MIT J-WAFS Food and Water News: upcoming events, funding opportunities, and more.

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J-WAFS Abdul Latif Jameel World Water and Food Security Lab

J-WAFS Food & Water News

August 2016

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J-WAFS News

J-WAFS Solutions Program awards $750K in commercialization grants

The Abdul Latif Jameel World Water and Food Security Lab (J-WAFS) today announced four new grant recipients in its J-WAFS Solution program. J-WAFS Solutions is sponsored by Abdul Latif Jameel Community Initiatives, and provides commercialization grants to help develop products and services that will have a significant impact on water and food security, with related economic and societal benefits.

The program, managed by the MIT Deshpande Center for Technological Innovation, is in its second year. Like direct Deshpande grants, the goal of the funding is to advance a technology to the point where it can attract customer interest and investments to commercialize a product and launch a spinout company, and/or to license the technology to an existing organization. Funds support work to refine and enhance an innovation, systematically explore potential markets, and assess commercial viability, whereby the technology and market risks are sufficiently reduced.

The four new grants go to faculty in the Departments of Chemical Engineering, Chemistry, and Mechanical Engineering. John H. Lienhard V, director of J-WAFS and the Abdul Latif Jameel World Water and Food Security Professor, said that MIT faculty continue to devise innovative technologies that are applicable to a range of challenges in the food and water sectors.

"Commercializing effective technologies with sound business models is one of MIT's most effective mechanisms to have a positive impact on the world," he said. "The J-WAFS Solutions program is helping not only to stimulate creative problem solving, but also to support entrepreneurial faculty and students who are motivated by problems of global importance."

Following on prior J-WAFS seed funding, Alan Hatton, the Ralph Landau Professor of Chemical Engineering Practice, has been awarded a commercialization grant for the development of an affordable and robust purification technology. Seeing a need for separation technologies that can be applied to water purification needs in a range of contexts – from point-of-source treatment to remote in-situ purification devices to large-scale, centralized wastewater treatment facilities – the lab has been developing electrochemically-mediated adsorptive processes for water treatment. J-WAFS Solutions funding will support the development of a demonstration unit and exploration of commercial application opportunities.

A new project lead by Rohit Karnik, associate professor in the Department of Mechanical Engineering, and co-PI Amy Smith, senior lecturer in the Department of Mechanical Engineering and co-director of D-Lab, takes a very different approach to water purification. Addressing the largely unmet need to provide safe and affordable drinking water to very low-income groups, Karnik is developing low-cost water filters that exploit the natural filtration capabilities of xylem tissue in wood. Particularly in regions lacking access to piped water supply systems, microbial contamination is a major threat to health. With J-WAFS Solutions funding, Karnik's lab will work with Amy Smith to validate filtration performance in the lab and in the field, while also assessing the usability, desirability, and affordability of low-cost filters and devising a strategy for local manufacture and commercialization.

Gang Chen, the Carl Richard Soderberg Professor in Power Engineering and head of the Department of Mechanical Engineering, was funded for his proposal on "Floating, Heat Localizing Solar Receivers for Distributed Desalination." The lab's invention is a wavelength-selective, insulating, solar powered still (WISPS) tarp structure that can blanket ocean, lake, and pond surfaces to generate freshwater onsite. The project addresses the challenges associated with scalability, cost, and water safety associated with seawater desalination by capitalizing on a recent innovation by Chen that achieves high evaporation rates and high efficiency by localizing high temperatures to the water surface.

The fourth funded project addresses the need for simple and rapid detection of pathogenic bacteria in food and water samples in order to prevent widespread infection, illness, and even death. Using a carbohydrate array detection scheme based on specific binding interactions of bacteria with carbohydrates, Timothy Swager, the John D. MacArthur Professor of Chemistry, and Alexander M. Klibanov, Novartis Professor, Chemistry and Bioengineering, are developing a system that will be able to simultaneously detect multiple types of pathogenic bacterial strains. The project will focus initially on the occurrence of food poisoning from ground beef – a common problem because of the prevalence of E. coli contamination in beef and dairy cattle and because bacteria that may only be on the surface and readily killed by cooking become dispersed throughout the meat during the grinding process.

