USC Viterbi
School of Engineering
Sonny Astani Department of Civil and Environmental Engineering

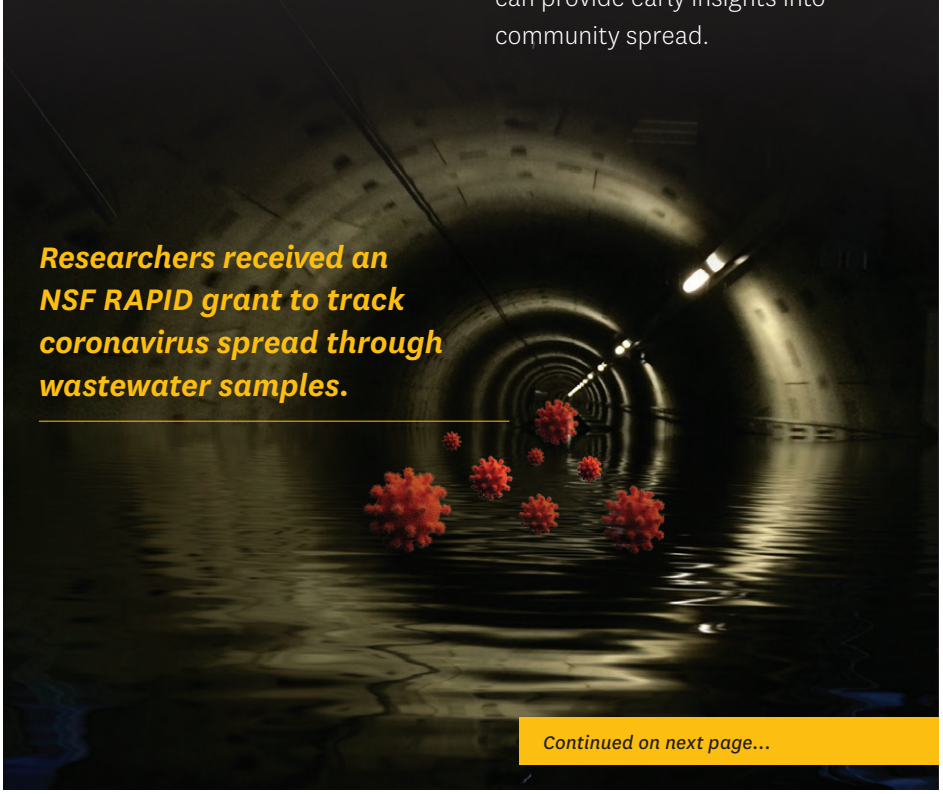
FALL 2020

NEWSLETTER

Wastewater Surveillance Offers Clues About Community COVID-19 Spread

Even as social distancing measures are being eased in certain states and around the globe, COVID-19 continues to spread, and experts expect periods of resurgence as public life resumes.

According to research published in *Nature*, scientists across the world have begun analyzing wastewater for the new coronavirus as a way to estimate infections in the community, given that most people will never be tested. This coronavirus, also known as SARS-CoV-2, can shed into fecal matter, even if infected individuals are asymptomatic. Thus, wastewater can provide early insights into community spread.



Researchers received an NSF RAPID grant to track coronavirus spread through wastewater samples.

Continued on next page...

Big Impacts

Uncovering Precursors of Harmful Water Reuse Byproducts

Potable water reuse is a boon for sustainability, but USC researchers warn of potentially toxic byproducts. Research by **Daniel McCurry**, assistant professor in the Sonny Astani Department of Civil Engineering, and doctoral student **Jiaming Lily Shi** suggests that certain wastewater treatment processes, namely ozonation, could convert chemicals present in the water to chloropicrin.

Continued on page 3...

Spotlight On...

Continued on pages 4 & 5...

