



Tanju Karanfil, PhD

Curriculum Vitae

- Vice President for Research, Clemson University
- Professor of Engineering and Environmental Sciences
- Professional Engineer Licensed in South Carolina
- Board Certified Environmental Engineer by the American Academy of Environmental Engineers and Scientists
- Fellow of the International Water Association
- Principal Member, Turkish Academy of Sciences

OVERVIEW

Dr. Karanfil became vice president for research at Clemson University in 2016, leading the university's research enterprise through a period of tremendous growth. He currently maintains an active research portfolio as well, focusing on water quality and improvements to water, wastewater and hazardous waste treatment systems, and serves as a consultant to water and wastewater utilities.

- ▶ [Click to read a short biography](#)
- ▶ [Click to read an administrative biography](#)
- ▶ [More on Dr. Karanfil's research interests & impact](#)

ACHIEVEMENTS

Institutional

\$229M in total R&D expenditures in 2020

34% increase in total R&D expenditures from 2015-2019

Academic

160 peer-reviewed articles; 56 h-index; >9,600 citations

100+ graduate students & postdoctoral researchers mentored

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Division of Research
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Clemson, SC 29634-0901

Research Lab

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Research Laboratory
342 Computer Court
Anderson, SC 29625



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SHORT BIOGRAPHY

Dr. Karanfil is the Vice President for Research and a Professor of Environmental Engineering and Earth Sciences at Clemson University. He is a registered professional engineer in the State of South Carolina, a Board-Certified Environment Engineer by American Academy of Environmental Engineers, and a Fellow of International Water Association.

Professor Karanfil received his bachelor's degree in environmental engineering from Istanbul Technical University in Turkey in 1988. He completed his graduate work (M.Sc., 1991, Ph.D., 1995, Post-doc., 1996) at the University of Michigan in Environmental Engineering under the supervision of Professor Walter J. Weber, Jr., a member of National Academy of Engineering.

Professor Karanfil has been an Environmental Engineering and Earth Sciences faculty as an instructor (1996-1998), Assistant Professor (1998-2002), Associate Professor (2002-2006), and Professor (2006-present). He served as the Department Chair of Environmental Engineering and Earth Sciences (2008-2014) and the Associate Dean for Research and Graduate Studies in the College of Engineering and Science (2014-2016). Since February 2016, he is the Vice President for Research of Clemson University. He also serves as a consultant to water and wastewater utilities and consulting companies.

Dr. Karanfil's research interests are in the fundamentals and applications of physicochemical processes in natural and engineered environmental systems. His primary research is on adsorption and disinfection by-product (DBP) formation processes and technologies. He also studies the impact of wildfires on water quality and has aided the development of novel environmental treatment technologies. His findings have been published in the premier journals

of his field – *Environmental Science and Technology*, *Water Research*, *Carbon*, *Journal of Colloid and Interface Sciences*, and *Journal of American Water Works Association*. He has authored more than 160 peer-reviewed journal publications with an h-index of 56 and over 300 other technical presentations, reports, extended abstracts, and publications. He co-edited and published two books: *“Occurrence, Formation, Health Effects and Control of Disinfection By-Products in Drinking Water”* and *“Recent Advances in Disinfection by-Products.”* His research was supported by the National Science Foundation (NSF), U.S. Environmental Protection Agency, Department of Energy, and Water Research Foundation. His research has received more than \$11M in funding.

Professor Karanfil is recipient of the NSF CAREER award, S.C. Governor's Award for Excellence in Scientific Research and Special Science Award in Engineering from the Turkish Scientific Research Council, and has received several awards (e.g., CES McQueen Quattlebaum Faculty Achievement Award, Board of Trustees Award for Faculty Excellence) at Clemson University. He has mentored more than 120 graduate students, postdoctoral research associates and international visiting scholars. His students' research has been recognized as best Ph.D. thesis, best M.Sc. thesis, best paper, and best graduate student awards by various professional societies (AWWA, WEF, ACS). He is an Associate Editor of *Water Research* and served on the Editorial Advisory Board of the *Journal of the American Water Works Association*.

MORE THAN

160

**PEER-REVIEWED ARTICLES;
56 H-INDEX; ~10,000 CITATIONS**



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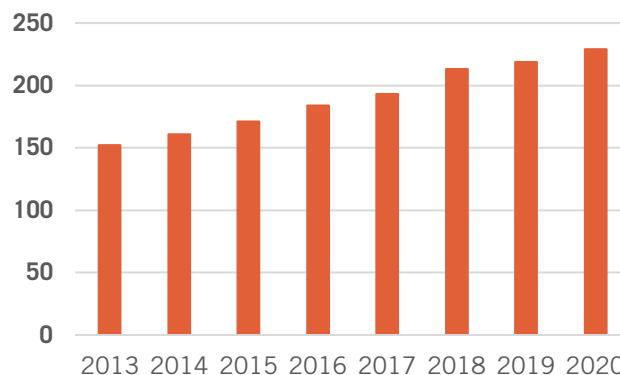
ADMINISTRATIVE BIOGRAPHY

Dr. Karanfil was appointed vice president for research at Clemson University in February 2016 to steer the university's research strategy, working closely with faculty and staff at Clemson and with collaborators in industry and the community.

Clemson joined the list of the nation's top research universities as a Carnegie R1 university in 2016, a reflection of its growth in research expenditures across disciplines and increases to the number of doctorate degrees awarded and postdoctoral and non-faculty researchers on staff. Clemson's performance across all of Carnegie's metrics have improved under Dr. Karanfil's leadership since receiving the R1 designation, and Clemson's R1 classification was confirmed in 2018. Total research and development expenditures are at their highest levels of at least the past eight years at \$229 million in 2020 (see chart below).

As vice president for research, Dr. Karanfil has spearheaded numerous initiatives to nurture research activity and collaboration, foster the professional development of faculty, expand partnership with industry and other external organizations, and secure high-value interdisciplinary research projects. He led a University consortium with Battelle to secure a 10-year management contract (\$3.5B) for Savannah River National Laboratory. He oversees the University's Dominion Energy Innovation Center (a \$100M investment), as well as numerous core facilities that have expanded under his leadership. He led the reorganization and refocus of the University's tech-transfer arm, the Clemson University Research Foundation, to increase opportunities for industry research collaboration. Dr. Karanfil also established programs to celebrate faculty accomplishments, including Researcher of the Year and the University Research, Scholarship and Artistic Achievement Awards, to nurture a positive research culture.

**Total R&D Expenditures
(millions)**



In addition to serving as Vice President for Research, Dr. Karanfil serves and represents Clemson University on several boards and committees (SC Smart-State Endowed Chair, SC EPSCoR, Clemson University Research Foundation, South Carolina Research Authority, South Carolina Universities Research and Education Foundation, Southeastern Universities Research Association, and Oak Ridge Associated Universities).

Before becoming Vice President for Research, Dr. Karanfil served as chair of the environmental engineering and earth sciences department and later as associate dean for research and graduate studies in the College of Engineering, Computing and Applied Sciences. He currently maintains an active research portfolio as well, focusing on water quality and improvements to water, wastewater and hazardous waste treatment systems. Read more about Dr. Karanfil's administrative record in [Section 2](#).



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RESEARCH INTERESTS

Dr. Karanfil's primary teaching and research interests are in the fundamentals and applications of physicochemical processes in water, wastewater and hazardous waste treatment systems. His research group is particularly interested in applying fundamentals of chemistry and engineering to address environmental challenges faced in practical applications, including both engineered and natural systems.

Dr. Karanfil has made significant scientific contributions (detailed below) in the areas of (i.) adsorption processes; (ii.) disinfection by-product formation; (iii.) wildfire impacts in water treatment; and (iv.) environmental treatment technologies:

- i. **Adsorption Processes:** Dr. Karanfil and his students have elucidated and advanced our understanding of the removal mechanisms of synthetic organic contaminants (SOCs) as well as natural organic matter by carbonaceous adsorbents (activated carbons, carbon fibers, carbon nanotubes, graphenes, ion exchange resins, microplastics). Dr. Karanfil has tailored sorbents for selective removal of target compounds from water and wastewaters. He has developed quantitative structure relationships for modeling of SOC adsorption by carbon nanotubes, which opened a new area of research in literature. His publications from the adsorption work have been highly cited, indicating utilization by the scientific community. His work has guided in the selection of sorbents and in designing and operating effective adsorbers and ion-exchange systems for water and wastewater treatment. He has developed and produced carbonaceous adsorbents, including their scale up for commercial production, from agricultural waste products for their valorization and reuse. His recent work has also examined the adsorptive interactions of microplastics in environment. Furthermore, his adsorption research documented the potentially negative environmental impacts of the release of carbon nanotubes in natural systems.
- ii. **Disinfection by-product (DBP) formation:** Dr. Karanfil's research has focused mainly on the formation and control of both regulated and emerging DBPs that are known to form in water but are not yet regulated. His research on trihalomethanes, haloacetic acids, halonitromethanes, haloacetonitriles, iodotrihalomethanes and nitrosamines revealed the factors (e.g., precursors, water chemistry, oxidant types, operational conditions) controlling their formation in drinking water, desalinated waters, wastewater effluents, as well as swimming pools. While studying the emerging DBPs, he has used a holistic approach to include the regulated DBPs and toxicological assessment to develop practical solutions for water utilities. The publications from the DBP research have also been highly cited in the literature, indicating their impact.



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- iii. **Wildfires impact on water quality:** In recent years, Dr. Karanfil and his collaborators have also investigated the impacts of wildfires on water quality and treatability. He investigated the impacts of wildfires around the U.S. Furthermore, he and his research group have studied the impact of fire-control techniques (e.g., prescribed fires, mechanical testing) to control wildfires, which have been systematically investigated for the first time, and showed that some of these techniques can be viable for certain regions to minimize the negative impacts and risks of wildfires.
- iv. **Development of novel environmental treatment technologies:** Dr. Karanfil and his research group have also explored the use of nanobubbles in both natural and engineered systems. Further, he has investigated regeneration activated carbons and biosolids saturated with per- and polyfluoroalkyl substances (PFAS) using microwave and thermal regeneration techniques. He has conducted fundamental mechanistic studies of these processes as well as examined factors controlling their practical applications.

RESEARCH IMPACT

Dr. Karanfil and his student's peer-reviewed publications have been continuously and increasingly cited. As of June 2021, the total of citations to Dr. Karanfil's journal publications is 9,707, according to [Google Scholar's database](#), and his h-index* is 56. In the great majority of these publications, Dr. Karanfil and his students are either the first author or corresponding author. These citation numbers belong to research papers.

