Advanced & Innovative Materials (AIM) Group, University College London (UCL)

AIM Group, jointly with the Institute of Concrete Technology

Nanotechnology and Sustainability in Concrete Construction

Professor Surendra Shah

Northwestern University

11th July 2018

17.30 for 18.00

All welcome

Tickets are free; please book to reserve your place

ict@concrete.org.uk

Department of Civil, Environmental & Geomatic Engineering
University College London

Lecture Theatre BO5, Chadwick Building
Gower Street, London WC1E 6BT

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Nanotechnology and Sustainability in Concrete Construction

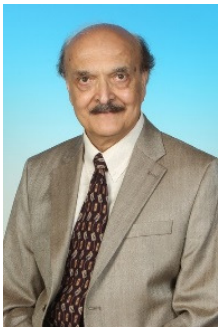
Super tall buildings such as one kilometre-high Kingdom Tower are constructed with concrete as a structural material. Such tall buildings are made with so called high performance concrete, which can have strength five times that of conventional concrete. The development of high strength concrete is a result of our understanding of particle packing, rheology and microstructure engineering. Concrete is a critical material for infrastructure; the worldwide consumption of concrete is about 2 tonnes for every living human being. However, its continuing use will require improving its sustainability. Nanotechnology is playing an increasing role in making concrete more sustainable. Some examples will be given.

One approach to making concrete more sustainable is to replace Portland cement (and its significant carbon footprint) with fly ash, a waste material from burning coal. When fly ash is replaced with Portland cement, the rate of strength development slows down, and this is not desirable. The addition of nano particles such as nano silica accelerates the chemical reaction by providing nucleation sites. In addition, characterization of the nano structure of calcium silicate hydrate by nano indentation, AFM, FTIR and NMR shows beneficial nano scale modification.

Manipulation of concrete rheology has been a key to make concrete more constructible. The viscosity should be sufficiently small so that concrete can be pumped a great distance, but the material should be thixotropic to reduce the pressure on form work. The addition of a small amount of nano clay has been shown to accelerate the rate of thixotropy. The rheology of ageing colloidal suspensions is being studied by computation modelling, as well as by measuring the dimensions of flocculated particles with laser spectrometers.

Concrete is a brittle material, prone to cracking. Concrete structures are reinforced by steel bars at a millimetre scale. However, flaws in cement paste are in nano scale. To reinforce concrete at nano scale, the addition of carbon nano tubes is studied. The key challenges include dispersion and rheology. Recent studies have demonstrated that adding a very small amount (005%) of well dispersed CNT has a profound effect on performance: mechanical properties, piezo-resistivity, transport properties as well as corrosion reinforcing steel. Such multi functionality is probably related to the altered nano structure of concrete.

Professor Surendra Shah



Professor Surendra Shah is Walter P. Murphy Professor(emeritus) at Northwestern University. He was the director of NS F funded Science and Technology Center of Advanced Cement Based Materials. He is an honorary member of ACI and RILEM. He has published over 500 journal articles on various aspects of concrete technology.

He is a member of US National Academy of Engineering, Chinese Academy of Engineering and Indian Academy of Engineering. Currently he is a distinguished Professor at IIT Madras, Honorary Professor at Tongji University, Hongkong Poly, and Jinan University and a member of Institute of Advanced Studies at HKUST.

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