Remarkable Research

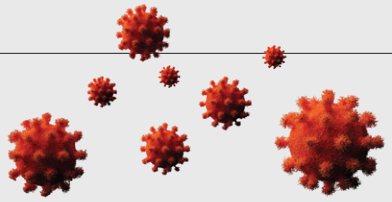
Striving Toward Smart, Sustainable and Resilient Cities

Doctoral candidate **Eyuphan Koc's** work focuses on designing holistic and convergent frameworks investigating the resilience of metropolis-scale transportation systems. Working across traditional research silos, he seeks to bridge data, tools and methods from fields as diverse as transportation systems analysis, natural hazard sciences, urban informatics and disaster economics.

Continued on page 5...

Wastewater Surveillance Offers Clues About Community COVID-19 Spread

Continued from page 1...



Adam Smith, associate professor in the USC Sonny Astani Department of Civil and Environmental Engineering, and his research group are among those looking into wastewater samples. Partnering with researchers at Howard University, North Carolina State University and Rice University, the researchers received $200,000 from the National Science Foundation Rapid Response Research (RAPID) fund to conduct wastewater-based surveillance of SARS-CoV-2 as a community-scale indicator of infection rates. Ultimately, the researchers hope to also collaborate with local public health departments, including the Los Angeles County Department of Public Health, to help prepare local communities for new outbreaks.

The virus, which primarily causes respiratory tract infections, can also infect the gastrointestinal tract. Many people who haven't been tested or who are asymptomatic could still be shedding the virus, so wastewater analysis could provide further information on how the virus is spreading and warn about deviations from the baseline.

"The goal isn't to identify an actual number of infections in the community," Smith says, "but instead to correlate the wastewater data to clinical data and provide complementary intel. As social distancing is relaxed, an increase in viral RNA in wastewater could help serve as an early warning that community spread is increasing once again."

A Collaborative Approach to Pandemic Management

The percentage of infected individuals who shed the virus in feces has been reported in the range of 30 to 60%, Smith says, and detectable amounts of the virus can persist longer in feces than in a respiratory sample, sometimes up to 47 days. This type of viral shedding means the virus will likely be found in municipal wastewater collection systems, an idea that has been confirmed by scientists in the United States, the Netherlands and Sweden.

Smith's research collaborators include Francis de los Reyes, professor of civil, construction and environmental engineering, associate faculty of microbiology, and training faculty of biotechnology at NC State University; Lauren Stadler, assistant professor of civil and environmental engineering at Rice University; Jeseth Delgado Vela, assistant professor of civil and environmental engineering at Howard University; and Nadine Kotlarz, a postdoctoral research scholar at NC State University. The team is examining wastewater samples from treatment plants in Houston, Raleigh, Los Angeles and the Washington, D.C., metro area.

> ***"Lots of different academics and utilities are playing a role. It's great that we're coming together as a community of engineers to play whatever role we can to help in the current pandemic."***
>
> **– Adam Smith**

Big Impacts

Uncovering Precursors of Harmful Water Reuse Byproducts

Potable water reuse is a boon for sustainability, but USC researchers warn of potentially toxic byproducts.

In World War I, German forces used concentrated chloropicrin to cause irritation and illness among opposing soldiers. Later, the harmful chemical compound was used as a pesticide. So, what are the implications if this chemical is found in our wastewater?

Recent research by **Daniel McCurry**, assistant professor in the USC Sonny Astani Department of Civil and Environmental Engineering, and doctoral student **Jiaming Lily Shi** suggests that certain wastewater treatment processes, namely ozonation, could convert chemicals present in the water to chloropicrin.

Their findings, published in *Environmental Science & Technology*, show that wastewater reuse treatment processes that add the chemical compound ozone to disinfect drinking water create nitromethane, a chemical used as a fuel additive in drag racing. Dangerous enough on its own, when nitromethane interacts with the chlorine required to make treated wastewater potable, it can result in the formation of the highly toxic chloropicrin.

No aspects of current water reuse processes are focused on breaking down such a compound, McCurry says. Toxic and unregulated, chloropicrin has been studied as a disinfection byproduct in drinking water since the 1980s, but there has been little progress in identifying its precursors and formation mechanism until now.