A one-year renewal grant was awarded for another project that is pursuing point-of use identification of contaminants in drinking water and food through a different technology. Jointly led by Professor Michael S. Strano of the Department of Chemical Engineering and Professor Anthony Sinskey of the Department of Biology, this interdisciplinary project is leveraging new MIT nanotechnology to develop a single integrated platform that can address all important food and water contaminants – including bacterial pathogens, heavy metals, and allergens – in a low cost, widely deployable nanosensor array.

Renee J. Robins, executive director of J-WAFS, noted that the new projects span various aspects of ensuring a safe supply of water and food.

"Whether the issue is clean water for a rural village in India or enjoying a juicy hamburger cooked on the grill without fear of food poisoning, MIT researchers are developing technologies that will greatly improve people's ability to have clean water and safe food at their ready disposal," she commented.

The four new 2016 J-WAFS Solutions grant recipients and their projects are:

- "Floating, Heat Localizing Solar Receivers for Distributed Desalination"
  - PI: Gang Chen, Carl Richard Soderberg Professor in Power Engineering and head of the Department of Mechanical Engineering
- "Electrochemically-mediated Adsorptive Processes for Water-remediation"
  - PI: Alan Hatton, Ralph Landau Professor of Chemical Engineering Practice
- "Development of Low-Cost Water Filter Using Sapwood Xylem"
  - PI: Rohit Karnik, associate professor of mechanical engineering; Amy Smith, Senior Lecturer, Department of Mechanical Engineering and Co-director, D-Lab
- "Detection of Pathogenic Bacteria Using Dynamically Reconfigurable Liquid Colloid Particles (DRLCPs)"
  - PI: Timothy Swager, the John D. MacArthur Professor of Chemistry, and Alexander M. Klibanov, Novartis Professor, Chemistry and Bioengineering

The renewal project, which will receive a second year of $150,000 in funding, is:

- "A Multiplex, Nanosensor Platform for the Real Time Monitoring of Food and Water-Borne Contaminants"
  - PIs: Michael S. Strano, the Carbon P. Dubbs Professor of Chemical Engineering; Anthony J. Sinskey, Professor of Microbiology and Health Sciences and Technology

MIT students win recognition at water sector conferences

Emily Tow and Quantum Wei, doctoral students in Professor John Lienhard's lab, recently represented MIT at water sector conferences, receiving awards for their academic work. At Singapore International Water Week (SIWW) in July, Tow won a Best Poster Award for her poster of the research paper she co-authored with Lienhard, "Comparison of fouling behavior in forward osmosis and reverse osmosis desalination at brackish and seawater salinity." The Singapore International Water Week is the premier global platform to share and co-create innovative water solutions. The biennial event gathers stakeholders from the global water industry to share best practices, showcase the latest technologies and tap business opportunities.

Wei, the co-vice president of the MIT Water Club for 2016-2017, received the First Place Student Oral Presentation Award for his paper at the Universities Council on Water Resources Conference (UCOWR), held in Pensacola Beach, Florida this past June 21-23. The paper, co-authored with Lienhard and Ronan McGovern, is titled "Energetic Benefits of Staged Reverse Osmosis." UCOWR is an organization of universities, non-academic institutions, and international affiliates leading in water resources education, research, and public service. UCOWR institutional members and delegates are at the forefront of water resources related research and education, and hold an annual national conference.

MIT Innovation Initiative hosts seminar on food safety

For the July installment of its monthly lunch-time speaker series, the MIT Innovation Initiative's Lab for Innovation Science and Policy featured Charley Swofford and John Helferich addressing innovation around food safety challenges. Swofford is a postdoctoral associate in Professor Anthony Sinskey's laboratory. Helferich is a packaged foods industry professional-turned-researcher, studying as a PhD candidate within the MIT Institute for Data, Systems, and Society.

