively.

As many instances have been reported of slab failure of buildings and deck failure of bridges are the result of poor quality control. Combining Slake Durability Test and Petrographic Test can give good insight to the real nature of aggregate to be used in concrete.

2. Slake durability test

Two standard cycles of drying and wetting is carried out in standardized conditions and weight loss is calculated of the original weight in percent. For rock containing clay minerals as original component of rock or secondary clay produced due to

weathering and alteration of rock, imbibe water through adsorption and absorption resulting into swelling of rocks and its breakage. In this study we have selected four rocks used as aggregate of 20 mm size for working out its durability (TABLE), as per the provision given in the code.

TABLE: Slake Durability Index for Weathering

S. No.	Aggregate Rock Type	Initial dry wt. (A)	Dry Wt. after 1st cycle (B)	Dry Wt. after 2nd cycle (C)	Retained (%) after 1st cycle (B×100)/A	Retained after 2nd cycle (C×100)/B	Durability Class
1	Meja Quartzite (Dark Gray)	106	98	96	92.45	90.56	90 - 95 VH
2	Sahira Quartzite (Dark Gray)	103	90	88	89.32	82.52	75 - 90 M
3	Sindhora Quartzite (Light Gray)	111	89	78	80.18	70.27	50 - 75 M
Slake Durability Classes : 0 – 25 Very Low (VL), 25 – 50 Low (L), 50 – 75 Moderate (M), 75 – 90 High (H), 90 – 95 Very High (VH), 95 – 100 Extremely High (EH)							

3. Results

As per the slake durability test, the studied rock aggregates of 20 mm come under high and moderate durability class but fall short from being in very high or extremely high durable class. The reason ascribed to this is their petrofabric.

The best rock comes to be from Ahruara Quartzite which is coarse grained in nature but has good interlocking texture with anisotropic fabric (Fig. 1 a and b). It is followed closely by Sahira Quartzite which is medium to fine in grain size but has good interlocking texture (Fig. 1 c and d).

The one, not well performing rock aggregate with moderate durability is Sindhora Quartzite. The rock show granular texture as seen under microscope (Fig. 1 e and f). But commercially it is called as quartzite, a tag given to metamorphic rocks. Hence it is not necessary that the rocks by their color and by virtue of commercial name should be blindly used for concrete.

4. Conclusion

It is common to test different physio – mechanical properties of aggregate to be used for concrete. The slake durability test can give good results especially incorporating weathering conditions by wetting and drying. The petrographic analysis which is not usually carried out gives the real nature of texture and mineral composition which ultimately control the strength and durability of concrete.

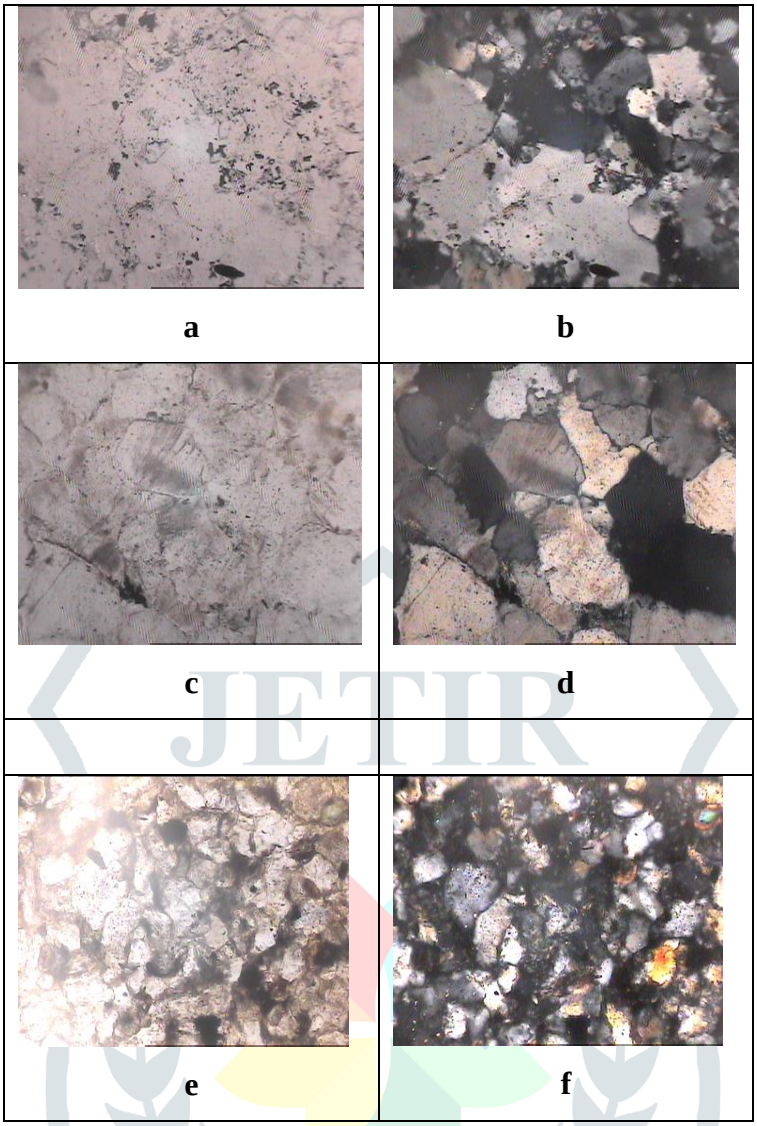

Figure 1: Photomicrograph under nonpolarized and polarized light of very well indurated quartzite from Ahruara (a and b), Sahira (c and d) and Sindhora (e and f), under 70 X magnification showing interlocking texture.

References

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