Uncovering the Precursors

"We suspected that any chemical having the functional group N-methylamine could serve as an efficient nitromethane precursor during ozonation," McCurry says. Bearers of this functional group include stimulant drugs like ephedrine and methamphetamine, and certain antidepressants, such as Prozac and Zoloft.

While ozone has been proven effective in removing many pharmaceutical compounds and trace contaminants from wastewater, in certain circumstances, it has been shown to increase the toxicity of the treated water. The addition of chlorine (Cl^2) during the final steps of treatment to make wastewater drinkable creates Cl^3CNO^2, known as chloropicrin. Even at low concentrations, chloropicrin has demonstrated harmful effects ranging from eye and skin irritation to asthma and vomiting.

"We can't yet pin the nitromethane on any particular chemical in wastewater, but we can say that wastewater has all of these chemicals in it, and they all form nitromethane/chloropicrin," McCurry says.

McCurry and Shi are currently evaluating whether nitromethane persists in reuse treatment processes. Their work is funded by the Foundation for Cross-Connection Control and Hydraulic Research and the Rose Hills Foundation.

SPOTLIGHT ON...

An Environmental Engineer Focused on Safe and Sustainable Water Management

*A Q&A Session with **Amy Childress**, Director of the Environmental Engineering Program*

Q: You recently returned from a sabbatical. Where did you go and what did you do?

A: I received a Fulbright U.S. Scholar grant to collaborate with Claus Hélix-Nielsen, head of the Department of Environmental Engineering at the Technical University of Denmark. We pursued common interests in novel membrane materials and processes. I collaborated with other researchers on studies involving industrial symbiosis, nature-based solutions and satellite technology at the intersection of national security and the environment.

Q: Are you glad to be back at USC?

A: Yes. I am engaged in joint research projects with Assistant Professors Kelly Sanders, Adam Smith and Dan McCurry. Kelly and I recently completed two Electric Power Research Institute-funded projects – including a system-scale evaluation of integrating potable reuse systems with desalination systems, for which our doctoral student Xin Wei developed a novel framework.

Q: Tell us about your other research.

A: As part of a National Science Foundation project, my doctoral student Allyson McGaughey and I are investigating the wetting mechanisms of polymeric materials under high-salinity conditions. We showed that liquid entry pressure distribution predicts wetting resistance better than minimum LEP values currently used. Working with Professor Malancha Gupta's team, we also found that reduced surface porosity was more effective than increased surface hydrophobicity in preventing scaling-induced wetting and introduced the concept of a permeability/wetting resistance trade-off for membrane distillation membranes.

Q: Tell us about your work on advisory panels.

A: I serve on expert advisory panels for regional and international desalination and wastewater reclamation projects, including Orange County Water District's Groundwater Replenishment System, the Pure Water San Diego potable reuse project, Padre Dam Municipal Water District's Advanced Water Purification Demonstration Project and the East County Regional Potable Water Feasibility Study, as well as Singapore's Public Utilities Board. These experiences help me connect classroom learning with real-world application for my students and inform my research. This includes a current project with Dan and doctoral student Sophia Plata considering the implications of a raw water augmentation approach to direct potable reuse of treated wastewater.

Q: What do you miss most about work and life before COVID-19?

A: I miss in-person teaching, answering students' questions face-to-face, inviting doctoral students into my office to discuss research, sharing meals with my colleagues, department meetings, and traveling to conferences and meetings. I am hopeful that the research being carried out by Adam and others on wastewater surveillance as a detection tool for COVID-19 outbreaks improves community decision-making in terms of timing and speed of returning to normal operations.

Department of CEE Welcomes New Business Manager

The Sonny Astani Department of Civil and Environmental Engineering's new business manager, **Anabel Diaz**, comes from the USC Leonard Davis School of Gerontology, where she began her business management career more than 20 years ago as a student worker. Diaz has a bachelor's degree in business finance from the USC Marshall School of Business and a master's degree in public administration from the USC Sol Price School of Public Policy.