Swofford's presentation, titled *Tools for Combating Economically Motivated Adulteration in China*, focused on the microbiological angle of food safety. Swofford explained the structure of China's mass production system of food and noted how subcontractors, who are poorly regulated, are economically motivated to adulterate their products. This practice could be as harmless as diluting milk but as dangerous as treating food with cheaper but more hazardous chemical preservatives. And since China has become a major food producer for the world's markets, supplying the "value" store brands, for example, negative effects of adulteration will be more global and impactful. "This is not just a concern for China but for all of us," underscored Swofford.

To help improve food safety regulation in China, Swofford and his colleagues at the Sinskey lab are helping to develop two technologies that will make it easier and faster to detect food fraud through deliberate contamination. The first is a multiplex contaminant detection platform (MCDP) being developed with funding from J-WAFS. The MCDP is a portable, inexpensive, carbon nanotube-based sensor for detecting pathogens, antibiotics, and other microbiological contaminants. It reacts to undesired chemicals in a sample of food, producing a change in the fluorescent shift that can be read by a cell phone camera. This technology will accelerate the inspection process from days to minutes, and is more quantitative than the presently available.

The second speaker, Helferich, discussed food safety from a sociological perspective. Drawing upon his decades of experience as a food safety professional, Helferich mentioned how food safety issues can arise from imperfect managerial decision-making. These issues include everything from permitting ill employees to work--risking product contamination--to putting off major production line fixes--increasing the risk of catastrophic failure. To improve this managerial decision-making, Helferich is developing a new model for system safety that integrates irrational behavior concepts into organizational behavior frameworks.

Helferich also noted how a fundamental philosophical difference between managers and safety officials affects their outcomes. "Managers are promoters, motivated by achieving success, while safety officials are preventers, motivated by avoiding failure," said Helferich. Recognizing these differences and building accommodations into managerial decision-making processes, Helferich believes, can prevent food-borne illnesses and deaths.

J-WAFS Highlight

Urban versions of the Everglades could spare cities from water dangers

The Florida Everglades is the second largest wetland on the planet. Its two million acres of swamps, marshes, mangroves, and coastal prairies gradually transfer water out of Lake Okeechobee and 100 miles southwest to the Florida Bay. In the process, the Everglades controls flooding, purifies the water, collects rainfall which supports vegetation, recharges South Florida's main freshwater source (the Biscayne Aquifer), insulates inland areas from tidal waves and tropical storms, and provides habitat to over 700 species of wildlife. These vital ecological functions became evident in the aftermath of increasing flood damage, extended drought, and other environmental degradation following widespread drainage and development of Florida's wetlands into farmland during the late 19th and early 20th centuries. The ecological and societal importance of the Everglades to Florida became so obvious that environmentalists lobbied to have Congress declare it a national park in order to gain governmental protection.

As climate change continues to accelerate water crises arising from more intense and volatile weather, such as floods and droughts, which accelerate water crises, scientists working to protect society from these destructive events are now investigating the use of wetlands in mitigating the problems. MIT professors Heidi Nepf of the Department of Civil and Environmental Engineering and Alan Berger of the Center for Advanced Urbanism (CAU), with funding from J-WAFS, are engaged in a two-year project, titled *Strategies for Urban Stormwater Wetlands*, which explores the use of artificially constructed wetlands as a stormwater solution and urban resiliency infrastructure. As Nepf and Berger explain, cities are increasingly facing threats to their water systems, namely stormwater-related pollution, flooding, and water scarcity. Existing research on constructed wetlands shows great promise in addressing these interrelated threats. (After all, the threats are partly the result of human destruction of wetlands.) However, the interaction of constructed wetlands with stormwater and their integration into urban systems is not well understood. So Nepf, Berger, and their multidisciplinary team of designers, engineers, and urban planners are investigating how mimicking the Everglades in cities using constructed wetlands could spare them from water-related dangers.