MORE THAN
9,700
CITATIONS

**The h-index attempts to measure both the productivity and impact of the published work of a scientist or scholar. A scholar with an index of h has published h papers each of which has been cited in other papers at least h times.*



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1. EDUCATION, REGISTRATION, and EXPERIENCE

EDUCATION

Ph.D., University of Michigan, 1995, Environmental Engineering

M.Sc., University of Michigan, 1991, Environmental Engineering

B.Sc., Istanbul Technical University, TURKEY, 1988, Environmental Engineering

PROFESSIONAL REGISTRATION

Professional Engineer, South Carolina, 2003, No. 23143

American Academy of Environmental Engineers, 2005, No. 04-10040

PROFESSIONAL EXPERIENCE

Clemson University

2016 - current	Vice President for Research, Clemson University
2014 - current	ORAU Councilor of Clemson University
2014 - 2016	Associate Dean for Research and Graduate Studies, College of Engineering and Science
2008 - 2014	Chair, Department of Environmental Engineering and Earth Sciences
2008 - 2014	Director, Clemson Environmental Institute
2006 - current	Professor of Environmental Engineering and Earth Sciences
2002 - 2006	Associate Professor of Environmental Engineering and Science
1998 - 2002	Assistant Professor of Environmental Engineering and Science,
1996 - 1998	Instructor of Environmental Engineering and Science

University of Michigan

1995 - 1996	Postdoctoral Research Fellow in the Department of Civil and Environmental Engineering
1991 - 1995	Graduate Student Research/Teaching Assistant in the Department of Civil and Environmental Engineering



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CONSULTING EXPERIENCE

- Design South Professionals, 2012-2013, technical and analytical assistance with the Stage 2 D/DBPR of Easley and Powdersville water utilities

- Startex, Jackson, Wellford and Duncan Water District, 2010-2011, iron and manganese in SJWD water sources and their removal during water treatment

- The Scientific and Technological Research Council of Turkey & Middle East Technical University, 2009-2013, Hazardous Waste Management in Compliance with European Union Environmental Regulations in Turkey

- Arch Chemicals, 2010-2011, evaluation of oxidants for swimming pools

- Design South Professionals, 2010-2011, technical and analytical assistance with the planning of Pioneer water treatment plant

- BP Barber, 2008, rapid small-scale column tests for assessing the feasibility of GAC adsorption in controlling the formation of DBPs at the Orangeburg DPU WTP and distribution system

- Startex, Jackson, Wellford and Duncan Water District, 2006-2007, monitoring of organic carbon sources in SJWD water sources

- Design South Professionals, 2006-2007, technical and analytical assistance with the implementation chemical phosphorus removal and filtration in Anderson wastewater treatment plant

- Startex, Jackson, Wellford and Duncan Water District, 2005-2006, characterization of organic carbon sources in Lyman Lake

- Startex, Jackson, Wellford and Duncan Water District, 2005, characterization the removal of organic carbon, manganese and iron in SJWD water treatment plant



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CONSULTING EXPERIENCE continued

- Startex, Jackson, Wellford and Duncan Water District, 2004, understanding the reactivity of natural organic matter in the SJWD water sources toward disinfection by-product formation
- Design South Professionals, 2003-2004, technical and analytical assistance for reducing disinfection by-product formation at Greer water treatment plant
- Design South Professionals, 2003, technical and analytical assistance in the phosphorus removal from Anderson wastewater water treatment plant
- Western Carolina Regional Sewer Authority, 2002-2004, technical assistance to provide solution for stringent metal discharge requirements imposed municipal wastewater treatment plants
- Applied Biochemists, 2002, disinfection by-product formation as a result of algacide application in natural waters
- Design South Professionals, 2000-2002, technical and analytical assistance in the planning and design of Easley water treatment plant
- Startex, Jackson, Wellford and Duncan Water District, 1996-2001, technical assistance in the planning and design of drinking water treatment plant
- Western Carolina Regional Sewer Authority, 1996-2002, technical assistance in the solution of disinfection problems observed in municipal wastewater treatment plants
- Erim Insaat, Istanbul, TURKEY, 1989, development of computer programs for hydraulic analysis of irrigation systems
- Arisan, Istanbul, TURKEY, 1988-1989, development of computer programs for mathematical modeling of wastewater and storm water collection systems.



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MEMBERSHIPS

- Member, Association of Environmental Engineering and Science Professors, AEESP, (1996-)
- Member, American Carbon Society, (1997-)
- Member, American Chemical Society, ACS, (1990-2000)
- Member, American Society of Engineering Education, ASEE, (1998-2001)
- Member, American Water Works Association, AWWA, (1990-)
- Member, International Association on Water Quality, IAWQ, (1993-)
- Member, Water Environment Federation, WEF, (1990-)

PROFESSIONAL ACTIVITIES

- Fellow, International Water Association (2015-)

- Associate Editor, Water Research (2020-)

- Editorial Advisory Board, Journal of American Water Works Association (2008-2013)

- Water Research Foundation, formerly called American Water Works Association Research Foundation,
 - Member of Project Advisory Committee (PAC) overseeing Research Foundation Projects, PAC member for project #361, (1998-2000), # TC01-5 (2002-2004), DON (2002-2005), # 4022 (2006-2010), # 4162 (2008-2010), # 4412 (2011-2012), # 4462 (2013-2015)
 - American Water Works Association South Carolina Section
 - Member of Research Committee (1997-2001)
 - Member of Publications Committee (1997-2001)
 - Member of Student Activity Committee (1997-2001)
 - Member, Standard Methods Committee



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PROFESSIONAL ACTIVITIES continued

- Reviewer for papers submitted for publication to:
 - *Advances in Environmental Research*
 - *ASCE Journal of Environmental Engineering*
 - *Carbon*
 - *Chemosphere*
 - *Desalination*
 - *Environmental Science & Technology*
 - *Environmental Engineering Science*
 - *Environmental Toxicology and Chemistry*
 - *Industrial & Engineering Chemistry Research*
 - *Journal of Hazardous Materials*
 - *Journal American Water Works Association*
 - *Separation Science and Technology*
 - *Waste Management*
 - *Water Environment Research*
 - *Water Research*

- Reviewer for research proposals submitted:
 - *American Water Work Association Research Foundation,*
 - *Water Research Foundation*
 - *National Science Foundation*
 - *North Carolina Water Resources Research Institute*

- 2007, American Chemical Society, Symposium Lead and Organizer on “*Occurrence, Formation, Health Effects and Control of Disinfection By-Products in Drinking Water*”

- 2010, Annual World Carbon Conference, American Carbon Society
 - Member of Technical Committee
 - Chair of Three Technical Sessions

- Nano 2010, Fifth International Conference on Environmental Effects of Nanoparticles and Nanomaterials
 - Member of Technical Committee
 - Chair of a Technical Session



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PROFESSIONAL ACTIVITIES continued

- Istanbul International Solid Waste, Water, and Wastewater Congress 2013
 - Member of Scientific Committee

- 2014, American Chemical Society, Symposium Lead and Organizer on “*Occurrence, Formation, Health Effects and Control of Disinfection By-Products in Drinking Water*”

- Tenure and Promotion Files and Program Reviews
 - Arizona State University
 - Georgia Institute of Technology
 - King Abdullah University of Science and Technology
 - Peking University (twice)
 - Qatar University
 - Southern Methodist University
 - The University of British Columbia
 - University of Akron (twice)
 - University of Florida (twice)
 - University of Georgia (twice)
 - University of Illinois Urbana-Champaign
 - University of Memphis
 - University of North Carolina



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2. ADMINISTRATIVE RECORD

2016-present Vice President for Research, Clemson University

As the chief research officer of Clemson University, a Carnegie R1 (highest research activity) doctoral university, Dr. Karanfil oversees a research portfolio of about \$200M in total R&D expenditures per year, which has been on a continuous rise and hit a high mark of \$229 million in 2020. Dr. Karanfil oversees ~\$600M worth of annual proposal submissions from a faculty body of about 1,000. As described in this section, Dr. Karanfil has spearheaded numerous initiatives to enhance the research culture at Clemson, to increase proposal submissions, and to improve competitiveness for research awards. Proposal submissions have increased significantly under his leadership (see chart on following page). Dr. Karanfil has placed particularly strong emphasis on high-value research projects valued above \$2 million. Since 2015, Clemson faculty have earned 58 such awards, valued at a combined \$281 million.

Dr. Karanfil serves in numerous leadership roles:

- Serves as the Clemson representative on the governing board of Savannah River National Laboratory.
 - Dr. Karanfil led the Clemson University and University consortium team that bid for management of Savannah River National Laboratory with Battelle. The team won the contract, which is valued at about \$3.5 billion over the next 10 years.
- Oversees the operation of the [Clemson University Dominion Energy Innovation Center](#), a 100M+ investment.
 - Dr. Karanfil has worked to bring new funding opportunities to the facility, including industry contracts.
- Oversees Clemson University Research Foundation, the innovation and tech transfer arm of the University: <http://curf.clemson.edu/>
 - During Dr. Karanfil's tenure, CURF reorganized its operational structure to further nurture and support industry collaboration.
- Oversees the operation of selected [University Core Facilities](#), including:
 - The Electron Microscopy Facility
 - Clemson Light Imaging Facility (CLIF)
 - Godley-Snell Research Center
 - Aquatics Animal Research Lab
 - These facilities have expanded and added equipment under Dr. Karanfil's leadership.
- Oversees the University's performance in the Carnegie Classification and related data analytics.
 - Clemson's performance in Carnegie metrics have improved under his leadership.



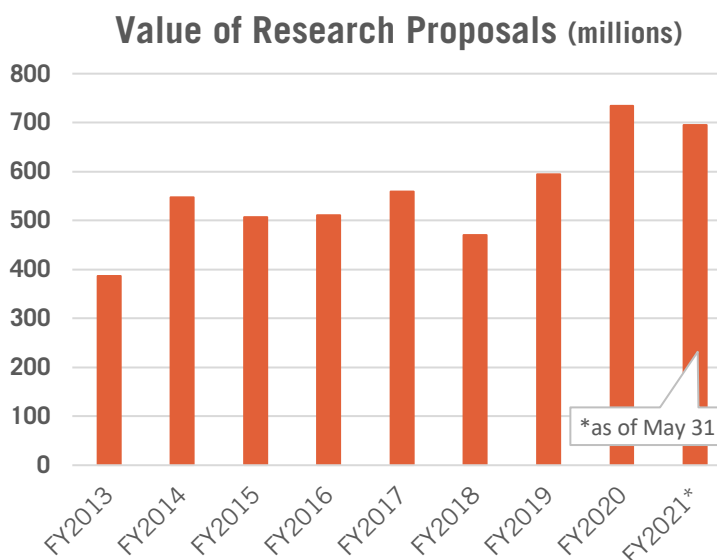
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During his tenure as Vice President for Research, Dr. Karanfil has undertaken numerous duties and responsibilities and reported several accomplishments that have contributed to the university's strategic plan to become a perennial R1 institution:

- Works with the Research and Economic Development Committee of the Clemson University Board of Trustees and presents the University Research Report at quarterly board meetings.
 - <https://blogs.clemson.edu/clemsonresearch/category/quarterly-research-report/>
- Serves on the President's Executive Leadership Team:
 - <https://www.clemson.edu/administration/elt.html>
 - Supported and participated in the Development of the Clemson Strategic Plan, particularly the Research component: ClemsonForward: <https://www.clemson.edu/forward/>. He has been the principal leader for the implementation of the research plan. Clemson exceeded the ClemsonForward goal of \$100M in annual competitive expenditures seven years ahead of the target date.
 - Supports the development of several key University strategic initiatives, especially with research and academic development components, including collaborations with the Offices of Governmental Affairs and VP for External Affairs as well as determination of the University's Federal and State priorities.
 - During the COVID-19 pandemic, Dr. Karanfil worked with university and college leadership to reduce research activity to essential activity, while developing numerous resources to help faculty during modified operations, including guidance documents and a directory of funding opportunities and potential collaborators.
- Serves as the University Representative in several boards and committees (e.g., Smart-State Chair, EPSCoR, SCRA, SCBIO, SCFCA, SCUREF, SURA, ORAU).
 - Dr. Karanfil has presented webinars to APLU Council of Research Officers and Council on Governmental Relations to provide national leadership on the financial impact of COVID-19 on university research.





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- Oversees the university's research enterprise.
 - Dr. Karanfil has put in place various mechanisms and initiatives (examples in bullets below) designed to support an increase in the submission of large (>\$ 2M) collaborative & inter-disciplinary research proposals (e.g., STC, PIRE, ERC, EFRC, MRSEC, NNMI, NNCI, NRT, EPSCoR Track 1 and 2).
 - Clemson's Federal expenditures had been relatively flat at about \$50M for 15 years until 2016. Since then, Clemson has been on a positive trajectory, exceeding \$80M in 2020.
 - Implemented the "R-Initiative" programs to stimulate interdisciplinary and collaborative research: <http://www.clemson.edu/research/r-initiatives/>
 - Through those programs, the Division of Research has invested more than \$6M in projects involving 358 faculty in the past three years.
 - These funds have helped faculty secure \$6M in additional external funding, acquire 14 new pieces of instrumentation, and publish 10 books and 38 journal articles. Additionally, funds have helped 78 students earn PhDs and have assisted in the hiring of 18 postdocs and research faculty.
 - Established the [Researcher of the Year](#) and [University Research, Scholarship and Artistic Achievement Award](#) programs to celebrate faculty excellence and improve research culture.
 - Established the [Career Academy](#) to help junior faculty draft competitive proposals for young investigator awards. Average number of career awards received at Clemson have doubled under Dr. Karanfil's leadership.
 - Implemented a Federal Priorities initiative with Washington DC consultants, McAlister and Quinn, to identify and secure significant research funding, in the areas of military vehicles, human genetics, health extension, advanced lasers, materials and smart autonomous ground systems.
 - Established the annual University Research Symposium to connect faculty for interdisciplinary research collaborations:
 - <http://www.clemson.edu/research/symposium.html>

These efforts have improved the research culture at Clemson and have resulted in significant increases in large proposal submissions and overall research awards at the University.

