



**POLITECNICO
DI TORINO**
Department of
Environment, Land,
and Infrastructure Engineering

PURDUE
UNIVERSITY
LYLES SCHOOL OF CIVIL ENGINEERING



WORKSHOP

EngiMat – Engineering the rheological properties of materials

Politecnico di Torino

June 18th, 2018

Meeting Room DIATI3-P1

PRESENTATION

The workshop is jointly organized by PoliTO and Purdue University as a part of the research project entitled “RheoCom”.

The workshop will focus on the properties a set of complex materials employed in various civil and environmental engineering applications. Part of the program will focus on surface chemistry and interphase interactions, due to their crucial role played in the materials engineering process.

The workshop is aimed at providing a state-of-the-art review and at stimulating discussion among participants.

PROGRAM

9:00 – Welcome

Prof. R. Sethi – Director of DIATI (Department of Environment, Land and Infrastructure Engineering)

Prof. E. Santagata – Director of LAQ-MIR (High-Quality Laboratory – Innovative and Recycling Materials)

9:15 – Introduction and presentation of RheoCom project

Prof. O. Baglieri – Principal Investigator

9:30 – Surface chemistry of minerals

prof. C. Johnston

Experimental and theoretical methods continue to provide new insights into the size, shape, reactivity, and stability of clay minerals. Although diverse and complex, the surface chemistry of all clay minerals is defined spatially on a common scale of nanometres. The seminar is organized around the nanoscale architecture of clay minerals examined at several different length scales. The first, and perhaps most important, is the length scale associated with hydrogen-bonding which dominates the surface chemistry of many clay minerals. The second length scale considered is that associated with clay_water and clay_organic interactions.

10:15 – 10:30 - *Coffee break*

10:30 – Clay-water interactions

prof. C. Johnston

Water is an integral part of many clay mineral structures and can be found in diverse nano-confined environments. The seminar will focus on clay mineral-water interactions, which are critically linked to essentially all physical, chemical, and biological aspects of clay science. Infrared spectroscopic methods (mid-IR, near-IR) are particularly sensitive to the vibrational bands of both adsorbed H₂O and structural OH groups. Applications to study clay mineral-water interactions have provided chemical insights which include clay mineral swelling, hysteresis, molecular mechanisms of water adsorption, chemical reactivity, cation exchange, hydrophobic/hydrophilic nature of clay surfaces, and clay mineral-organic interactions.

11:15 – Complexity of nano-structured materials

prof. M. Piumetti

Over the years, nanostructured materials have received much attention due to their valuable applications in many research fields. In particular, these complex materials can be supported on micro- and mesoporous solids to improve their overall performances toward environmental applications. On the other hand, the activity of many nanostructured systems depend on their chemical composition, structural and textural properties. Moreover, for these complex systems cooperative and/or synergetic effects may arise. In the present seminar, the complexity of nanostructured systems and related materials will be illustrated, showing the role of geometric and electronic properties on their performance.

12:00 – Rheological Studies and Stress Anomalies in Sheared Dense Granular Ensembles

prof. T.G. Murthy

Granular flows are ubiquitous in nature and industry, however a comprehensive understanding – i.e. a continuum model that is applicable over a range of velocities has not emerged. We present the results of an extensive experimental study on the rheology of a dense granular ensemble in a modified cylindrical Taylor-Couette cell. We employ a multi axis transducer capable of measuring all the components of the stress on the walls of the Couette cell. These measurements reveal an interesting anomaly in the stress measurements, wherein all the stresses rise exponentially with depth. Using a series of imaging experiments, we confirm that a single toroidal vortex that spans the entire Couette cell exists which causes this interesting stress anomaly.

13:00 – 14:30 – *Lunch*

14:30 Engineering the rheology of clay-water systems

prof. M. Santagata

Clay-water dispersions, which fall within the broad class of materials that is referred to as soft matter, have significance in a number of contexts within civil engineering. The seminar will focus on the rheological behavior of these materials emphasizing how, as a result of the dependence of structure and rheology on geochemical parameters and on polymeric additions, there is the opportunity to control the properties of these complex colloid-water systems to achieve a desired response at the macro-scale.

15:15 Application of pore fluid engineering

prof. M. Santagata

Pore fluid engineering represents a novel approach to ground improvement that relies on the modification of the pore fluid between the grains to achieve the desired response at the macroscale. The seminar will discuss applications of this concept to address problems such as soil liquefaction, tailings management and oil recovery.

16:00 – 16:15 – *Coffee break*

16:15 Bituminous binders reinforced with carbon-nanotubes and nano-clays

prof. O. Baglieri – Dr. L. Tsantilis

Due to their unique mechanical properties and to their large surface area to volume ratio, carbon nanotubes (CNTs) and nanoclays (NCs) are currently considered as very promising modifiers for bituminous binders, capable of greatly improving their performance characteristics in a wide range of temperatures and loading conditions. The seminar will discuss some open issues related to this emerging technology, including dispersion techniques for preparing uniform bitumen- nano-sized additive blends, testing methodologies, practical applications and scale-up perspectives.

17:00 – Final remarks and closure

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