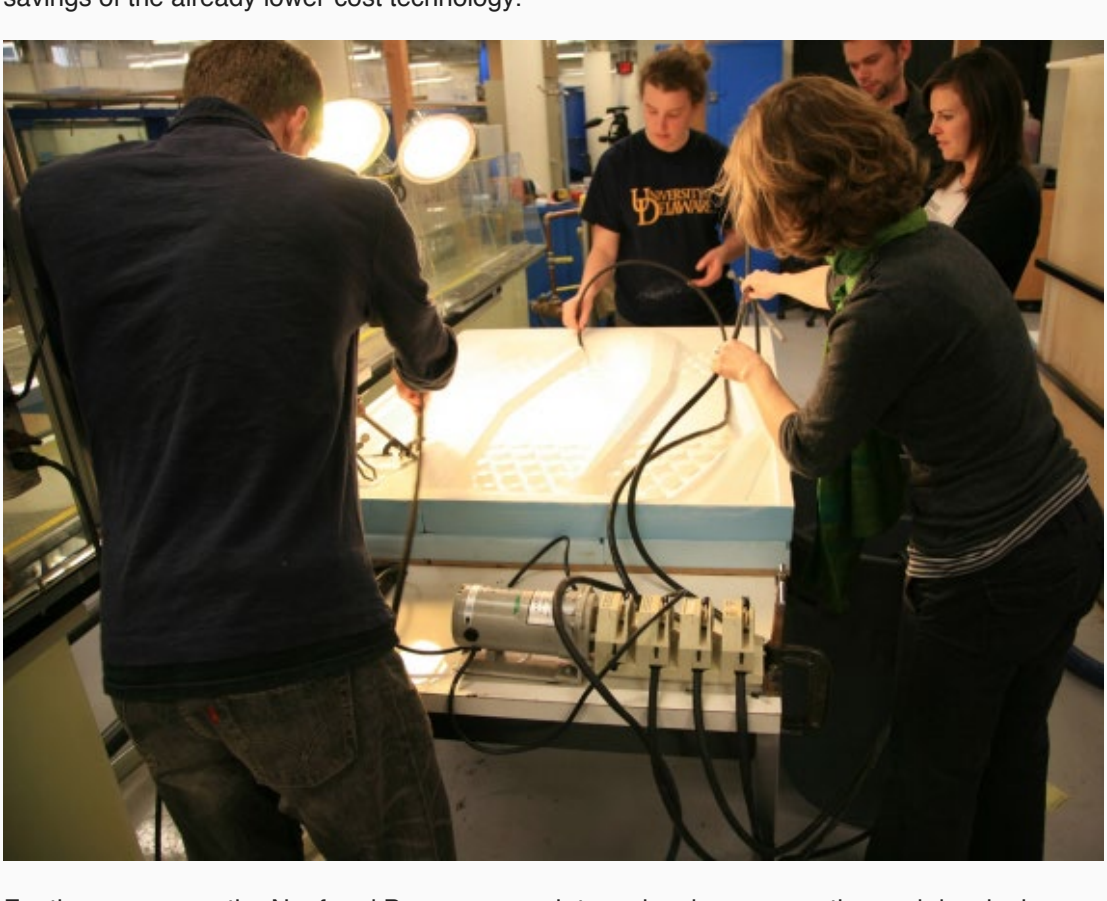
Water-sensitive urban design is land planning that integrates stormwater, groundwater, and wastewater management goals into urban design to minimize the environmental impact and to improve aesthetic or recreational appeal. In this project, the research team is aiming to, as CAU reseach associate Celina Balderas Guzman says, "merge urban functionality with hydrological performance." And they see constructed wetlands as an all-inclusive solution to these goals.

The problem with urban environments is that they are full of impervious surfaces, such as concrete and metals, which prevent water (and other compounds) from seeping into the ground. This creates runoff that must be managed. And historically, water management systems have been designed to rapidly transport runoff away from cities and into the natural watershed.

This conveyance-centric design creates a few problems. Firstly, it means that the infrastructure is not equipped to retain water for use. This is particularly disconcerting as the effects of climate change increasingly make water scarce: 40 states within the next 10 years are expected to experience water shortages. Secondly, it means that when stormwater rapidly washes into streams and lakes it carries with it elevated concentrations of pollutants. This deteriorates environmental quality, and specifically, it pollutes the same surface water bodies that we draw our drinking water from, imposing greater water treatment needs on municipal systems. Lastly, the combination of impervious surfaces and rapid diversion to rivers, lakes, and the ocean prevents the re-charging of groundwater, another important source of drinking water in many communities.

