2019-2020 G-I Speakers Program

Geoenvironmental Engineering Committee

Megan Hart, Assistant Professor, PhD

Civil and Mechanical Engineering, University of Missouri Kansas City

Proposed Title: **Emerging Contaminants of Concern in Geoenvironmental Applications**

Abstract: Emerging contaminants of concern make headline news, promote new or refreshed regulatory standard shifts, and stimulate litigation. Of these emerging contaminants of concern the per and poly fluorinated alkyl substances (PFAS), or "forever chemicals", are increasingly found in the everyday environment including the foods we eat, the clothes we wear, the water we drink, and many commercially available products we use daily without concern. PFAS are a class of persistent organic pollutants that are increasingly shown to have adverse impacts on the environment and alarmingly shown to negatively impact human health. PFAS in general is a complex, exotic, human made compound with unknown end toxicity or environmental fate. PFAs is recalcitrant to mainstream remedial alternatives and requires a multi-modal approach to treatment in the multitude of media in which geoenvironmental engineers may encounter PFAS. This presentation provides a comprehensive listing of current remedial treatment techniques for PFAS that are being utilized across the spectrum of environmental media such as soil, cuttings, groundwater, wash water, etc. Primary techniques for treatment will be presented including the principle remedial technique and design of remedial solutions. New developments or promising new technologies for PFAS treatment will also be presented.

Arvin Farid, Associate Professor, Ph.D., P.E.,

Civil Engineering, Boise State University

Title 1: **Introduction of radar-based geophysics for geoenvironmental engineering.**

Abstract: Electromagnetic waves have been used in various applications from communication to nondestructive detection. This talk will discuss the potential of radar-based methods for geotechnical and geoenvironmental engineering problems as well as their advantages, disadvantages, and the fundamentals of their use.

Since soil is a complex, potentially heterogeneous, lossy, and dispersive medium, modeling the propagation and scattering of electromagnetic (EM) waves in the soil is more challenging than in air or in other less complex media. The fundamentals of the numerical modeling of EM wave propagation and scattering in soil through solving Maxwell's equations using a finite difference time domain (FDTD) method will be discussed. In addition, an experimental simulation will also be discussed. The results of the corresponding numerically simulated example will then be compared and validated against the abovementioned experimental results. Overall, through a geoenvironmental application, methodology, and challenges of measurement, processing, solving forward and inverse problems in time and frequency domains, and image reconstruction will be discussed.

Title 2: **Electromagnetic Waves for Geotechnical / Geoenvironmental Applications**

Abstract: In-situ remediation techniques that enable the removal of contaminants are, in general, relatively slow and ineffective. Electromagnetic (EM) waves have long been used for the detection and monitoring of anomalies in soils. This talk will introduce the use of electromagnetic (EM) waves to control various mechanisms (e.g., induce contaminant flow, control airflow, etc.) to improve or expedite the clean-up process. This effect is studied within resonant cavities to examine the flow of a contaminant simulant (a nonreactive dye) and air-channel formation within aqueous and porous media under EM stimulation of various frequencies and power levels. Relevant multiphysics processes were numerically simulated, experimentally validated, and used to solve inverse problems to reach

governing equations of these phenomena. Several simulant-flow and air-channel-formation scenarios under EM stimulation at different frequencies and power levels were studied. The side effects of EM waves on the hydraulic conductivity of soils and microbial activities were also studied and analyzed. Governing models were then developed to correlate EM waves' characteristics and the flow and hydraulic-conductivity alteration.

Navid H. Jafari, Ph.D.

Assistant Professor and LADIA Sea Grant Fellow

Coastal Studies Institute

Department of Civil and Environmental Engineering
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Title 3: **Disposal Recommendations for Industrial Wastes to Limit Heat Generation, Hydrogen Sulfide Production, and Slope Instability**

Disposal of high-water content sludge wastes can pose problems in landfill operations due to trafficability of compaction equipment, long-term slope stability, and generation of odors. As sludge wastes become increasingly solidified with binding agents, such as cements and fly ashes to improve strength characteristics, the corresponding hydration process of calcium oxide generates heat. The presentation will present findings from bench-scale semi-adiabatic tests to estimate the time required for the heat to dissipate from solidified sludge waste stockpiles and the shear strength after solidification. Best management practices will be summarized at the end.

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Title 4: **Vertical Barriers for GeoEnvironmental Applications**

A presentation on vertical barriers for geoenvironmental applications is proposed for the Geoenvironmental speaker series. The presentation offers a balance of theory and practice across the spectrum of design, construction, monitoring and performance (short and long term). The presentation will first overview the primary techniques currently employed and identify the principle functions of vertical barriers in geoenvironmental applications. Design and construction methods for the primary techniques are presented. Discussed are field monitoring practice and procedures including advantages and limitations of various methods. Techniques presented include slurry trench cutoff walls of soil-bentonite, cement-bentonite and in situ mixed walls using multi-auger, cutter soil mixer, and trench remixing in situ mixing techniques. New developments in vertical barriers will be presented.

Joseph Scalia IV

Assistant Professor | Department of Civil & Environmental Engineering

Colorado State University

Title 5: **Advantages and Limitations of the Observational Method in Remediation**

Abstract: *The observational method established by Karl Terzaghi and promulgated by Ralph Peck has been used by geotechnical engineers for over 75 years as an approach for addressing uncertainties inherent with subsurface conditions and earthen materials. Current advances in internet of things (IoT) technologies hold the potential to shift the paradigm of remediation away from the current study, design, build paradigm to the observational method. Data from inexpensive internet connected sensors can now be viewed in real time by engineers and regulators through online dashboards customized to evaluate relevant working hypotheses developed from an existing site conceptual model. When behavior deviates from the working hypothesis, modifications to the plans for remediation can be made rapidly following pre-established contingency plans, the site conceptual model can be advanced, and an updated working hypothesis established. Advantages and limitations of applying the observational method to remediation will be discussed.*

Dimitrios Zekkos, PhD, PE

Associate Professor, University of California at Berkeley.

Title 6: **Applications of Aerial and Land-Based Robotic Platforms in Landfills**

Abstract: Robotic platforms, such as Unmanned Aerial Systems (UASs), or drones, as well as land-based robots, are having a dramatic effect on the way we design, operate and maintain civil infrastructure. In this presentation, specific examples of application of robotic platforms to address important landfill engineering issues will be presented. Specifically, robots are expected to provide a rapid and inexpensive way to collect landfill performance data. Data collected can be used to assess construction process, monitor remotely waste operation activity, derive landfill geometries for stability purposes, as well as measure settlements of the waste mass. Equipped with many sensors, robots can assist in quantifying spatially methane emissions as well as thermal hotspots that may be indicators of irregular waste activity. Ongoing research work and examples associated with such applications will be presented and specific guidance for the implementation of robots in landfill practice will be provided.