Since 2015, Clemson faculty have earned 58 competitive awards valued above \$2M (e.g., NSF EPSCoR Track-1 and Track-2, NSF NRT, NSF ADVANCE, DOE EPSCoR, NIH COBREs, NIH R01s, several NSF CAREERS, DoT Transportation Center, etc.).

Additionally, Dr. Karanfil manages an operational budget of \$15-20M and leads the Division of Research, which consists of 10 units and more than 100 staff members. Maintaining an efficient operation and budget balance each year under Dr. Karanfil's leadership has allowed for strategic investments to advance research.

58 Major projects of at least \$2M since 2016

Total value of these projects is

\$281M



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2014-2016 Associate Dean for Research and Graduate Studies, College of Engineering and Science, Clemson University

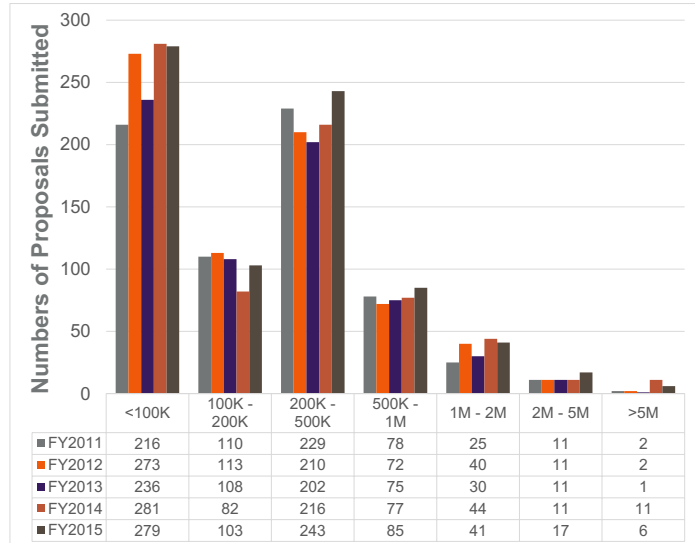
- As the chief research officer of College of Engineering and Science, oversaw a research portfolio of about \$40M expenditures per year, \$300M worth of proposal submissions by about 300 T/TT faculty in the College and the research infrastructure of the College. Also oversee graduate programs in 14 departments of College that consist of about 1,800 graduate students/yr. College graduates over 100 Ph.D. per year.
- Managed the distribution of \$500K internal funding through the TIGER (Transformative Initiative for Generating Extramural Research) grants program, to provide financial support for the establishment or expansion of multi-disciplinary collaborations teams to lead to the development of large competitive proposals.
- Created and added the position of Large Research Proposal Coordinator to offer coordination and communication support to PI's of select large research proposals.
- Led and coordinated implementation of Elsevier's Pure Experts system at Clemson to create first centralized CES Experts Database, a first for the university as well.
- Led and coordinated the development of a centralized, searchable equipment inventory database to support a collaborative research environment.
- Developed new CES ADRGS website, which is the primary resource for graduate studies, post-doc affairs, college research events and news, proposal development and grant management in the college including several templates.
- Started annual CES Research Symposium as a platform for faculty across the college to tell their stories and find others of similar or complementary interests.
- Broadened the CES ADRGS Seminar Series to include many outside speakers with wide appeal, including project and program managers from government agencies, as well as internal speakers with strong knowledge of specific funding agencies to encourage faculty to submit more successful research proposals.
- Established first Post-Doc Support Office in the college which became sustaining member of the National Post-doc Association. This office has successfully supported development of a Clemson Post-Doc Association, developed handbooks and resources, participated in National Post-Doc Appreciation week, held annual summer research seminar series, and sent representatives to the annual NPA conference.



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- Provided administrative support and oversight in many large proposals including cost-share requests and negotiations, space needs and several other related matter.
- The chart at right shows the proposal submissions trends in the College of Engineering and Sciences.
- Provide oversight to the CES Proposal Development/Pre-Awards (6 FTE) and Grant Management/Post-Awards (5 FTE) offices.



- Increase efforts to support department-centric graduate programs at the college level
- Implemented regular meeting of the CES Graduate Faculty and Staff Coordinators
- Added Assistant Director of Graduate Studies & Post-Doc Affairs position
- Oversee College of Engineering and Science Graduate Teaching Assistant Training at beginning of academic years. Have recreated the training to include a website with many resources and information for graduate TA's to reference.
- Oversee the implementation of Dean Scholar Programs
- Developed and published semi-annual CES Research Newsletter, Convergence.
- Lead to the development of Dean Faculty Award Program for faculty retention and recognition.
- Implemented regular meetings of new committees/groups to seek input from departments, ADRGS Advisory Board and Research Infrastructure Committee.

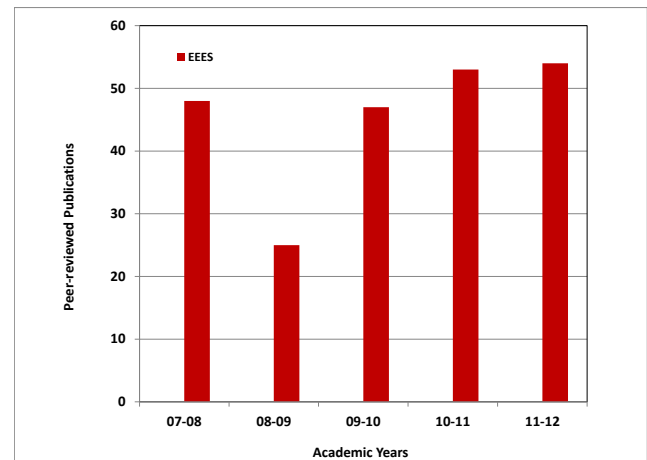
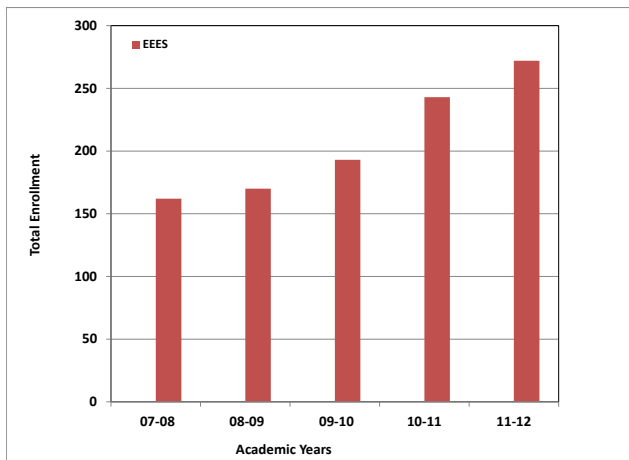
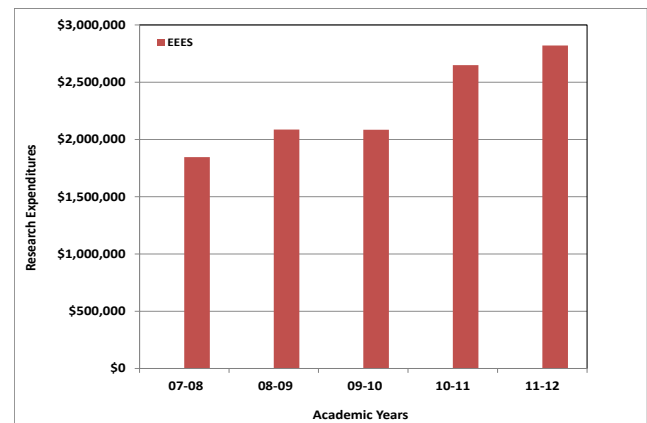
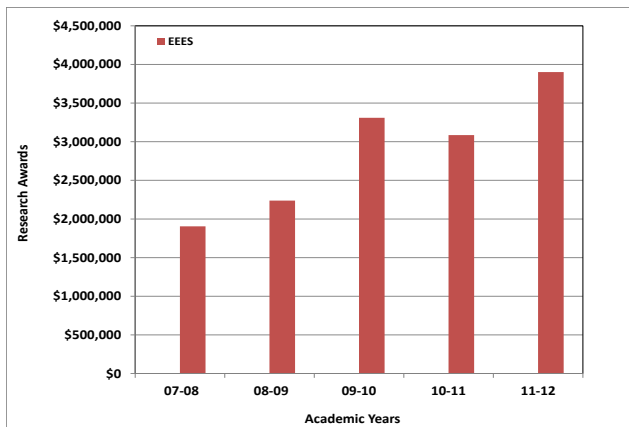


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2008-2014 Chair, Environmental Engineering and Earth Sciences, Clemson University

Department Trends



- Successfully hired several tenure-track faculty members (Anctil, Darnault, Finneran, Ladner, Shuller, and Yi), lecturers (Coulson, Nammouz), a laboratory manager (Cummings), and a staff person (Economy). All the hired personnel were the top choices of the Department in the search processes.
- Generated resources for the departmental share of the start-up packages for the new faculty members during the great recession and period of budget cuts. These resources were generated mainly from: (i) the careful management of departmental budget, (ii) new revenue sources generated through online courses offered during summer, and (iii) a grant (\$400K) obtained from the Nuclear Regulatory Commission.



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- Worked with Dean Gulari and assisted President Barker in attracting \$1M Toshiba Endowed Chair Position from Shaw Corporation as a part of the Will to Lead Capital Campaign. Dr. Tim DeVol was appointed as the first holder of the Endowed Chair.
- Several faculty and students have won important national recognitions: Two junior faculty received CAREER Awards, Clemson University Sigma Xi Young Investigator Award, Kavli Fellow of the National Academy of Sciences, and several graduate students' national fellowships and recognitions (e.g., NSF GRF, EPA STAR, Best Ph.D. thesis, Best paper etc.).
- Led to a successful creation of a new undergraduate degree in environmental engineering, the first degree of its kind in South Carolina. The new degree reached 110 undergraduate students after 4 years. Application to ABET for accreditation was submitted for the degree. Site visit will be scheduled for Fall 2013.
- Successful ABET visits and re-accreditation were completed for the two other degrees in the Department (Biosystems Engineering, BS and Environmental Health Physics, MS). The ABET site visit of our new Environmental Engineering degree was just completed with no concern or short comings. A full accreditation is expected at the summer meeting of ABET.
- Led the departmental preparation to the Strategic Planning Meeting with the 3 mission Vice Presidents of the University.
- Department's new research awards and expenditures have been continuously increasing in the past five years. During 2011-2012, the new research awards reached \$3.9M, while the research expenditures totaled \$2.8M. This corresponds to approximately \$200K/TT faculty and \$125K/TT faculty, respectively. During the same period, Department average peer-reviewed publication productivity was 3.0/faculty.
- Carefully managed and delivered balanced department budgets every year during the challenging economical times.
- Served as the Director of Clemson Environmental Institute (CEI). Prepared and submitted annual performance reports and obtained financial support from the Vice President for Research Office.
- Developed the workload and teaching assignments of all EEES faculty members for three academic year periods to enable more effective and optimum use of faculty time.
- Developed a detailed annual faculty evaluation methodology, which did not exist previously in the department. The new methodology was discussed with the faculty, revised, and currently being used for the annual faculty evaluations.



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- Led the development and approval of a research equipment fee structure that allows EEES faculty to write equipment user fees in the research grant applications. This user fees structure is currently in place.
- Worked with faculty and lecturers to develop online course offerings during summer. Summer course revenues reached \$100 to \$150 K/year.
- Supported and worked together with Scott Brame for the successful organization of the Annual Hydrogeology Symposium (350 attendees and 30+ exhibitors) every year. The Symposium has been using the maximum physical capacity of the Madren Center during the last three years, and it continues to be a popular event. The Symposium is another good revenue resource for the department.
- Three Professional Advisory Boards (PABs) for ABET and one Department Advisory Boards were established. Their annual meetings were successfully held.
- Led the establishment of a new professional student chapter (joint chapter of American Water Works Association and Water Environment Federation) at Clemson.
- Led the development of a new web page for the department. Have supervised the maintenance and updates of the web page.
- Started many activities to establish alumni relationships which have been previously absent in the Department:
 - Started an alumni newsletter, which is currently being mailed two times a year to the alumni.
 - Sent periodic email updates to alumni about the department activities and accomplishments.
 - Started e-newsletter for the Department, currently being published three times in a year and distributed in the Department, College and the University.
 - Started an annual review publication for the Department, which is mailed every year to about 100 Dept. Chairs of Environmental Engineering pro-grams around the country.
 - Met with several alumni at the meetings, conferences and other functions, and work closely with the University development officers.
 - Developed an online donation link on the Department web page.