REMARKABLE RESEARCH

Investigating the Resilience of Metropolis-Scale Transportation Systems

Continued from page 1...

Smart, sustainable and resilient cities with functionalities drawn from engineered systems are the goal of **Eyuphan Koc's** work, which focuses on designing holistic and convergent frameworks investigating the resilience of metropolis-scale transportation systems.

A doctoral candidate advised by Lucio Soibelman, Fred Champion Estate Chair Professor in Engineering and chair of the Sonny Astani Department of Civil and Environmental Engineering, Koc focuses on frameworks – achieved through collaborations across traditional research silos – that can bridge data, tools and methods from fields as diverse as transportation systems analysis, natural hazard sciences, urban informatics and disaster economics.

Born and raised in Turkey, Koc received undergraduate degrees in civil engineering and industrial systems engineering from Boğaziçi University in Istanbul before coming to the USC Viterbi School of Engineering. At USC, he has earned a master's degree in systems architecting and engineering and is currently working on another master's degree in spatial data science.

During his doctoral studies, Koc has also worked on developing open data platforms for civil infrastructure systems designed to enable data-driven decision-making through linking and fusing diverse datasets from disparate sources. Pursuing interests in the broader fields of architecture, engineering and construction (AEC), he has spearheaded a new effort investigating "AEC in the 4.0 Era," which delves into topics like the impacts of collaborative project delivery methods on innovation diffusion, emergent modes of software and hardware development, and roles and responsibilities of higher education institutions to educate the AEC workforce of the future.

Koc has published three peer-reviewed journal articles, five peer-reviewed conference articles and a book chapter and has contributed to numerous research proposals. His research has been funded by the National Science Foundation, the California Department of Transportation and the METRANS Transportation Center. Koc has also volunteered within USC Viterbi's Mission Science K–12 outreach program.

SPOTLIGHT ON...

New Master's Program Focuses on Sustainable Built Environments

The new USC Viterbi School of Engineering master's program in Advanced Design and Construction Technology (ADCT) focuses on the built environment and seeks to develop future engineers and designers of sustainable cities and systems.

Guided by experts in disciplines like civil and environmental engineering, computer and data science, and artificial intelligence, students will learn integrative approaches to design, engineering and construction technology and gain expertise in sustainability, data analysis and visualization, computing, modeling, simulation, process engineering and manufacturing. Innovation and entrepreneurship will be emphasized in every aspect of the curriculum.

"We would like our future professionals to be agents of change...people who are technically savvy, design savvy and business-minded, with a real focus on computing and data, including modeling, simulation, AI and user experience technologies such as AR and VR," says Program Director David Gerber, associate professor of practice in the USC Sonny Astani Department of Civil and Environmental Engineering.

Graduates will be expected to demonstrate an understanding of the building process and how people behave within buildings, as well as how artificial intelligence and Internet of Things technologies can be employed to optimize factors like energy usage and ventilation.

"We are living at an inflection point," says Lucio Soibelman, Fred Champion Estate Chair Professor in Engineering and chair of the Astani Department of CEE. "For the first time in history, computers are intelligent enough to be capable of replacing humans in knowledge-based jobs. We want to prepare civil engineers for this new era."

HIGHLY ACCOMPLISHED

Qiming Wang and Daniel McCurry Receive 2020 Faculty CAREER Development Awards

Qiming Wang, Stephen Schrank Early Career Chair and assistant professor of civil and environmental engineering, was recognized with a National Science Foundation Early CAREER Award for his proposal to study the mechanics of a new material that can instantaneously change color when fractured and autonomously self-heal fractures. Wang's project could have a significant impact on the design of future resilient civil infrastructure. Such infrastructure could self-sense damage induced by fatigue, hazards and attacks, and then self-heal to restore structural performance.

Daniel McCurry, assistant professor of civil and environmental engineering, received his NSF CAREER Award to support a five-year project that will facilitate further expansion of wastewater reuse as a means of ensuring water security in drought-prone regions like Southern California. McCurry's project will apply modern tools from organic and analytical chemistry to identify the precursors of potentially toxic disinfection byproducts formed during wastewater reuse so that their formation can be avoided by reengineering reuse treatment processes.