Urban artificial wetlands would not have these problems, though. Emulating the features of their naturally occurring brethren, constructed wetlands are bodies of water placed near urban centers that serve to remove sediment and pollutants through biofiltration. The wetlands' physical, chemical, and biological processes decontaminate the water, allowing it to be retained and re-used. They also prevent environmental degradation and reduce or eliminate the need for separate water treatment facilities. In fact, constructed wetlands enhance the environment because they also serve as wildlife habitat and promote biodiversity. And being naturally integrated bodies of water, constructed wetlands can re-charge groundwater.

The multifunctionality of constructed wetlands is what makes them such a perfect urban water management solution. "Constructed wetlands are the only form that offers both water management infrastructure and water treatment," notes Balderas Guzman. "They can also function as park space and be an energy generator," she adds. By eliminating the need for other facilities to perform water treatment or generate energy, the multi-functionality compounds the savings of the already lower-cost technology.



For these reasons, the Nepf and Berger research team has been promoting and developing guidelines for the design of urban constructed wetlands, which they plan to make publicly accessible to stakeholders such as urban planners and policymakers. In addition, the researchers have optimized performance through numeric and physical modeling of two cities, Los Angeles and Houston, which represent contrasting hydrological environments and illustrate the range of application of the designs.

While the team's research is oriented towards the retrofitting of American cities (largely because there are larger datasets available for them, notes Balderas Guzman), the team envisions widespread adoption in the developing world. China, India, and Africa are experiencing population booms and rapid urbanization, which means that they are in search of low-cost, resilient, eco-friendly urban infrastructure designs. The researchers look forward to seeing constructed wetlands play a role in the development of a world that is more urbanized yet more environmentally friendly and water resilient.

Funding and Other Opportunities

Dupont Summit 2016

The annual call for papers for this year's Dupont Summit on Science, Technology, and Environmental Policy is currently open. The goal of the Dupont Summit is to promote multidisciplinary conversation and networking across the social and political spectrum about pressing issues related to science, technology, and the environment. In order to submit a paper for consideration, please send a 1-2 page abstract to PSO Executive Director Daniel Gutierrez at dgutierrezs@ipsonet.org, or call (202) 349-9282. The early consideration deadline is September 15. Proposals submitted by the early deadline will be given priority.

BIG Pitch Collegiate Innovation Competition

BIG Pitch Collegiate Innovation Competition, presented by Ocean Exchange, will award a $10,000 cash prize to undergraduate and graduate innovations that improve economies, health, and the environment, fitting under the theme of sustainability. Ocean Exchange is an international platform for accelerating sustainable solutions. The deadline for final registration is September 30. For more info and to apply, visit OceanExchange.org.

The Food+City Challenge Prize

The Food+City Challenge Prize is an early-stage startup competition that encourages innovation within the food supply chain. The Prize uncovers solutions that address the challenges of getting safe, nutritious food to more people with less waste in a more efficient way. Finalists compete for $50,000 dollars. The deadline to submit is October 15. For more information, visit FoodandCity.org/Prize.

OpenIDEO: The Food Waste Challenge

OpenIDEO, an open innovation platform that enables people globally to use IDEO's design thinking methodology to develop innovative solutions to global issues, announces the Food Waste Challenge, a global effort to design creative solutions that dramatically reduce food waste. The challenge is run in partnership with the Rockefeller Foundation, the City of San Francisco, the Fink Family Foundation, and ReFED. To learn more about how to contribute and be eligible for their $25,000 prize, visit the Food Challenge's website.

Conservation International Water & Cities Fellowship

Conservation International is accepting applications for a Water & Cities Fellowship--a two-year assignment based in Bogotá, Colombia. The strategic goal of the fellowship is to quantify how much ecosystem conservation and restoration can contribute to water provision and flood prevention in Bogotá, Mexico City, and Rio de Janiero, and to compare the cost of such actions with other hard infrastructure solutions. The methods, data, and results developed by the fellow will be used to build support for ecosystem conservation and restoration in and around the three cities, and will be used as models to be replicated in other cities in Latin America and beyond. For additional information and to apply, click here.

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