

# MICROSTRUCTURAL CHARACTERIZATION OF GEOPOLYMERIC CONCRETE REINFORCED FOR STEEL FIBER

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Geopolymers are inorganic polymers that exhibit amorphous to semicrystalline structure characterized as polysialates [2]. They're nanocomposites composed with a whole of argillo – minerals' lamellas dispersed in an amorphous thermorigid matrix of polysialates charge balanced due to the cation's presence. Geopolymer is used as agglomerate on geopolymer concrete instead of Portland cement. The development of this kind of material is an important step for the production of ecologically friendly concretes seeing that gas emission is substantially reduced and the potential use of by-products as source materials [1]. Geopolymer's study demands utilization of a large variety of techniques. In this work, results of scanning electron microscopy (SEM) are introduced in order to collect informations for a better understand of geopolymeric concrete's microstructure. A Geopolymeric Cement Concrete (GCC) was developed and its characteristics were compared with Portland Cement Concrete (PCC) through the establishment of some designs parameters (consumption of binders, water/aggregates ratio and mortar content). This concrete mechanical performance was evaluated by fatigue behavior.

The SEM micrographs presented in Figure 1 show the characteristics morphologies of both concretes (geopolymeric concrete and Portland concrete). However, in both concrete's micrographs, is noticed the occurrence of irregular fracture's surface - a common characteristic of concretes. Figures 1A and 1B show the denser (and less porous) microstructure of geopolymeric concrete compared with Portland cement concrete.

A better adherence between the matrix of geopolymeric concrete and the aggregate can be noticed in Figure 2B, starting from the smallest degradation of the interface aggregate/matrix due to the inexistence of Portlandite's gradients concentration in this area. Figure 2A shows that the cracking propagation tends to outline the aggregate at the aggregate/matrix interface. As well as it happens in geopolymeric concrete, in the case of Portland concrete, a larger degradation is observed in the transition area due to the great number of porous and the presence of Portlandite's crystals, which limits considerably its mechanical properties.

In Figure 3A show the matrix of the Portland cement concrete and the steel fiber. The Figure 3B shows the formation of Portlandite's crystals present in Portland cement. The number 1 (one) corresponds to Portlandite or calcium hydroxide, the number 2 corresponds to calcium silicate hydrated (C-S-H) and the number 3 corresponds to calcium aluminate hydrated. A better adherence between the matrix of geopolymeric concrete and the steel fiber can be noticed in Figure 4A, starting from the smallest degradation of the interface fiber/matrix due to the inexistence of Portlandite's gradients concentration in this area.

The Figure 4B show the relation between strength and number of cycles on fatigue tests for both concretes submitted to constant tension and two percentages of steel fibers used (0,5% and 1,0%). The test results indicated that the GCC fatigue's strength was higher than that obtained for PCC, in the two percentages of steel fibers.

The results of fatigue tests in the several accomplished variations, shows a better behavior in fatigue of the GCC. In the case of relationships among tensions (RT) of 0,70 (70% of static strength), the GCC presents values 15% above the values showed to the PCC under the same conditions. For higher tensions, about 80%, the results of the GCC showed values 96% above the PCC, in the two percentages of steel fibers.

## Acknowledgements

The authors are grateful to CAPES and CNPQ for the financial support.

## References

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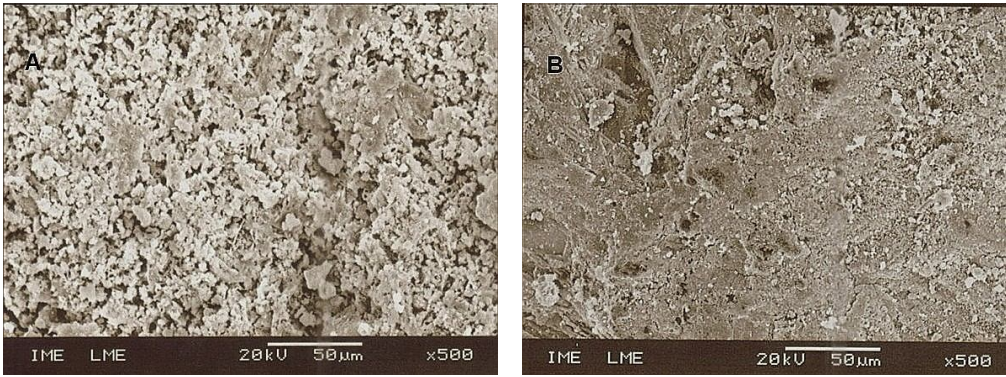


Figure 1 - (A) Porous structure of CCP, (B) Compact and massive structure of CCG.

