Nanomedicine & Biotherapeutic Discovery

Extended Abstract

# UHPC and its diffusion properties

**Sarka Nenadalova**

## Abstract

UHPC (ultra-high performance concrete) is a modern cementitious composite material with compressive strength more than 150 MPa and tensile strengths more than 5 MPa. Except improved compressive strength, it has better toughness in case of failure of bending, tension and compression and high durability. In Kassel University we have started project aimed on diffusion properties of UHPC. Not only water vapour resistance factors have been examined but also other diffusion parameters are discussed on this paper. We thanks grant Call 027 International mobility of researchers for the support. In this study, an extensive literature review has been conducted on the material characterization of UHPC and its potential for large-scale field applicability. The successful production of ultra-high performance concrete (UHPC) depends on its material ingredients and mixture proportioning, which leads to denser and relatively more homogenous particle packing. A database was compiled from various research and field studies around the world on the mechanical and durability performance of UHPC. It is shown that UHPC provides a viable and long-term solution for improved sustainable construction owing to its ultra-high strength properties, improved fatigue behavior and very low porosity, leading to excellent resistance against aggressive environments. The literature review revealed that the curing regimes and fiber dosage are the main factors that control the mechanical and durability properties of UHPC. Currently, the applications of UHPC in construction are very limited due to its higher initial cost, lack of contractor experience and the absence of widely accepted design provisions. However, sustained research progress in producing UHPC using locally available materials under normal curing conditions should reduce its material cost. Current challenges regarding the implementation of UHPC in full-scale structures are highlighted. This study strives to assist engineers, consultants, contractors and other construction industry stakeholders to better understand the unique characteristics and capabilities of UHPC, which should demystify this resilient and sustainable construction material.

Ultra-high performance concrete (UHPC) is a novel construction material exhibiting enhanced mechanical and durability properties, which can lead to economical construction through reducing the cross-sections of structural members with associated materials savings and lower installation and labor costs (Tang 2004). The relatively high initial cost of UHPC has restricted its wider use in the construction industry. However, ongoing research and investigations are filling knowledge gaps in order to commence innovative UHPC having reduced initial cost.

Furthermore, the development and wide acceptance of an UHPC design code provisions should encourage stakeholders in the construction industry to implement large scale applications. This becomes even more relevant with the more recent push by organizations such as the American Concrete Institute, which identified using high-strength steel reinforcement in concrete as a top research priority. Combining UHPC and high-strength steel is expected to yield unique structures in the near future. UHPC potential applications include tall structures, rehabilitation works, structural and non-structural elements, machine parts and military structures. Lighter weight structures owing to smaller cross-sections can be made using UHPC. Therefore, UHPC can be effectively utilized in the precast concrete industry. Moreover, UHPC was widely used in pedestrian footbridges and highway bridges. For example, the first UHPC footbridge in Canada was constructed in 1997. In the United States, Wapello County Mars Hill was the first highway transportation bridge constructed with UHPC in 2006. In the Kinzua Dam Stilling Basin, UHPC was used for rehabilitation and strengthening purposes. Furthermore, architecturally and aesthetically appealing structures can be made using UHPC (Schmidt et al. 2004, 2012; Fehling et al. 2008).

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Sarka Nenadalova
Universitat Kassel, Germany, E-mail: sarka.nenadalova@cvut.cz

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Universitat Kassel, Germany, E-mail: sarka.nenadalova@cvut.cz