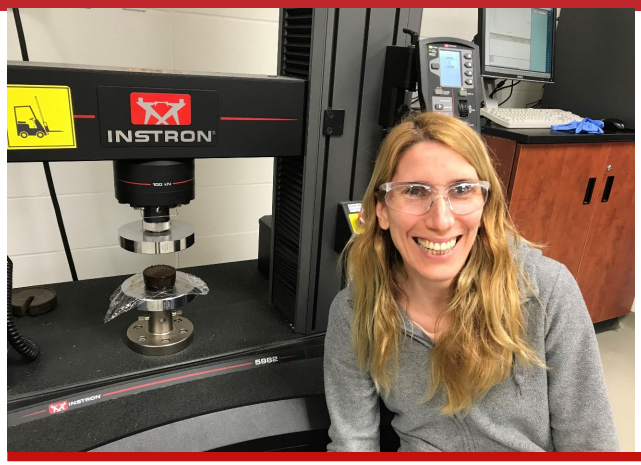

The UNIVERSITY CONSORTIUM

Dr. Erica Pensini

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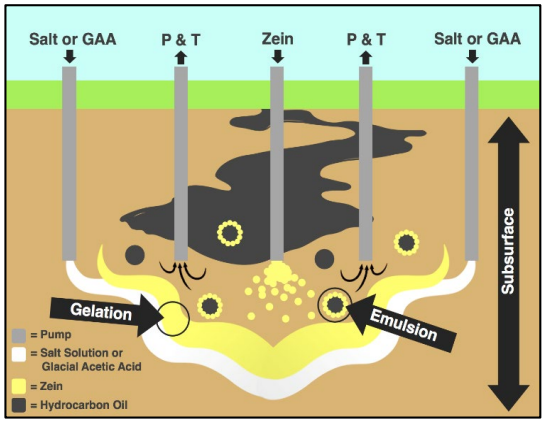
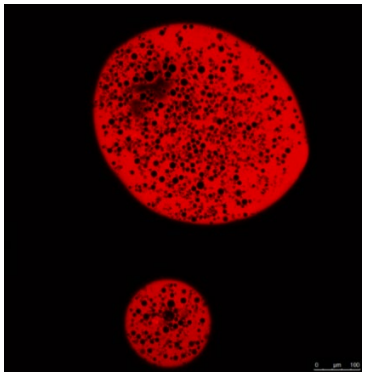
Dr. Pensini received her PhD in Environmental Engineering from the University of Toronto. Her research interests are at the crossroads between the oil & gas, environmental and chemical engineering sectors. They encompass green process engineering, soil remediation, water treatment, colloid, polymer, emulsion and interface science. Dr. Pensini's research projects include:

Reactive Gels for Soil /Groundwater Remediation

The majority of the existing remediation technologies for soil and groundwater contamination do not allow simultaneously treating and immobilizing the contaminants, thus preventing their migration during the treatment. Our goal is to fill this gap by simultaneously immobilizing and treating subsurface contaminants. We are currently working on the development of reactive polymeric gels with tunable viscosity. The low viscosity of the gel in the clean zones facilitates its transport, while their high viscosity around the contaminated areas impedes contaminant migration. Bacteria embedded in the gel favour the biodegradation of the immobilized contaminants, allowing their remediation in situ.



Zein is used to emulsify hydrocarbons and trap them by gelling zein with salt or acetic acid (GAA)



Double emulsions gel on demand in hydrocarbon proximity. Addition of bacteria allows biodegradation of pollutants.

Oil-Water Separation Filters

We are developing inexpensive, non-toxic materials that can be injected in porous media, coating soil grains (e.g. sand, limestone and other minerals) and forming semi-permeable barriers. These semi-permeable barriers allow water flow, while impeding the flow of non-polar solvents. The oil accumulated upstream of the semi-permeable barriers can therefore be pumped from the subsurface, while protecting downstream receptors. Our materials can also be injected on sand beds, and used to treat surface waters and liquid effluents, in which water and oil are emulsified. This research will be expanded to filter solvents that are organic but polar, and to exclude other pollutants (e.g. heavy metals).

Reactors in a Bubble

Natural stabilizers and enzymes are used to stabilize air bubbles in water, in the context of air sparging. Air bubble stabilizers are selected to enhance contaminant sorption from water, while enzymes allow degradation. This concept is being expanded to treat hydrocarbons in water, by creating reactive emulsions. These emulsions would be stabilized by materials that act both as emulsifiers and degrading agents, forming water/oil emulsions with high surface area, where reactions occurr at oil/water interfaces.

Natural adsorbents for the removal of contaminants from water

We are developing bio-based sorbents to remove organic contaminants from water, ranging from textile dyes to hydrocarbons, as well as phosphorus. The sorbents developed to remove hydrocarbons contain enzymes, to allow contaminant degradation following sorption. Materials used to produce sorbents include vegetable proteins or natural emulsifiers, which are used to make sorbent emulsion gels.

Bio-based Plastic Alternatives

We are developing inexpensive, bio-based, spray-on mulching, bale and silage wrap. Our mulching films slowly release fertilizers, hence limiting phosphorus losses, while also reducing water evaporative losses and plastic waste.

Selected Papers

K. Gatzos, A. G. Marangoni, A. J. Gravelle, P. Daggupati and E. Pensini. Spray-On Mulching Films from Zein. Submitted.

T. Marshall, K. Lamont, A. G. Marangoni, L.-T. Lim, X. Wang, E Pensini. Trypan Blue Removal from Water with Zein Sorbents and Laccase. Submitted.

T. Marshall, M. Corradini, K. M. Estepa, A. G. Marangoni, L.-T. Lim, Erica Pensini. Naphthalene Remediation Using Zein: Sorbents and Reactors on an Air Bubble. Submitted.

T. Marshall, A. Gravelle, A. Rodriguez-Uribe, M. Misra, A. Mohanti, A. G. Marangoni, L.-T. Lim, E. Pensini. Zein-Based Materials: Effect of Submicron Size Carbon Inclusion and Potential Applications. Submitted.

T. Marshall, K. M. Estepa, M. Corradini, A.G. Marangoni, B. Sleep, E. Pensini. Selective Injectable Barriers for Non-Aqueous Phase Liquid Separation from Groundwater. Submitted.

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L. Molnar, E. Pensini, Md A. Asad, C. A. Mitchell, L.C. Nitsche, L.J. Pyrak-Nolte, M.M. Krol. Colloid Transport in Porous Media: A Review of Classical Mechanics and Emerging Topics. Transport in Porous Media 2019, pp. 1-28.

M. Del Rosso, C. Collier, H. Brodie, S. Ramalingam, D. Cabral, E. Pensini. Characterization of Graphene Electrodes for Microsystems and Microfluidic Devices. Scientific Reports 2019, 9(1), pp.5773.

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