

Graphene oxide as an additive in cement – Synthesis and characterization of GO –

Bachelor's / Master's thesis project

Introduction

Portland cement, being a major component of concrete in constructions, is a widely used material in modern society. Even though it has been used for well over a hundred years, the reactions of Portland cement with water to form hardened concrete are not yet fully resolved. This is mainly due to the great complexity of the system. Today, this complexity is further increased by the many materials that are added to the cement to decrease environmental impact, reduce cost and increase performance. One new promising additive is graphene oxide, an oxidized form of graphene. Functional groups, such as $-\text{COOH}$, $-\text{O}-$, $-\text{OH}$ and $-\text{SO}_3\text{H}$, make graphene oxide hydrophilic and soluble in water, and thus suitable as an additive in cement paste. When adding 0.03 wt% graphene oxide to cement paste the normally low tensile strength is reported to increase by up to 78% during early hydration. It has also been observed that the presence of graphene oxide can change the microstructure, resulting in a reduction in the brittleness and cracking of hardened cement. These properties are highly desirable to improve and graphene oxide is therefore an interesting additive for further investigation.

Aim of the project

In this project graphene oxide will be synthesized and characterized. Graphene oxide is complex and an understanding how it interact with the cement matrix is therefore of vital importance. The follow will be investigated:

- Different routes for synthesis of graphene oxide and their main products
- Characterization of graphene oxide concerning particle size, degree of oxidation etc.
- Impact of various graphene oxide samples on hydration of Portland cement and/or pure cement components.

Methods

The main methods in this project are wet chemical synthesis, infrared spectroscopy, isothermal calorimetry and scanning electron microscopy. However, depending on the development of the project and the preferences of the student, other methods can also be used.

Organisation

The project is performed by one student or several students working on different parts of the project. The work may be carried out as a 15hp or 30hp or degree project.

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Energy and Materials

Chemical and Biological Engineering