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- Completed annual faculty reviews, Tenure/Promotion and Post Tenure Reviews, and staff reviews.
- Completed several successful department infrastructure upgrades with the assistance of the Laboratory Manager (Cummings) and the Building Manager (Dunn), and used good planning and creative ways for funding these projects: (i) two graduate student office areas in Brackett Hall were renovated, (ii) a new office space in the L.G. Rich Laboratories was created for the Laboratory Manager, (iii) computers in the L.G. Rich Laboratories were completely renewed, (iv) unused laboratory spaces at the L.G. Rich Laboratories were identified, cleaned and made available to the faculty research. In addition, the old vitrification laboratory used to be a storage space was cleaned and made available for some large-scale research projects, (v) classroom, cantina, entrance area furniture, and conference room were upgraded at Rich Laboratories, (vi) renovation of 4th floor of the Brackett Hall including new classroom, laboratories, student lounges, a computer laboratory for the new Environmental Engineering and Biosystems Engineering majors was completed, (vii) reorganization of the 3rd floor of the Brackett Hall including the main Departmental Office was completed, (viii) several equipment in the Department's analytical laboratory were updated, new equipment were purchased, funds for these needs were generated. Department currently has state-of-art analytical research facilities, which are maintained by a full-time laboratory manager.
- Annual Chair Meetings were held with each group of EEES majors (BE, Env. Eng., Geology) in the Fall to learn about their experiences, needs and wishes.



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3. PUBLICATIONS

Books

Karanfil, T. Mitch, W., Westerhoff, P. and Xie, Y. *Recent Advances in Disinfection By-Products*. American Chemical Society, 459 pages (2015).

Karanfil, T. Krasner, S.W., Westerhoff, P. and Xie, Y. *Occurrence, Formation, Health Effects and Control of Disinfection By-Products in Drinking Water*. American Chemical Society, 365 pages (2008).

Book Chapters (*Peer-Reviewed or **Editorial Review)

1. *Kanan, A., Selbes, M. and Karanfil, T. "Chapter 21: Occurrence and Formation of Disinfection By-Products in Indoor US Swimming Pools" in *Recent Advances in Disinfection By-Products Formation*. Eds. Karanfil, T. Mitch, W., Westerhoff, P. and Xie, Y. American Chemical Society, pp. 405-430 (2015).
2. *Selbes, M., Shan, J., Kaplan Bekaroglu, S.S. and Karanfil, T. "Chapter 12: Carbonaceous and Nitrogenous Disinfection By-Product Formation Potentials of Amino Acids" in *Recent Advances in Disinfection By-Products Formation*. Eds. Karanfil, T. Mitch, W., Westerhoff, P. and Xie, Y. American Chemical Society, pp. 215-234 (2015).
3. *Selbes, M., Glenn, M. and Karanfil, T. "Chapter 9: The Role of Pre-oxidation in Controlling NDMA Formation: A Review" in *Recent Advances in Disinfection By-Products Formation*. Eds. Karanfil, T. Mitch, W., Westerhoff, P. and Xie, Y. American Chemical Society, pp. 135-149 (2015).
4. *Karanfil, T., Krasner, S.W., Westerhoff, P. and Xie, Y. "Chapter 1: Disinfection By-Products: An Overview" in *Occurrence, Formation, Health Effects and Control of Disinfection By-Products in Drinking Water*. Eds. Karanfil, T. Krasner, S.W., Westerhoff, P. and Xie, Y. American Chemical Society, pp. 2-19 (2008).
5. *Karanfil, T., Hong Y. and Song, H. "Chapter 9: HAA Formation and Speciation during Chloramination" in *Occurrence, Formation, Health Effects and Control of Disinfection By-Products in Drinking Water*. Eds. Karanfil, T. Krasner, S.W., Westerhoff, P. and Xie, Y. American Chemical Society, pp. 123-139 (2008).



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Book Chapters (*Peer-Reviewed or **Editorial Review) continued

6. *Tan, Y., Kilduff, J.E. and Karanfil, T. "Chapter 17: Natural Dissolved Organic Matter Removal and Subsequent Disinfection Byproduct Formation: A Comparison of Ion Exchange and Activated Carbon" in *Occurrence, Formation, Health Effects and Control of Disinfection By-Products in Drinking Water*. Eds. Karanfil, T. Krasner, S.W., Westerhoff, P. and Xie, Y. American Chemical Society, pp. 242-256 (2008).
7. **Hong Y., Liu, S., and Karanfil, T. "Chapter 1.2: Chloramination for Disinfection By-Product Control," in *Advances in Control of Disinfection By-Products in Drinking Water Systems*, Nikolau, A., Rizzo, L. and Selcuk H. Eds., Nova Science Publishers, Inc. pp. 29-55 (2007).
8. **Tan, Y., Kilduff, J.E., and Karanfil, T. "Chapter 7.6: Ion Exchange Processes for Natural Organic Matter Removal and Disinfection By-Product Control," in *Advances in Control of Disinfection By-Products in Drinking Water Systems*, Nikolau, A., Rizzo, L. and Selcuk H. Eds., Nova Science Publishers, Inc. pp. 457-475 (2007).
9. *Karanfil, T. "Chapter 7: Activated Carbon Adsorption in Drinking Water Treatment," in *Activated Carbon Surfaces in Environmental Remediation*, Bandosz, T. Eds., Interface Science and Technology, Volume 7, pp. 345-374 (2006).
10. *Kilduff, J.E., Srivatasana, R., and Karanfil, T. "Preloading of GAC by Natural Organic Matter: Effect of Surface Chemistry on TCE Uptake," in: *Characterization of Porous Solids VI, Studies in Surface Science and Catalysis, Vol 44*. Rodriguez-Reinoso, F.; McEnany, B.; Rouquerol, J.; Unger, K., Eds. Elsevier Science BV. pp. 553-560 (2002).
11. **Karanfil, T. and Logan, B. "Gas Transfer: Measurement of Oxygen Mass Transfer Coefficient in Simulated Engineered and Natural Systems," in *Environmental Engineering Processes Laboratory Manual*, Powers, S. Ed., Association of Environmental Engineering and Science Professors, Illinois (2001).
12. *Karanfil, T., Kitis, M., Kilduff, J.E., and Wigton, A. "Chapter 13: The Use of GAC Adsorption for NOM Control and Its Reactivity to DBP Formation," in *Natural Organic Matter and Disinfection By-Products*, Barrett, S., Krasner, S., and Amy, G., Eds., ACS Symposium Series, Washington, DC: American Chemical Society, pp. 190-205 (2000).



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1. Westerhoff, P., Sharma, N., Zeng, C., Karanfil, T., Kim, D., Ghosh, A., Seidel, C., Samson, C., Eaton, A. "Occurrence Survey of Bromide and Iodide in Water Supplies" Water Research Foundation, Denver, Colorado, 145 pages (2021)
2. Russell, C., Cornwell, D., Reckhow, D., Brown, R., Karanfil, T., Ersan, M. and Evans, A. "Unintended Consequences of Implementing Nitrosamine Control Strategies" Water Research Foundation, Denver, Colorado, 203 pages, (2018).
3. Dickenson, E.R.V., Mitch, W.A., Karanfil, T. "Major Sources of Nitrosamine Precursors from Raw Waters and Distribution Systems" Water Research Foundation, Denver, Colorado, 218 pages, (2017).
4. Uzun, H., Kim, D., Beita-Sandi, W., Ersan, M.S., Karanfil, T. and Petry, C. "Seasonal Changes of NDMA FP in Surface Waters and its Removal during Water Treatment" Water Research Foundation, Denver, Colorado, 279 pages, (2016).
5. Amburgey, J.E., Alansari, A.Y., Karanfil, T., Selbes, M., Kim, J., Lee, S., and Park, Y. "Coagulation-Ceramic Membrane Filtration for US Surface Water Treatment," Water Research Foundation, Denver, Colorado, 283 pages, (2014).
6. Karanfil, T., Hu, J., Jones, D.B., Addison, J.A., and Song, H. "Formation of Halonitromethanes and Iodo-Trihalomethanes in Drinking Water," Water Research Foundation, Denver, Colorado, 349 pages, (2011).
7. Karanfil, T., Hong, Y. and Song, H. "Exploring the Pathways of HAA Formation during Chloramination," American Water Works Association Research Foundation, Denver, Colorado, 331 pages, (2007).
8. Karanfil, T., Cheng, W., Guo, Y., Dastgheib, S.A. and Song, H. "DBP Formation Control by Modified Activated Carbons," American Water Works Association Research Foundation, Denver, Colorado, 191 pages, (2007).
9. Westerhoff, P., Karanfil, T. and Crittenden, J. "Aerogel & Iron-Oxide Impregnated Granular Activated Carbon Media for Arsenic Removal," American Water Works Association Research Foundation, Denver, Colorado, 82 pages, (2006).



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Reports (Reviewed and Published in a Book Format) continued

10. Karanfil, T., Erdogan, I. and Schlautman, M.A. "The Role of Filtration in DOC, UV254 and SUVA254 Determinations," American Water Works Association Research Foundation, Denver, Colorado, 370 pages, (2005).

Refereed Journal Publications

1. Soyluoglu, M., Kim, D., Zaker, Y. and Karanfil, T. "Stability of Oxygen Nanobubbles under Freshwater Conditions," *Water Research*, in review (2021).
2. Grote, M., Boudenne, J-L., Croue, J-P., Escher, B., von Gunten, U., Hofer, T., Jenner, H., Jiang, J., Karanfil, T., Khalanski, M., Kim, D., Linders, J., Maas, J., Manasfi, T., Polman, H., Quack, B., Tegtmeir, S., Werschkun, B., Zhang, X. and Ziegler, G., "Inputs of Disinfection By-Products into the Marine Environment – Sources, Quantities and Potential Risks," *Water Research*, in review (2021).
3. Can-Sener, S.E., Thomas, V.M., Hogan, D.E., Maier, M.R., Carbajales-Dale, M., Barton, M.D., Karanfil, T., Crittenden, J.C. and Amy, G., "Recovery Potential of Critical Minerals and Metals from Aqueous Sources," *ACS Sustainable Chemistry & Engineering*, in revision (2021).
4. Chow, A., Chen, H., Olivares, C., Uzun, H., Wang, J-J., Tsui, M., Liu, Y., Burton, S., Robinson, E., Santos, F., Berhe, A.A., Karanfil, T., Trettin, C. and Dahlgren, R. "Wildfire Severity Controls Pyrogenic Dissolved Organic Carbon and Nitrogen Properties," *Nature Geosciences*, in review (2021).
5. Liu, C., Shin, Y-H., Ersan, M.S., Wagner, E., Plewa, M.J., Amy, G. and Karanfil, T., "Algal Organic Matter is Halogenated better by Iodine than Chlorine and Bromine and Formed Iodinated Byproducts Correlate with Toxicity of Disinfected Waters," *Environmental Science and Technology*, in revision (2021).
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7. Ersan, G., Ersan, M.S., Kanan, A. and Karanfil, T., "Predictive Modeling of Haloacetonitrile Formation Under Uniform Formation Conditions," *Water Research*, **201**, 117322 (2021).



