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Relative Volumes of Microstructural Phases in Heterogeneous System as Determined by Nanoindentation, X-ray Elemental Mapping and Image Analysis

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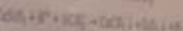
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1. Introduction

Quantitative phase determination of microstructural phases is an important tool for quality control purposes and also to monitor the reactions in heterogeneous material systems. In case of cementitious materials these phases govern additional contribution due to complex chemical reaction phenomena. In this experimental work, three different methods have been utilized to study the volume fraction contribution to the microstructure of heterogeneous microstructural systems. The methods used are nanoindentation, SEM-EDS image analysis and X-ray elemental mapping.

3. Materials: Carbonated Natural Wollastonite (CaSiO₃) System

Reaction Mechanism



- 1. Measure refractive index microstructure with phase contrast microstructure images
- 2. Image gel
- 3. Measure carbonates and
- 4. Measure grains of wollastonite



4. Results

Phase	Volume Fraction (%)
Wollastonite	~45
Carbonate	~35
Gel	~15
Other	~5

5.2. X-ray elemental mapping: Multiphase image analysis

Procedure

1. Individual X-ray elemental maps were obtained for major elements (i.e., Si, Ca, Fe, etc.).
2. Using software, software, these elemental maps were overlaid and then stacked and filtered based on the filter threshold function. (Image on the right is a color image).
3. Acquisition of phase will occur based on different color properties. These phases were measured for their volume of 2D, and a 3D can be made based on the generated data.

Image 1



Image 2



Image 3



Image 4



Image 5



Table 1

Phase	Volume Fraction (%)
Wollastonite	~45
Carbonate	~35
Gel	~15
Other	~5

6. Comparison of the test methods

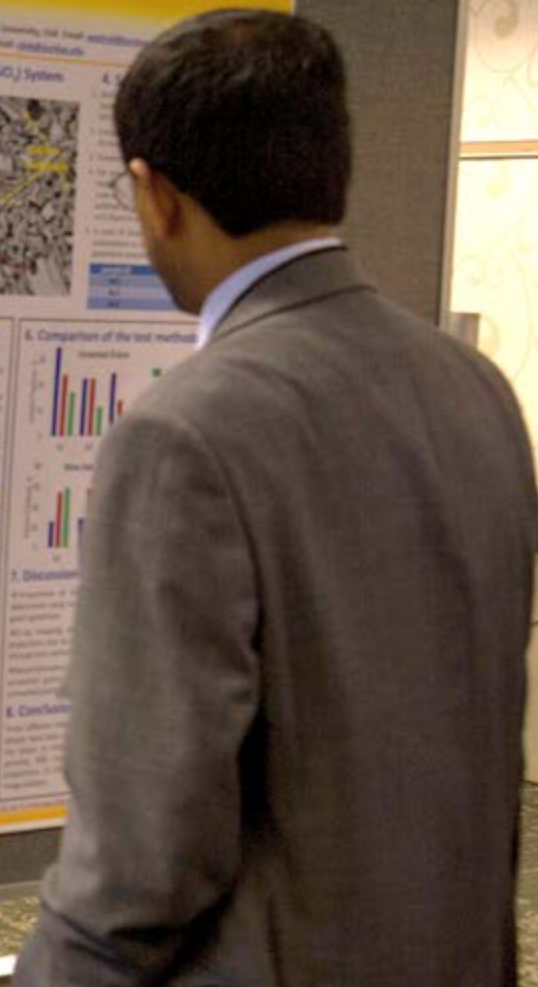


7. Discussion

The results of this study show that the three methods used in this study are very similar and can be used to determine the volume fraction of the phases. The quantitative data obtained from the three methods are very similar and can be used to determine the volume fraction of the phases.

8. Conclusion

The results of this study show that the three methods used in this study are very similar and can be used to determine the volume fraction of the phases. The quantitative data obtained from the three methods are very similar and can be used to determine the volume fraction of the phases.









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Application of neural network for concrete carbonation depth prediction

Daming Luo

School of Civil Engineering
Xi'an University of Architecture and Technology

July 24, 2014







