# UNIVERSITY of HOUSTON

## CULLEN COLLEGE of ENGINEERING
Department of Civil & Environmental Engineering

## CIVE 6111 Graduate Seminar Series

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### Application of Stabilized Nanoparticles for In Situ Remediation of Contaminated Soil and Groundwater

**Friday, Feb. 20, 2015**
3:00 pm - 4:00 pm
Room: 102D (Eng. Bldg. 1)

**Abstract:** Remediation of soils and groundwater contaminated with chlorinated solvents and toxic metals has been a major environmental challenge for decades. Yet, a safe and sustainable in situ remediation technology remains lacking. Through more than a decade of intensive research, we have developed a strategy to stabilize various nanoparticles using low-cost and "green" polysaccharides (starch and carboxymethyl cellulose (CMC)) as a stabilizer. The stabilizers can facilitate controlling the size, delivery and transport of nanoparticles, such as zero-valent iron (ZVI), magnetite, Fe-Mn oxides, iron sulfide, $MnO_2$, and iron phosphate, all of which have shown promising for environmental cleanup applications.

Bench- and field-scale experimental data showed that the stabilized ZVI nanoparticles can rapidly degrade chlorinated solvents in water and soils. The nanoparticles can also facilitate in situ reductive immobilization of a number of redox sensitive metals and radionuclides such as Cr(VI), U(VI) and Tc(VII) in soils and groundwater. For example, when a Cr(VI)-laden soil column was treated with 5.7 bed volumes of 0.06 g/L of the nanoparticles, the TCLP (toxicity characteristic leaching procedure) leachability of Cr(VI) was reduced by 90%.

We developed a number of other types of stabilized nanoparticles to curb the leachability of toxic metals, such as Hg, As, Pb, and Cd in soil and groundwater. These nanoscale sorbents offer some unprecedented advantages over traditional aggregated particles, including 1) they can be delivered and dispersed in various soils and attack contaminant plumes deep in aquifers; and 2) they offer strong affinity and high sorption capacity toward the target metals.

We also preliminarily characterized the environmental fate and transport of these stabilized nanoparticles in the subsurface. While the application of the stabilizers facilitated the soil deliverability and dispersion of the nanoparticles, the delivered nanoparticles are virtually immobile under typical soil and groundwater conditions, and thus, will serve as a long term sink for the contaminants without causing adverse environmental impacts.

**About the speaker:**

**Dr. Dongye (Don) Zhao** is the Huff Endowed Professor of Environmental Engineering at Auburn University. He received his Ph.D. in Environmental Engineering from Lehigh University in 1998. His research focuses on nanomaterials for in situ remediation of contaminated soil and groundwater (dechlorination and immobilization of metals and radionuclides); and fate, transport and environmental impacts of nanoparticles and radionuclides in the subsurface. Since the 2010 DwH oil spill, his group has also been actively studying dispersant effects on weathering and environmental fate of persistent oil components. His research has been supported by U.S. Department of the Interior, EPA, DOE, DoD, NSF, Air Force Center for Engineering and the Environment (AFCEE), and the American Water Works Association Research Foundation (AWWARF). He has published more than 90 peer-reviewed journal papers, 6 U.S. patents, 70 invited presentations, and 150+ other publications/presentations. He was the first to use starch and cellulose for producing soil-deliverable iron-based nanoparticles, which have been pilot-tested at several sites worldwide.