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8. Bakkaloglu, S., Ersan, M., Karanfil, T. and Apul, O. "Effect of Superfine Pulverization of Powdered Activated Carbon on Adsorption of Carbamazepine in Natural Source Waters," *Science of the Total Environment*, **793**, 148473 (2021).
9. Gagliano, E., Falciglia, P.P., Karanfil, T., Roccaro, P. "Microwave Regeneration of Granular Activated Carbon Saturated with PFAS," *Water Research*, **198**, 117121 (2021).
10. Olivares, C.I., Uzun, H., Erdem, C.U., Zhang, W., Trettin, C., Liu, Y., Burton, S., Robinson, E., Karanfil, T. and Chow, A. "Increased Organohalogen Diversity After Disinfection of Water from a Prescribed Burned Watershed," *ACS ES&T Water*, **1 (5)**, 1274-1282 (2021).
11. Chen, H., Tsai, K-P., Liu, Y., Tolic, N., Rosalie, K.C., Burton, S., Karanfil, T. and Chow, A. "Characterization of Dissolved Organic Matter from Wildfire-induced *Microcystis aeruginosa* Blooms Controlled by Copper Sulfate as Disinfection Byproduct Precursors using APPI(-) and ESI(-) FT-ICR MS," *Water Research*, **189**, 116640 (2021).
12. Kanan, A., Soyluoglu, M. and Karanfil, T. "Removal of the precursors of regulated DBPs and unknown TOX from surface waters and wastewater effluents using mixed anion exchange resins," *Chemosphere*, **263**, 128094 (2021).
13. Apul, O.G., Perreault, F., Ersan, G. and Karanfil, T. "Predictive Model Development for Adsorption of Organic Compounds by Carbon Nanomaterials: An Overview of the Last Decade from Ground up," *Environmental Science: Water Research & Technology*, **6**, 2949-2957 (2020).
14. Uzun, H., Zhang, W., Olivares, C., Erdem, C.U., Coates, A., Karanfil, T. and Chow, A. "Effect of Prescribed Fires on the Export of Dissolved Organic Matter, Precursors of Disinfection By-Products and Water Treatability," *Water Research*, **187**, 116385 (2020).
15. Zhang, X., Kim, D., Freedman, D.L. and Karanfil, T. "Impact of Biological Wastewater Treatment on the Reactivity of *N*-Nitrosodimethylamine Precursors," *Water Research*, **186**, 116315 (2020).
16. Kanan, A. and Karanfil, T. "Estimation of Haloacetonitriles (HANs) Formation: Uniform Formation Conditions versus Formation Potential," *Science of the Total Environment*, **744**, 140987, (2020).



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17. Huan, C., Uzun, H., Chow, A. and Karanfil, T. "Low Water Treatability Efficiency of Wildfire-induced Dissolved Organic Matter and Disinfection By-product Precursors," *Water Research*, **184**, 116111 (2020).
18. Kim, D. Kanan, A., Sharma, N., Westerhoff, P. and Karanfil, T. "Total organic halogen (TOX) species formation at different locations in drinking water distribution systems," *Environmental Science: Water Research & Technology*, **6**, 2542 - 2552 (2020).
19. Zhang, X., Kim, D., Freedman, D. and Karanfil, T. "Source Characterization and Removal of N-Nitrosamine Precursors During Activated Sludge Treatment," *Environmental Science: Water Research & Technology*, **6**, 2432 - 2443 (2020).
20. Erdem, C.U., Ateia, M., Liu, C. and Karanfil, T. "Activated Carbon and Organic Matter Characteristics Impact the Adsorption of DBP Precursors when Chlorine is Added Prior to GAC Contactors," *Water Research*, **184**, 116146 (2020).
21. Liu, C., Ersan, M.S., Wagner, E., Plewa, M.J., Amy, G. and Karanfil, T. "Toxicity of Chlorinated Algal-impacted Waters: Formation of Disinfection Byproducts vs. Reduction of Cyanotoxins," *Water Research*, **184**, 116145 (2020).
22. Linard, E.N., Lee, C.M., Karanfil, T. and van der Hurk, P. "Competitive Adsorption of PAHs to Carbon Nanotubes and the impact on Bioavailability to Fathead Minnow (*Pimephales promelas*)," *Environmental Toxicology and Chemistry*, **39**, (9) 1702-1711 (2020).
23. Uzun, H., Dahlgren, R.A., Olivares, C., Karanfil, T. and Chow, A. "Two-years of Post-Wildfire Impacts on Dissolved Organic Matter, Nitrogen, and Precursors of Disinfection By-Products in California Stream Waters," *Water Research*, **181**, 115891 (2020).
24. Partlan, E., Ren, Y., Apul, O.G., Ladner, D.A. and Karanfil, T. "Adsorption Kinetics of Synthetic Organic Contaminants onto Superfine Powdered Activated Carbon" *Chemosphere*, **253**, 126628 (2020).
25. Martin, T., Uzun, H., Ruecker, A., Majidzadeh, H., Ulus, Y., Zhang, H., Shaowu, B., Joel, B., Karanfil, T. and Chow, A. "Concentration and Isotopic Composition of Mercury Exported in a Blackwater River as Affected Extreme Flooding Events," *Limnology and Oceanography*, **65** (9), 2158-2169 (2020).
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27. Ateia, M., Zeng, T., Tharayil, N., Pilla, S. and Karanfil, T. "Sorption Behavior of Real Microplastics (MPs): Insights for Organic Micropollutants Adsorption on a Large Set of Well-Characterized MPs," *Science of the Total Environment*, **720**, 137634 (2020).
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38. Ike, I., Karanfil, T., Cho, J. and Hur, J. “Oxidation byproducts from the Degradation of the Dissolved Organic Matter by Advanced Oxidation Processes – A Critical Review,” *Water Research*, **164**, 114929 (2019).
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159. Kaplan Bekaroglu, S.S. and Karanfil, T. "Control of DBPs with GAC Adsorption for Stage 2 D/DBPR," *2009 South Carolina Environmental Conference*, Myrtle Beach, South Carolina, (March 2009).
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162. Kanan, A. and Karanfil, T. "Formation of THM and HAA in Swimming Pools," *2009 South Carolina Environmental Conference*, Myrtle Beach, South Carolina, (March 2009).
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169. Yadav, A., Guo, Y., and Karanfil, T., "How to Select Activated Carbons for Controlling the Impact of Dissolved Natural Organic Matter on the Adsorption of Synthetic Organic Compounds," 233th National Meeting of American Chemical Society in Chicago, Illinois, Division of Environmental Chemistry, Extended Abstracts and Program, Vol. 47, no. 1. (March 2007).
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175. Cheng, W., Guo, Y., Song, H., Dastgheib, S.A. and Karanfil, T. "Removal of Dissolved Organic Matter by Steam-Treated Activated Carbons for Disinfection Byproduct Control in Drinking Water Treatment," 231th National Meeting of American Chemical Society in Atlanta, Georgia, Division of Fuel Chemistry, Extended Abstracts and Program, Vol. 46, no. 1. (March 2006).
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192. Hoskins, J.S., Karanfil, T. and Serkiz, S.M. (invited, award presentation) "Removal and Sequestration of Iodide by Using Silver Impregnated Activated Carbon," 224th National Meeting of American Chemical Society in Boston, Massachusetts, Division of Environmental Chemistry, Extended Abstracts and Program, Vol. 42, no. 2. (August 2002).



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202. Kilduff, J.E., Karanfil, T., Chin, Y.P. and Weber, W.J., Jr. "Adsorption of Humic Substances on Activated Carbon: A High-Performance Size Exclusion Chromatography Study," 209th National Meeting of American Chemical Society in Anaheim, California, Preprints of Papers, 638-641, (April 1995).

PRESENTATIONS (those not listed under publications)

203. Karanfil, T., Uzun, H. and Selbes, M. (invited) "Formation and Control of Emerging Disinfection By-Product: N-Nitrosodimethylamine," King Fahad University, Saudi Arabia, December 29, 2014.
204. Karanfil, T., (invited) "The Workshop on Disinfection By-Product: N-Nitrosodimethylamine," King Fahad University, Saudi Arabia, December 29, 2014.
 - a. Presentation 1: Formation and Health Effects of Disinfection Byproducts
 - b. Presentation 2: Control of Disinfection Byproducts
 - c. Presentation 3: DBP Formation During Seawater Desalination & Implications
 - d. Presentation 4: Disinfection Byproducts Formation in Swimming Pools
205. Karanfil, T. and Selbes, M. (invited) "NDMA, a Chloramination Disinfection By-Product: Its Precursors, Formation and Control," 20th Southeastern Regional Technology Conference, Greenville, South Carolina, January 30-31, 2014.



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207. Karanfil T. (invited) "Adsorption of Organic Contaminants by Carbonaceous Adsorbents: From Macro to Nano," King Abdullah University Science and Technology, Saudi Arabia, May 4, 2013.
208. Karanfil, T. (invited) "Occurrence, Formation and Control of N-Nitrosodimethylamine," King Abdul Aziz University, Saudi Arabia, May 6, 2013.
209. Karanfil, T. (invited) "Disinfection By-Products: Occurrence and Toxicity," SC DHEC 2012 Surface Water Systems Meeting, July 25, 2012.
210. Karanfil, T. (invited) "Disinfection By-Products: Experience in the United States," Tsinghua University Beijing, China, May 30, 2011.
211. Karanfil, T. (invited) "Control of Disinfection By-Product Precursors in Water Treatment," International Symposium: Endocrine Disruptors, Pharmaceutical Compounds and Disinfection By-Products: Which Monitoring and Treatment Solution for Water Utilities, Tsinghua University Beijing, China, May 26-27, 2011.
212. Lewis, D. and Karanfil, T. (invited) "Manganese Control Strategies," Tsinghua University Beijing, China, May 30, 2011, *SC AWWA Partnership for Safe Water Committee Workshop*, Columbia, South Carolina, May 26, 2011.
213. Karanfil, T. (invited) "Formation and Control of Disinfection By-Products: an Overview toward Stage 2 D/DBP Rule," 17th Southeastern Regional Technology Conference, Greenville, South Carolina, January 27-28, 2011.
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PRESENTATIONS (those not listed under publications) continued

215. Jones, D.B., Saglam, A., Triger, A., Song, H. and Karanfil, T. "Iodo-Trihalomethane Formation from Pre-oxidation and Chloramination of Waters Containing Bromide and Iodide," American Water Work Association DBP Webcast, April 7, 2010.
216. Karanfil, T. (invited) "UV₂₅₄ Analysis: Recommended Procedures and Guidelines," 20th Annual South Carolina Environmental Conference, Kingston Plantation, Myrtle Beach, South Carolina, March 13-17, 2010.
217. Karanfil, T., Hu, J., Jones, D. and Song, H. "Formation of Halonitromethanes and Iodo-Trihalomethanes at Treatment Facilities," 2009 Gordon Conference on Drinking Water Disinfection By Products, South Hadley, Massachusetts, August 2009.
218. Karanfil, T. (invited) "Formation and Control of Disinfection By-Products," *SC AWWA Partnership for Safe Water Committee Workshop*, Columbia, South Carolina, May 2009.
219. Karanfil, T. (invited) "Formation and Control of Halonitromethanes in Drinking Water Treatment and Wastewater Effluents," Missouri University of Science and Technology, Department of Civil and Environmental Engineering, Rolla, Missouri, April 2008.
220. Karanfil, T. (invited) "Exploring the Formation and Speciation of Halonitromethanes at the Treatment Facilities," Penn State University, Department of Civil and Environmental Engineering, State College, Pennsylvania, October 2007.
221. Karanfil, T., Hong, Y. and Song, H. "Exploring the Formation of Haloacetic Acids During Chloramination," 2006 Gordon Conference on Drinking Water Disinfection By Products, South Hadley, Massachusetts, August 2006.
222. Karanfil, T. (invited) "Selection of Activated Carbons for Drinking (Tap) Water Treatment," Procter and Gamble, Cincinnati, Ohio, January 2006.
223. Karanfil, T. (invited) "Tailoring Activated Carbons and Carbon Fibers for Drinking Water Treatment," Carbons for a Greener Planet Research Frontiers Workshop, The Pennsylvania State University, State Park, Pennsylvania, May 2005.