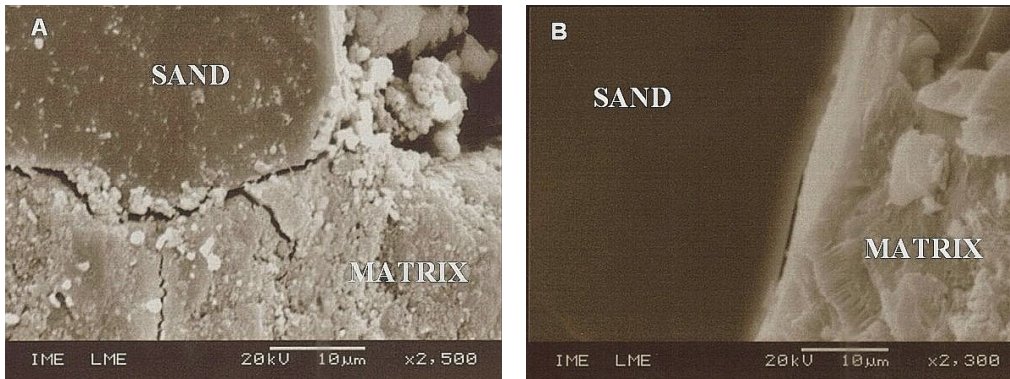


Figure 2 - (A) Interface matrix-aggregate in PCC, (B) Interface matrix-aggregate in GCC.

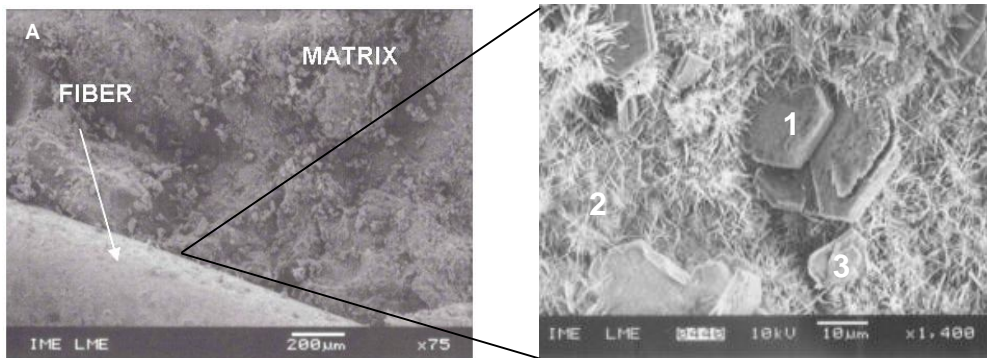


Figure 3 - (A) Interface matrix-aggregate in PCC, (B) Formation of Portlandite's crystals.

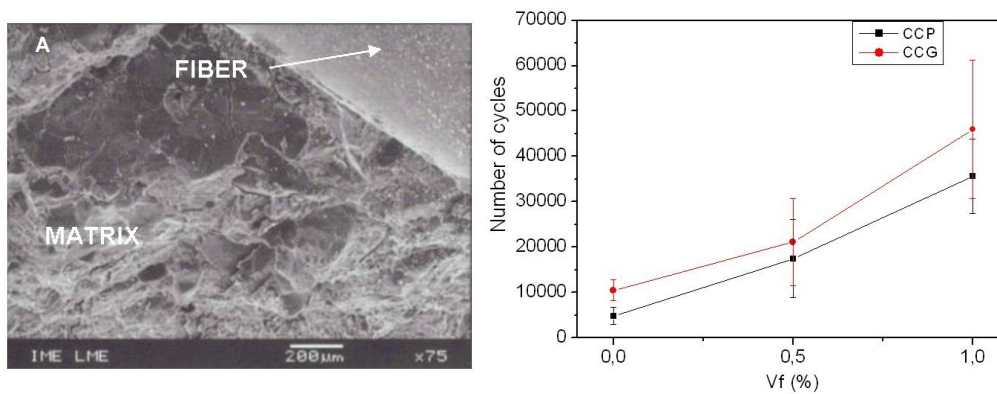


Figure 4 - (A) inexistence of Portlandite's gradients in GCC, (B) Results of the fatigue tests.