Feature

Masdar Institute Ensuring the Safety of Crops Grown with Treated Wastewater in the UAE

Innovative Research at Masdar Institute Investigates the Use of Wastewater for Edible Crop Irrigation, Reducing Need for Desalinated Water

Abu Dhabi-UAE: 31 March, 2015 – Desalination was the first major technological innovation that allowed the UAE to overcome its freshwater resource scarcity to achieve greater quality of life. The next innovative breakthrough that will dynamically improve the UAE's water security will be in the form of wastewater treatment, says a team from the Masdar Institute of Science and Technology.

While desalination has and will continue to provide the majority of the UAE's freshwater for domestic use, it is a costly and energy-intensive process, necessitating the need for alternative water sources. Treating wastewater for limited use – like agriculture and cooling – in place of desalinated water could provide energy and cost savings. Already, Abu Dhabi recycles some of its municipal wastewater, with roughly 60 percent of the treated municipal wastewater being reutilized for landscape irrigation. But due to limited irrigation distribution networks, the remainder is discharged to the Gulf.

The Masdar Institute scientists want to capitalize on unused treated wastewater, known as treated effluent, so it can be utilized to help the country meet its various water needs, sustainably and cost-effectively.

"Agriculture accounts for nearly 60 percent of Abu Dhabi's water consumption. The use of treated effluent for irrigation could free-up Abu Dhabi's limited freshwater for our drinking and washing needs while providing more water for agriculture - enhancing both food and water security. Essentially, it could be a win-win situation," Dr. Farrukh Ahmad, Associate Professor, Water and Environmental Engineering and project lead, explained. He is joined in the project by Dr. Andreas Henschel, Assistant Professor, Computing and Information Science; Dr. Jorge Rodriguez, Assistant Professor, Chemical and Environmental Engineering; and Yamrot Amha, Research Engineer and Masdar Institute Alumna.

Their research is focused on determining the wastewater quality – in terms of microbiological safety – so it can be decided whether it needs additional cleanup before it can be recycled back into our food production chain through edible crop irrigation.

"The treated effluent we are targeting is the wastewater that has undergone a conventional treatment process followed by chlorine disinfection – a process that removes much of the organic and biological contaminants in wastewater. While conventional treatment and chlorine remove most biological contamination, they do not

necessarily render the water safe for potable consumption or for edible crop irrigation," Dr. Ahmad explained.

In order to use treated effluent for crop irrigation, the water must be properly treated such that it does not pose adverse health risks to the crops' consumers, namely us – the people who eat the crops.
"When considering the use of treated wastewater for agricultural use, reliable methods need to be in place for determining the quality of that treated water – so we know what is in it before we use it to grow our food – and the effectiveness of its treatment – so we know whether our treatment method works," Dr. Ahmad added.

Dr. Ahmad's team is developing reliable methods for detecting disease-causing bacteria, or pathogens, in the treated effluent using next-generation DNA sequencing (NGS) technology.
"NGS allows us to extract genetic information from the bacteria, sequence large stretches of its DNA and analyze it in a timely manner. Based on the NGS technology, our team has developed novel protocols to isolate specific regions of the bacteria's genome, enabling us to better identify bacterial pathogens based on the evolutionary changes in their DNA. Our study is one of only two in the world that has applied and developed new protocols for NGS in wastewater treatment and recycling," Dr. Rodriguez explained.

The water was tested for pathogens at three different stages of the treatment plant and after chlorine disinfection. The team discovered that some classes of bacteria, which contain human pathogens, may be resistant to chlorine disinfection.

A risk assessment was administered to determine whether adverse health effects, specifically outbreaks of the bacteria *Salmonella,* can result from consuming food irrigated with this treated effluent. The health-risk evaluation model studied whether three vegetables frequently consumed uncooked – lettuce, cabbage and cucumber – would potentially cause a disease in the person eating it, if treated wastewater was used for their cultivation.

Of the three vegetables considered, lettuce showed the highest risk of infection, suggesting that further investigations and advanced treatment might be required prior to the use of treated effluent for edible crop agriculture.

The use of treated municipal wastewater to irrigate edible crops that this research is looking to promote is an example of the integrated thinking needed in the UAE to enhance food and water security while reducing energy consumption. This research provides an innovative solution to help meet the UAE's growing demand for water and food sustainably, while also reducing the country's energy and carbon emission load.

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About Masdar Institute

The Masdar Institute of Science and Technology (Masdar Institute) was established by the government of Abu Dhabi as a not-for-profit, private graduate university to develop indigenous R&D capacity in Abu Dhabi addressing issues of importance to the region.

In collaboration with the Massachusetts Institute of Technology (MIT), Masdar Institute has developed an academic and research platform that articulates its mission and vision according to critical energy and sustainability challenges.

An important characteristic of Masdar Institute is its focus on complex real-world problems that require a multidisciplinary approach for the development of solutions from an integrated technology, systems and policy perspective. This multi-interdisciplinary and integrated approach is supported by the structure of its academic programs and by the emphasis placed on engaging external partners from industry, government, and other academic institutions in collaborative activities.

Serving as a key pillar of innovation and human capital, Masdar Institute remains fundamental to Masdar's core objectives of developing Abu Dhabi's knowledge economy and finding solutions to humanity's toughest challenges such as climate change.

Masdar Institute integrates theory and practice to incubate a culture of innovation and entrepreneurship, working to develop the critical thinkers and leaders of tomorrow. With its world-class faculty and top-tier students, the Institute is committed to finding solutions to the challenges of clean energy and climate change through education and research.

Masdar Institute offers degrees in:

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- MSc Materials Science and Engineering
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