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PRESENTATIONS (those not listed under publications) continued

224. Karanfil, T., Dastgheib, S.A. and Mauldin, D. (invited) "Can Activated Carbon Fibers be Used to Minimize Competition between Natural Organic Matter and Small Molecular Weight Organic Chemicals During Water Treatment," WaterCAMPWS Annual Symposium, Atlanta, Georgia, April 2005.
225. Hur, J., Schlautman, M.A., Karanfil, T., Smink, J., Klaine, S.J. and Hayes, J.C., 2005. "Impacts of Urban Activities and Wastewater-Treatment Plant Effluents on the Water Chemistry of the Reedy River under Low Flow Conditions," 15th Annual South Carolina Environmental Conference, Kingston Plantation, Myrtle Beach, South Carolina, March 20-25, 2005.
226. English, R.W., Smink, J.A., Pike, J.W., Goddard, M.A., Klaine, S.J., Post, C.J., Schlautman, M.A., Karanfil, T., Hur, J.M., Powel, B.A., Morse, J.C., Hayes, J.C. "Response of Macroinvertebrates to Land Use Change in a Small Watershed," (invited) presentation at the *Emerging Issues along Urban/Rural Interfaces: Linking Science and Society Conference*, Atlanta, GA, March 13-16, 2005.
227. Schlautman, M.A, Smink, J.A., Pike, J.W., Goddard, M.A., English, R.W., Post, C.J., Klaine, S.J., Karanfil, T., Hur, J.M., Powel, B.A., Morse, J.C., Hayes, J.C. "Impacts of Urbanized and Non-urbanized Land Use On a Downstream Impoundment," (invited) presentation at the *Emerging Issues along Urban/Rural Interfaces: Linking Science and Society Conference*, Atlanta, GA, March 13-16, 2005.
228. Klaine, S.J., Smink, J.A., Pike, J.W., Goddard, M.A., English, W.R., Post, C.J., Schlautman, M.A., Karanfil, T., Hur, J. M., Powell, B.A., Morse, J.C. and Hayes, J.C. "Downstream Impacts of Urbanization in Small Watersheds," (invited) presentation at the *Emerging Issues along Urban/Rural Interfaces: Linking Science and Society Conference*, Atlanta, GA, March 13-16, 2005.
229. Karanfil, T. (invited) "Activated Carbon and Carbon Fiber Adsorption for Water and Wastewater Treatment Operations," the 2005 Borchardt Conference, The University of Michigan, Ann Arbor, Michigan, February 2005.



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PRESENTATIONS (those not listed under publications) continued

230. Hayes, J. C., Klaine, S.J., Smink, J. A., English, W. R., Templeton, S., Post, C., Morse, J., Schlautman, M. A, Karanfil, T. "Changing Land Use and the Environment (CLUE)" CSREES National Water Quality Conference, La Jolla, California, February 2005.
231. Klaine, S.J., Smink, J. A., Pike, J. W., Goddard, M. A., English, W. R., Post, C., Schlautman, M. A, Karanfil, T., Hur, J. M., Powell, B. A., Morse, J. and J. C. Hayes. "The Impact and Control of Erosion in the Upstate" *Dealing with Dirt* Conference sponsored by Upstate Forever and the Saluda-Reedy Watershed Consortium, Palmetto Exposition Center, Greenville, South Carolina, September, 2004
232. Mauldin, D., Dastgheib, S.A. and Karanfil, T. "The Preloading Effect of Natural Organic Matter on the Adsorption of Trichloroethylene by Granular and Fibrous Activated Carbons," 78th ACS Colloid and Surface Science Symposium, Yale University, New Haven, Connecticut, June 2004.
233. Dastgheib, S.A. and Karanfil, T. "Exploring the Dependency of Adsorption Energy and Beta Coefficient of the Dubinin-Radushkevich Equation on the Physicochemical Characteristics of Activated Carbons," 78th ACS Colloid and Surface Science Symposium, Yale University, New Haven, Connecticut, June 2004.
234. Cheng, W., Dastgheib, S.A. and Karanfil, T. "Selective Removal of Natural Organic Matter From Waters by Treated Activated Carbons," 78th ACS Colloid and Surface Science Symposium, Yale University, New Haven, Connecticut, June 2004.
235. Hirsh, S. and Karanfil, T. "Fate of Selected Metals and Analysis of Metal Removal Technologies at a Municipal Wastewater Treatment Plant," *2004 South Carolina Environmental Conference*, Myrtle Beach, South Carolina, 21-24 March 2004.
236. Klaine, S. J., Schlautman, M. A., English, W. R., Hayes, J. C., Karanfil, T., Templeton, S. R., Smink, J. A. and Post, C. J. "A Watershed Approach to Characterize the Influence of Land Use Change on Aquatic Resources." Presented at the 24th North America Annual Meeting of the Society of Environmental Toxicology and Chemistry, Austin, TX, November 2003.



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PRESENTATIONS (those not listed under publications) continued

237. Karanfil, T., Dastgheib, S.A. and Cheng, W. "Tailoring Activated Carbons for Removing Natural Organic Matter from Water Supplies," 2003 AIChE National Meeting, San Francisco, California, 16-21 November 2003.
238. Dastgheib, S.A., Karanfil, T. and Mauldin, D. "Trichloroethylene Adsorption by Modified Fibrous and Granular Activated Carbons: An Integration of Aqueous Phase, Gas Phase, and Water Vapor Adsorption Studies," 2003 AIChE National Meeting, San Francisco, California, 16-21 November 2003.
239. Schlautman, M.A., Karanfil, T., Hepplewhite, C., Erdogan, I. and Smink, J. "Changing Land Use and the Environment: Abiotic Water Quality Measurements," 2003 South Carolina Environmental Symposium, Myrtle Beach, South Carolina, 15-17 October 2003.
240. Karanfil, T. and Kilduff, J.E. (invited) "Activated Carbon Surfaces: Tailoring for Water, Wastewater and Hazardous Waste Treatment," EPA Region 4 Meeting, 10 September 2003.
241. Klaine, S. J., Schlautman, M. A., English, W. R., Hayes, J. C., Karanfil, T., Templeton, S. R., Smink, J. A. and Post, C. J. "A Watershed Approach to Characterize the Influence of Land Use Change on Aquatic Resources," American Geophysical Union Chapman Conference on Ecosystem Interactions with Land Use Change, Santa Fe, NM, June 2003.
242. Freedman, D.L., Payauys, A. and Karanfil, T. "Enhanced Biotreatment of Textile Manufacturing Wastewater," 2002 South Carolina Environmental Symposium, Myrtle Beach, South Carolina, 6-8 November 2002.
243. Karanfil, T. (invited) "Formation and Speciation of THMs and HAAs in the Presence of Chloramine and Chlorine," The 4th *Drinking Water Technology Forum*, The South Carolina and Georgia Sections of the American Water Works Association, Hilton Head Island, South Carolina, 19-20 September 2002.



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PRESENTATIONS (those not listed under publications) continued

244. Karanfil, T., Schlautman, M.A. and Erdogan, I. "Current Practices for Measuring TOC/DOC and UV Absorbance: Implications for SUVA Determinations," *2002 Annual Conference*, American Water Works Association, New Orleans, Louisiana, 22-26 June 2002.
245. Wigton, A., Kilduff, J.E. and Karanfil, T. "Modeling Adsorption Competition Between TCE and NOM Using a Competitive Adsorption Framework," *The Third International Conference on Remediation of Chlorinated and Recalcitrant Compounds*, Monterey, California, 20-23 May 2002.
246. Rombardo, F. and Karanfil, T. "The Formation and Speciation of Disinfection By-Products in the Presence of Chlorine and Chloramine," *2002 South Carolina Environmental Conference*, Myrtle Beach, South Carolina, 17-19 March 2002.
247. Erdogan, I., Karanfil, T. and Schlautman, M.A. "Selection of Filters for Measurements of Dissolved Organic Carbon (DOC) Concentration and Ultraviolet Absorbance (UV) in Natural Water Samples," *2002 South Carolina Environmental Conference*, Myrtle Beach, South Carolina, 17-19 March 2002.
248. Allen, A. and Karanfil, T. "Analysis of ORP-Controlled Disinfection Process at the Pelham Municipal Wastewater Treatment Plant," *2002 South Carolina Environmental Conference*, Myrtle Beach, South Carolina, 17-19 March 2002.
249. Srivastava, R., Kilduff, J.E. and Karanfil, T. "The Influence of Surface Chemistry and Competition from Natural Organic Matter on the Uptake of Hazardous Pollutants by Activated Carbon," *New England Water Environment Federation Annual Meeting*, Boston, Massachusetts, 29-31 January 2002.
250. Hoskins, J., Karanfil, T., and Serkiz, S. "Evaluation of Iodide Sequestration Using Silver Impregnated Activated Carbon," *Migration' 01*, 8th International Conference on Chemistry and Migration Behavior of Actinide and Fission Products in the Geosphere, 16-21 September 2001, Bregenz, Austria.
251. Allen, A. and Karanfil, T. "Analysis of Random Fecal Violations in a Municipal Wastewater Treatment Plant with ORP Control," *2001 South Carolina Environmental Conference*, Myrtle Beach, South Carolina, 14-18 March 2001.



Tanju Karanfil, PhD
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PRESENTATIONS (those not listed under publications) continued

252. Karanfil, T. and Kilduff, J.E. "Brominated DBP Formation and Speciation Based on the Specific UV Absorbance Distribution of Natural Waters," USEPA, National Center for Environmental Research, STAR Drinking Water Progress Review Meeting, Silver Spring, Maryland, 22-23 February, 2001.
253. Karanfil, T., (invited) "Insight to Formation and Speciation of Disinfection By-Products during Drinking Water Treatment Operations," Bosphorus University, Istanbul, TURKEY, 9 October 2000.
254. Karanfil, T., "The Reactivity of Natural Organic Matter for Disinfection By-Product Formation," Quadrangle Conference, Georgia-Tech, 18-20 February 2000.
255. Suber, S.H., and Karanfil, T. "The Development of a Protocol for SUVA Measurements in Fresh Waters," 9th South Carolina Environmental Conference, 14-17 March 1999.
256. Karanfil, T., (invited) "The Importance of GAC Surface Chemistry on the Adsorption of Priority Pollutants and Natural Organic Matter," Eckenfelder/Brown and Caldwell Seminar Series in Environmental Engineering at the Department of Civil Engineering, Vanderbilt University, 2 November 1998.
257. Steinhilber, D., and Karanfil, T. "Disinfection Difficulties in WCRSA Wastewater Treatment Plants," 8th South Carolina Environmental Conference, 18-20 March 1998.
258. Kilduff, J.E., Karanfil, T., and Weber, W. J., Jr. "Effects of Surface Properties on the Adsorption of Disinfection By-Product Precursors by GAC," Disinfection By-Products Symposium in Huston, Texas, 20-21 March 1997.
259. Johnson, M.D., Karanfil, T., Kilduff, J.E., and Weber, W. J., Jr. "Influence of GAC Preloading on Subsequent TCE Sorption," 18th Midwest Environmental Chemistry Workshop, 7-9 October 1995.



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PRESENTATIONS (those not listed under publications) continued

260. Kilduff, J.E., Karanfil, T., and Weber, W.J., Jr. "Blockage of GAC Pores by Dissolved Organic Solutes," 67th Annual Meeting of Water Environment Federation, 17-21 October 1994.

261. Karanfil, T., Schlautman, M.A., and Weber, W. J., Jr. "Oxygen Sensitive Sorption of Background Organic Materials by Granular Activated Carbon," 17th Midwest Environmental Chemistry Workshop, 8-9 October 1994.