USC CMAA and AGC Student Chapters Adapt to COVID-19

Coordinating interaction between members and industry partners has always been the goal of USC's Construction Management Association of America and Associated General Contractors of America student chapters. In light of the pandemic, the chapters are adapting with virtual information sessions, happy hours and a CMAA-specific career fair. To enhance their digital infrastructure, they have added a members-only portal offering access to recorded "dinner & learns," general meetings and events.

USC ASCE Student Chapter Expands Online Presence

Due to the pandemic, the student chapter of the American Society of Civil Engineers at the University of Southern California was unable to attend the Pacific Southwest Conference in Spring 2020, and all design teams were forced to pause their work. For Fall 2020, ASCE has added more virtual social events and online mentoring and information sessions. Design teams will also be working on modified designs for the next PSWC.

HIGHLY ACCOMPLISHED

Congratulations, 2020 Graduates

The Astani Department of CEE celebrated the accomplishments of 12 doctoral, 110 master's and 35 bachelor's program graduates in 2020! We know our graduates will make an incredible impact in their industries, communities and global society.

Master's Students Receive Awards

The Sonny Astani Department of Civil and Environmental Engineering is proud of our Master's Award recipients, who were selected for notable performance in both academia and practice. Service awardees are recognized for their outstanding service to their department, profession and community, while research awardees are recognized for stellar research, volunteering and campus program involvement.

Master's Service Awards recipients included environmental engineering student **Jiaqi Wang** and civil engineering students **Yunjia Zou** and **Aishwarya Sambisavan Iyer**. Best Dissertation Awards went to environmental engineering student **Yamrot Amha** and civil engineering student **Meida Chen**. In October 2019, outstanding RAs and TAs were also recognized for their commitment and engagement to their field. These awardees included **Ashrant Aryal**, **Amirhosein Mousavi Nasabi Shams**, **Calogero-Benedetto Rizzo** and **Sina Taghvaee**.

12 DOCTORAL PROGRAM GRADUATES

110 MASTER'S PROGRAM GRADUATES

35 BACHELOR'S PROGRAM GRADUATES

USC Viterbi
School of Engineering

3620 S. Vermont Avenue, KAP 210
Los Angeles, California 90089-2531

cee.usc.edu

Nonprofit Org.
U.S. Postage
PAID
University of
Southern California

STAY CONNECTED

Visit our website, **cee.usc.edu**, for in-depth CEE Trojan family highlights.

We're eager to hear about the great things our alumni are doing. Please share your successes with the Trojan community by emailing your updates to **salinapa@usc.edu**.

CHAIR'S MESSAGE

As we navigate through the new school year, I would like to thank our faculty, students and staff for continuing to adapt, work hard and thrive despite the COVID-19 outbreak and other hardships of 2020.

This semester, the pandemic has continued to alter our traditional methods of learning, teaching and research. Online classes and new research precautions, among a slew of other substantial shifts, have brought about unique trials and tribulations. Yet while the COVID-19 outbreak continues to influence our lives, the Sonny Astani Department of Civil and Environmental Engineering has taken these challenges in stride, with every member of this community truly embodying the spirit of resilience.

Although we could not congratulate our graduating students in person, we honored 35 bachelor's, 110 master's and 12 doctoral students at our department's first virtual graduation ceremony. We wish them all well in their career paths ahead. We also proudly recognize recent promotions within our faculty. Drs. Adam Smith, Kelly Sanders and George Ban-Weiss have all received associate professorships with tenure, and all of our exemplary faculty continue to advance their fields in promising ways.

Even while facing these unprecedented times, I am proud that our department continues to rise to new heights, pioneering the engineering of a better and brighter world. I wish health, happiness and success to everyone and their families for the rest of this semester and beyond.

Lucio Soibelman, PhD
Fred Champion Estate Chair Professor in Engineering and Department Chair