EFFECTIVE DISPERSION OF NANO GRAPHENE PLATELETS

A. Talarou[1], N.D. Alexopoulos
Department of Financial Engineering, University of the Aegean, Chios, Greece

E.P. Favvas
Division of Physical Chemistry, NCSR "Demokritos", Ag. Paraskevi, Attica, Greece

The objective of this study is the development of a cementitious multifunctional material that itself can be simultaneously used as a construction material and a strain/damage sensor of structural components. To achieve this, the implementation of nano graphene platelets (NGPs) was studied. Initially, a method to effectively disperse the graphene nanoplatelets in the cementitious matrix was developed. Typically, NGPs tends to form agglomerates due to Van der Waals forces and their efficient dispersion is not a straightforward procedure. To this end, it is important for NGPs to be uniformly dispersed within the matrix so as to achieve effective reinforcement and improve the properties of the cementitious material. Use of ultrasonic processing and treatment with a 3rd generation superpasticizer was employed to homogeneously disperse NGPs in the mixing water. The latter was exploited as it is commonly used to improve the workability of cement based materials and is typically used within the matrix. The effect of the superplasticizer concentration was studied first, as several studies have indicated that the dispersing agent's concentration significantly affects the nanomaterials' dispersion. For homogeneous dispersion, a superplasticizer concentration close to 0.7% by weight of cement was found to be most efficient. To further improve the dispersion method, the effect of ultrasonic energy was investigated. Finally, the effect of different concentrations of the NGPs was studied. The electrical properties of the nanocomposites and specifically the electrical resistivity were evaluated using the 4-wire Ohms method. Three-point bending tests were performed at the 20×20×80 mm beam specimens at the age of 28 days, as shown in Figure 1. The mechanical properties of the NGPs-cementitious materials were evaluated using notched specimens. Fourier Transform Infrared (FTIR), X-ray diffraction (XRD), Scanning Electron Microscopy (SEM) and nitrogen porosimetry (N_2 adsorption) have been used in order to evaluate the structural characteristics of the pure graphene additive materials.

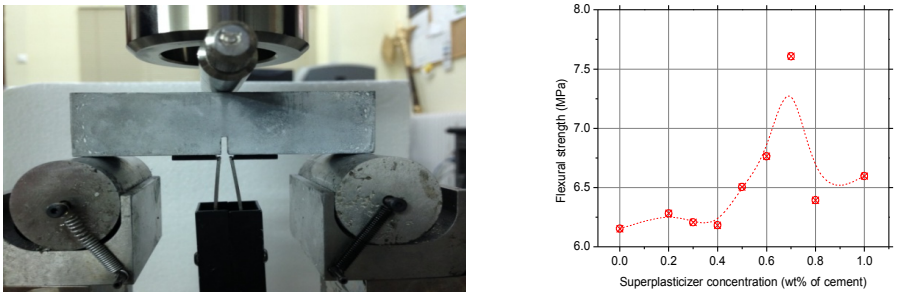

Figure 1: LEFT: Three-point bending test set up. RIGHT: Effect of superplasticizer concentration on the flexural strength of cementitious nanocomposites.

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References

[1] Metaxa, Seo, Konsta-Gdoutos, Hersam and Shah, Cement and Concrete Composites **34**, 612 (2012).
[2] Konsta-Gdoutos, Metaxa and Shah, Cement and Concrete Research **32**, 110 (2010).
[3] Tang, Shafiq, Chan, Wong and Cheung, Journal of Nanoscience and Nanotechnology **10**, 4967 (2010).

1 angel-niki.tallarou@gmail.com