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4. HONORS AND AWARDS

- South Carolina Excellence in Scientific Research (ESR) Award, South Carolina Academy of Sciences and Governor of South Carolina (2021)
- Scientific and Technological Research Council of Turkey (TUBITAK), Science Special Award in Engineering (2018) – TUBITAK Bilim Ozel Odulu – Muhendislik
 - One of the highest scientific achievement awards given in Turkey every year
- Akdeniz University, Environmental Problems and Applications Center, Science Award (2018)
- American Water Works Association, Membrane Treatment Best Paper Award (2016)
 - As the corresponding author of paper “Optimization of Coagulation Pretreatment Conditions in a Ceramic Membrane System” co-authors Meric Selbes (advisee, Ph.D. student) and Amir Alansari and James Amburgey from UNC Charlotte
- Fellow – International Water Association (2015-present)
- Gordon Conference – Disinfection By-Products
 - Discussion Leader 2013
 - Presenter 2015
- American Water Works Association, Academic Achievement Award (2015)
 - As the Research Advisor of M. Selbes, the recipient of 2015 Academic Achievement Award for the Best Doctoral Dissertation First Place Award
- American Water Works Association, Best Advanced Treatment of Water Paper Award (2014)
 - As the corresponding author of paper “Source water and microfiltration plant manganese control study” co-authors Daniel Lewis (advisee, M.Sc. student) and David Ladner
- American Water Works Association, Academic Achievement Award (2014)
 - As the Research Advisor of X. Gan, the recipient of 2014 Academic Achievement Award for the Best Master Thesis First Place Award



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- American Water Works Association, Academic Achievement Award (2011)
 - As the Research Advisor of J. Hu, the recipient of 2011 Academic Achievement Award for the Best Doctoral Dissertation First Place Award

- Clemson University, Board of Trustees Award for Faculty Excellence (2011)

- American Water Works Association, Academic Achievement Award (2010)
 - As the Research Advisor of D. Jones, the recipient of 2010 Academic Achievement Award for the Best Master Thesis First Place Award

- American Water Works Association, Academic Achievement Award (2009)
 - As the Research Advisor of J. Addison, the recipient of 2009 Academic Achievement Award for the Best Master Thesis Second Place Award

- American Water Works Association South Carolina Section, Membership Award (2008-2009)

- Clemson University, Board of Trustees Award for Faculty Excellence (2008)

- American Water Works Association, Academic Achievement Award (2007)
 - As the Research Advisor of Y. Hong, the recipient of 2007 Academic Achievement Award for the Best Doctoral Dissertation First Place Award

- Clemson University, Board of Trustees Award for Faculty Excellence (2006)

- Clemson University, College of Engineering and Science, McQueen Quattlebaum Faculty Achievement Award (2005)

- Clemson University, Certificate of Excellence (2004)

- Clemson University, Board of Trustees Award for Faculty Excellence (2003)



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- Clemson University, Board of Trustees Award for Faculty Excellence (2002)
- National Science Foundation, Early CAREER Award (2001)
- North Atlantic Treaty Organization (NATO), Ph.D. Fellowship, (1989-1992)
- Istanbul Technical University, Honor Student of Graduating Class of 1988 in Environmental Engineering Division (1988)

Students' Awards

National Awards

- American Water Works Association, 2015 Academic Achievement Award for the Best Doctoral Dissertation Award (Selbes, M, Ph.D. advisee)
- American Water Works Association, 2014 Academic Achievement Award for the Best Master Thesis First Place Award (Gan, X., M.Sc. advisee)
- American Water Works Association, 2011 Academic Achievement Award for the Best Doctoral Dissertation Award (Hu, Jia, Ph.D. advisee)
- American Chemical Society Division of Environmental Chemistry, 2011 Graduate Student Award in Environmental Chemistry, (Shao, Ting, Ph.D. advisee)
- American Water Works Association, 2010 Academic Achievement Award for the Best Master Thesis First Place Award (Jones, Darryl B., M.Sc. advisee)
- Water Environment Federation, 2009 Best Student Paper Award in the Masters Division (Shao, Ting, M.Sc., advisee)
- American Water Works Association, 2009 Annual Conference and Exposition Meeting, Fresh Ideas Poster Competition, Second Place, (Hu, Jia, Ph.D., advisee)
- American Water Works Association, 2009 Academic Achievement Award for the Best Master Thesis Second Place Award (Addison, Jesse A., M.Sc. advisee)



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Student National Awards continued

- American Water Works Association, 2009 LARS Ph.D. Scholarship Award (Jones, Darryl B., M.Sc. advisee)
- American Water Works Association, 2007 Academic Achievement Award for the Best Doctoral Dissertation Award (Hong, Ying, Ph.D. advisee)
- American Water Works Association, Annual Conference and Exposition (ACE) Poster Presentation, 2003 Best Poster Award, Third Place (Erdogan, Ilke, M.Sc. advisee)
- American Chemical Society Division of Environmental Chemistry, 2002 Graduate Student Research Paper Award (Hoskins, Jay, M.Sc. advisee)
- American Chemical Society Division of Environmental Chemistry, 2000 Graduate Student Award (Kitis, Mehmet, Ph.D. advisee)

South Carolina State Awards

- Water Environment Federation South Carolina Section, 2015 L.G. Rich Fellowship (Uz-un, Habibullah, Ph.D., advisee)
- Water Environment Federation South Carolina Section, 2013 L.G. Rich Fellowship (Apul, Onur, Ph.D., advisee)
- American Water Works Association, 2013 South Carolina Environmental Conference Best Poster Presentation Award (Ersan, Gamze, Ph.D., advisee)
- American Water Works Association, 2012 South Carolina Environmental Conference Best Poster Presentation Award (Uzun, Habibullah, Ph.D., advisee)
- Water Environment Federation South Carolina Section, 2012 A. Ray Abernathy Fellowship (Selbes, Meric, Ph.D., advisee)
- American Water Works Association, 2011 South Carolina Environmental Conference Best Poster Presentation Award (Selbes, Meric, Ph.D., advisee)
- Water Environment Federation South Carolina Section, 2010 L.G. Rich Fellowship (Selbes, Meric, Ph.D., advisee)



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Student South Carolina State Awards continued

- American Water Works Association, 2009 South Carolina Environmental Conference Best Poster Presentation Award (Hu, Jia, Ph.D., advisee)
- Water Environment Federation South Carolina Section, 2009 South Carolina Environmental Conference Best Poster Presentation Award (Shao, Ting, M.Sc., advisee)
- Water Environment Federation South Carolina Section, 2009 A. Ray Abernathy Fellowship (Jones, Darryl B., M.Sc. advisee)
- Water Environment Federation South Carolina Section, 2005 A. Ray Abernathy Fellowship (Erdogan, Ilke, M.Sc. advisee)
- Water Environment Federation South Carolina Section, 2003 A. Ray Abernathy Fellowship (Smith, Jacqueline M. advisee)
- Water Environment Federation South Carolina Section, 2001 A. Ray Abernathy Fellowship (Kitis, Mehmet, Ph.D. advisee)



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5. SPONSORED RESEARCH

The \$ amounts shown below are the total project amounts, and the \$ amounts in the parentheses are Dr. Karanfil's share in each project. [Total: \$11,323,090]

- “Identifying Effective Farming Practices to Reduce Risks of Per- and Polyfluoroalkyl Substances (PFAS) in Food Crop Production,” USDA / National Institute of Food and Agriculture, Co-Principal Investigator, \$499,947 (\$150,000), (2021-2025).
- “Microwave Regeneration of PFAS-Exhausted Granular Activated Carbons,” Principal Investigator, \$284,316 (284,316), (2021-2022).
- “Roles of Microplastics in Reclaimed Water – Altering Persistence and Bioavailability of Antimicrobials in Agricultural Soils,” USDA / National Institute of Food and Agriculture, Co-Principal Investigator, \$499,885 (\$150,000), (2020-2024).
- “Investigation of Nanobubble Technology for the Removal of MIB and Geosmin from Drinking Water,” Principal Investigator, \$200,000 (200,000), (2020-2022).
- “Commercial Scale Production of Activated Carbons from Soy Hulls for the Removal of Heavy Metals and Toxins from Water Sources,” Co-Principal Investigator, \$180,000 (\$42,118), (2020-2021).
- “Occurrence of Per- and Polyfluoroalkyl Substances along with their Potential Discharge Sources in Drinking Water Sources in South Carolina,” SC Water Resources Center, Principal Investigator, \$131,120 (131,120), (2020-2021).
- “GOALI: Developing an Eco-Genomic Framework for Biofilter Operation,” National Science Foundation, Co-Principal Investigator, \$340,216 (\$75,000), (2019-2022).
- “Water Quality Monitoring at the Selected Sites of SJWD Water District “SJWD Water District, Principal Investigator, \$154,686 (\$154,686), (2019-2020).
- Peroxide-producing Microbial Fuel Cells for Space Life Support Systems Applications, NASA EPSCoR, Co-Principal investigator, \$750,000 (\$75,000), (2019-2022).
- “Carbonized Hulls for Water Purification,” United Soybean Board, Co-Principal Investigator, \$159,712 (\$47,913), (2018-2019).



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- “Fuel Reduction Techniques as Effective Forested Watershed Management Practices against Wildfire: Drinking Water Quality Aspects,” United States Environmental Protection Agency, Office of Research and Development, National Center for Environmental Research and Quality Assurance (NCERQA), Science To Achieve Results (STAR) Grant Program, Principal Investigator, \$1,260,408 (\$630,204), (2015-2019).
- “Formation and Toxicity of Disinfection Byproducts in Desalinated Waters,” National Science Foundation, Co-Principal Investigator, \$339,870 (\$113,290), (2015-2019).
- “Major Sources of Nitrosamine Precursors from Raw Waters and Distribution Systems,” Water Research Foundation, Co-Principal Investigator, \$380,800 (\$110,800), (2012-2016).
- “RAPID: Extreme Flooding Mobilized Natural Organic Matter from Forested Wetlands – Implications of Mercury and Carbon Cycling in Coastal Blackwater Rivers,” National Science Foundation, Co-Principal Investigator, \$49,961 (\$10,000), (2016-2017).
- “Coupling Small-particle Adsorbents with Membranes for Trace Contaminant Removal in Water Treatment,” National Science Foundation, Co-Principal Investigator, \$325,284 (\$130,114), (2012-2015).
- “Supplemental Funding: Quantitative Structure-Adsorbability Relationship for the Adsorption of Organic Chemicals by Carbon Nanotubes,” National Science Foundation, Principal Investigator, \$63,402 (\$63,402), (2013-2014).
- “The Seasonal Patterns of NDMA Formation Potentials in Water Sources and Their Removal at Drinking Water Treatment Plants,” Water Research Foundation, Principal Investigator, \$300,000 (\$300,000), (2012-2016).
- “Formation of Halonitromethanes and Nitrosamines during Ozonation in Drinking Water,” National Science Foundation, Principal Investigator, \$323,857 (\$323,857), (2011-2014).
- “Quantitative Structure-Adsorbability Relationship for the Adsorption of Organic Chemicals by Carbon Nanotubes,” National Science Foundation, Principal Investigator, \$318,249 (\$318,249), (2010-2014).
- “Formation of Disinfection By-Products in Swimming Pools,” Arch Chemicals, Principal Investigator, \$36,000 (\$36,000), (2011).
- “Coagulation-Ceramic Membrane Filtration Process for US Surface Water Treatment: The Effects of Coagulation and Membrane Fouling,” Water Research Foundation, Co-Principal Investigator, \$267,254 (\$20,000), (2010-2013).



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- “Control of Iron, Manganese and Disinfection By-Products Prior to Microfilter Membrane System,” SJWD Water District, Principal Investigator, \$30,000 (\$30,000), (2010-2012).
- “Leaching of Inorganic Constituents and Total Organic Carbon from Tires,” South Carolina Department of Transportation through Clemson Asphalt Rubber Technology Services, Co-Principal Investigator, \$50,000 (\$25,000), (2008-2009).
- “Project Continuation Funding: Exploring Formation and Control of Emerging DBPs in Treatment Facilities: Halonitromethanes and Iodo-trihalomethanes,” American Water Works Association Research Foundation, Principal Investigator, \$34,427 (\$34,427), (2009-2010).
- “Exploring the Physical Factors and Chemical Interactions Involved in the Adsorption of Synthetic Organic Compounds by Carbonaceous Adsorbents,” National Science Foundation, Principal Investigator, \$325,000 (\$325,000), (2007-2011).
- “Leaching of Inorganic Constituents and Total Organic Carbon from Tires,” South Carolina Department of Transportation through Clemson Asphalt Rubber Technology Services, Co-Principal Investigator, \$80,000 (\$40,000), (2007-2009).
- “Exploring Formation and Control of Emerging DBPs in Treatment Facilities: Halonitromethanes and Iodo-trihalomethanes,” American Water Works Association Research Foundation, Principal Investigator, \$205,775 (\$205,775), (2007-2009).
- “Arsenic Removal Technologies – Phase I: Aerogel & Iron-Oxide Impregnated Granular Activated Carbon Media,” American Water Works Association Research Foundation, Co-Principal Investigator, \$133,000 (\$20,000), (2004-2006).
- “Development of Novel and Inexpensive Sorbents for Removal of Dissolved Organic Matter from Natural Waters,” National Science Foundation, Principal Investigator, \$355,396 (\$355,396), (2003-2006).
- “Changing Land Use and The Environment,” US Department of Agriculture-NRCS, Co-Investigator, \$1,060,290 (\$106,000), (2005–2007).
- “CAREER: Novel Use of Carbon Fibers for Removal of Priority Pollutants from Aqueous Solutions,” National Science Foundation, Principal Investigator, \$375,000 (\$375,000), (2001-2006).
- “Characterization of Organic Carbon Sources in Lyman Lake,” Startex, Jackson, Wellford and Duncan (SJWD) Water District, Principal Investigator, \$5,000 (\$5,000), (2005).



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- “Evaluation of Different Treatment Strategies and Alternatives to Solve Metal Difficulties in a Designated WCRSA Wastewater Treatment Plant,” Western Carolina Regional Sewer Authority, Principal Investigator, \$40,000 (\$40,000), (2003-2005).
- “Exploring the Mechanisms of Dihalogenated Acetic Acid Formation During Chloramination,” American Water Works Association Research Foundation, Principal Investigator, \$218,425 (\$218,425), (2003-2006).
- “DBP Formation Control by Modified Activated Carbons,” American Water Works Association Research Foundation, Principal Investigator, \$179,553 (\$179,553), (2003-2006).
- “Changing Land Use and The Environment,” US Department of Agriculture-NRCS, Co-Investigator, \$810,000 (\$81,000), (2004–2005)
- “Understanding the reactivity of natural organic matter in the SJWD water sources to-ward disinfection by-product formation,” Startex, Jackson, Wellford and Duncan (SJWD) Water District, Principal Investigator, \$10,000 (\$10,000), (2004).
- “Factors Affecting the Determination of SUVA in Fresh and Treated Waters: Development of a Standard Protocol,” American Water Works Association Research Foundation, Principal Investigator, \$ 143,785 (\$107,038), (2001-2004).
- “Changing Land Use and The Environment,” US Department of Agriculture-NRCS, Co-Investigator, \$680,000 (\$68,000), (2003–2004).
- “Tailoring Activated Carbon Surfaces for Water, Wastewater and Hazardous Waste Treatment and Recovery Operations,” United States Environmental Protection Agency, Office of Research and Development, National Center for Environmental Research and Quality Assurance (NCERQA), Science To Achieve Results (STAR) Grant Program, Principal Investigator, \$223,987 (\$127,220), (2000-2004).
- “Brominated DBP Formation and Speciation Based on the Specific UV Absorbance Distribution of Natural Waters,” United States Environmental Protection Agency, Office of Research and Development, National Center for Environmental Research and Quality Assurance (NCERQA), Science To Achieve Results (STAR) Grant Pro-gram, Co-Principal Investigator, \$391,423 (\$160,000), (2000-2004).
- “AWWA-South Carolina Section Graduate Student Research Assistant Fellowship,” Principal Investigator, \$20,000 (\$20,000), (1999-2002).
- “Enhanced Biotreatment of Textile Manufacturing Wastewater,” Hazardous Waste Management Research Fund, Principal Investigator, \$53,170 (\$38,814), (2000-2001).



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- “Chemical & Microbial Characterization of Water Quality in SJWD Water Sources: 2000-2001,” Startex, Jackson, Wellford & Duncan Water District, Principal Investigator, \$15,000 (\$15,000), (2000-2001).
- “Technical Assistance to Western Carolina Regional Sewer Authority in the Operation of Wastewater Treatment Plants in Greenville,” Western Carolina Regional Sewer Authority, Principal Investigator, \$18,000 (\$18,000), (2000-2001).
- “Transformation Reactions of Nitroaromatic and Nitrogen Heterocyclic Compounds on GAC Surfaces: Enhancement of GAC Adsorption in Natural and Engineered Environmental Systems,” Gulf Cost Hazardous Substance Research Center, Co-Principal Investigator, \$35,867 (\$17,934), (1999-2001).
- “Bench-Scale Testing and Technical Support for the Creation of an In Situ Reactive Wall,” FRx Incorporation, Co-Investigator, \$55,143 (\$6,890), (2000).
- “Chemical & Microbial Characterization of Water Quality in SJWD Water Sources: 1999-2000,” Startex, Jackson, Wellford & Duncan Water District, Principal Investigator, \$35,000 (\$35,000), (1999-2000).
- “AWWA-South Carolina Section Graduate Student Research Assistant Fellowship,” Principal Investigator, \$6,400 (\$6,400), (1998-1999).
- “Process Improvements in Disinfection and Sludge Dewatering at the Western Carolina Regional Sewer Authority Wastewater Treatment Plants in Greenville,” Western Carolina Regional Sewer Authority, Co-Principal Investigator, \$15,000 (\$15,000), (1998-1999).
- “Chemical & Microbial Characterization of Water Quality in SJWD Water Sources: 1998-1999,” Startex, Jackson, Wellford & Duncan Water District, Principal Investigator, \$29,750 (\$29,750), (1998-1999).
- “Water Quality Characterization in Lakes Cooley and Lyman,” Startex, Jackson, Wellford & Duncan Water District, Principal Investigator, \$45,000 (\$45,000), (1997-1998).
- “Process Improvements in Disinfection and Sludge Dewatering at the Western Carolina Regional Sewer Authority Wastewater Treatment Plants in Greenville,” Western Carolina Regional Sewer Authority, Co-Principal Investigator, \$13,000 (\$6,500), (1997-1998).
- “Technical Assistance to Western Carolina Regional Sewer Authority in the Operation of Wastewater Treatment Plants in Greenville,” Western Carolina Regional Sewer Authority, Co-Principal Investigator, \$10,000 (\$5,000), (1996-1997).



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Other Sponsored Activity

- “Junior Nuclear Environmental Engineering and Science Faculty at Clemson University,” Nuclear Regulatory Commission, \$400,000 (\$0), (2010-2013).
- “Graduate Course at Savannah River Site: EE&S 802 Environmental Engineering Principles,” Department of Energy, \$7,600 (\$7,600), (1999).
- “Physical and Chemical Processes in Industrial Water Treatment: Module I: Regulations and Aggregation and Precipitation Processes,” SCUREF/Westinghouse Savannah River Company, \$6,460 (\$6,400), (1999).



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6. GRADUATE STUDENT ADVISING AND POSTDOCTORAL RESEARCH ASSOCIATES

Dr. Karanfil has mentored more than 100 graduate students, post-doctoral research associates, and visiting scholars and exchange students.

Graduate Student Advising

Ph.D. Graduates (n=12)

1. Apul, O. "Predictive Model Development for Adsorption of Organic Contaminants by Carbon Nanotubes" (August 2014).
2. Beita-Sandi, W. "A Mixed Cation and Anion Exchange System for the Simultaneous Removal of N-nitrosodimethylamine and Trihalomethanes Precursors from Water" (August 2017).
3. Chen, W., "Removal of Dissolved Natural Organic Matter and Control of Disinfection By-products by Modified Activated Carbons," (August 2006).
4. Ersan, M.S., "The Formation and Control of Selected Unregulated Disinfection By-Products (DBPs) in Water Treatment," (December 2017).
5. Hong, Y., "Exploring the Pathways of Dihalogenated Acetic Acid (DXAA) Formation during Chloramination," (August 2006).
6. Hu, J. "Formation and Distribution of Halonitromethanes in Drinking Waters," (December 2009).
7. Hur, J., "Effects of Humic Substances (HS) Heterogeneity on Pyrene Binding to Dissolved and Mineral-Bound (HS)," (August 2002) (Co-advisor).
8. Kanan, A. "Occurrence and Formation of Disinfection By-Products in Indoor Swimming Pools" (May 2010).
9. Kitis, M., "Probing Chlorine Reactivity of Dissolved Organic Matter for Disinfection by-product (DBP) Formation: Relations with Specific Ultraviolet Absorbance (SUVA) and Development of the DBP Reactivity Profile," (May 2001).
10. Selbes, M. "The Effects of Amine Structure, Chloramine Species and Oxidation Strategies on the Formation of N-Nitrosodimethylamine," (August 2014).
11. Uzun, H. "N-Nitrosodimethylamine in Drinking Water: Temporal Formation Potential Patterns in Source Waters and Treatability of Precursors," (May 2016).
12. Zhang, X. "Impact of Biological Wastewater Treatment on the Reactivity of N-Nitrosodimethylamine Precursors," (May 2020).



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Master Graduates (n=46)

1. Addison, J., "The Formation and Speciation of Halonitromethanes in Wastewater Treatment Plant Effluents" (May 2008).
2. Allen, A., "Analysis and Optimization of an ORP-Controlled Disinfection Process," (May 2003).
3. Ariturk, E. "Removal of 2-Methylisoborneol (MIB) and Geosmin with Powdered Activated Carbon Produced from Soybean Hulls" (May 2021).
4. Baiden, L., "Analysis of Disinfection Difficulties at a Municipal Wastewater Treatment Plant" (August 2000).
5. Bakkaloglu, S. "Adsorption of Synthetic Organic Chemicals: A Comparison of Superfine Powdered Activated Carbon with Powdered Activated Carbon" (August 2014).
6. Beita-Sandi, W. "Removal of N-Nitrosodimethylamine and Trihalomethanes Pre-cursors with Powdered Activated Carbon" (August 2013).
7. Chen, C. "Removal of Bromide from Surface Waters Using Silver Impregnated Activated Carbon" (May 2015).
8. Cooper, J., "Analysis of Water Energy Use at Water Treatment Plants," (August 2010).
9. Cumbie, E., "Removal and Sequestration of Iodide from DOE Waste Streams using Silver Chloride Impregnated Activated Carbon," (August 2002).
10. Erdogan, I., "Factors Affecting the Dissolved Organic Carbon and Ultraviolet Absorption Measurements with Implications for Specific Ultraviolet Absorption Determination," (December 2003).
11. Ferrell, L. "Energy Management in Water and Wastewater Treatment," (December 2008).
12. Gan, X., "The Control of Carbonaceous and Nitrogenous Disinfection By-Products with Magnetic Ion Exchange Process," (December 2012).
13. Glen, M., "Control of N-Nitrosodimethylamine Formation via Preoxidation during Drinking Water Treatment," (August 2014).
14. Habib, N., "Formation and Speciation of Disinfection By-Products in Treated Wastewater Effluents during Chlorination," (December 2018)
15. Haddock, R., "Ultrafiltration Fractionation of Selected Natural Organic Materials," (May 2001).
16. Hirsh, S., "The Fate and Removal of Selected Metals at the Mauldin Road Wastewater Treatment Plant," (December 2004)
17. Hoskins, J., "Removal of Iodide Using Silver Impregnated Activated Carbon from DOE Waste Streams," (May 2001).
18. Johnston, A. "Developing a Greenhouse Gas Emissions Calculation Tool for Water Utilities," (August 2012).
19. Jones, D. "The Formation and Control of Iodinated Trihalomethanes in Drinking Water Treatment," (August 2009).
20. Keifer, M. C., "Industrial Pollution Prevention Assessment for Amoco Fabric and Fiber Company," (May 1999).
21. King, W. "Fractionation of Natural Organic Matter Using Ultrafiltration," (May 2000).



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22. Kose, S. "The Effects of Physical Factors on the Adsorption of Synthetic Organic Compounds by Activated Carbons and Activated Carbon Fibers," (August 2010).
23. Lauer, J., "The Use of Oxidants for NDMA Precursor Deactivation in Wastewater Treatment," (August 2014).
24. Lewis, D. "Evaluation of Manganese Control in the Source Water and Microfiltration Plant of a South Carolina Water Utility," (May 2011).
25. Longshore, M. "Sustainability through Energy Reduction Initiatives for Water Treatment Utilities: Preliminary Data Collection, Analysis and Energy Reduction Recommendations," (December 2010).
26. Orr, O. "The Characterization, Isolation and Fractionation of Natural Water from Three Surface Waters," (August 2009).
27. Ozburn, S. C., "Does a Wastewater Treatment Plant Discharge Affect the Performance of a Water Treatment Plant at the Downstream," (December 1998).
28. Partiban, R. "The Effect of Temperature on Emerging Disinfection By-Product Formation and Stability," (May 2015).
29. Reid, L., "Storm Water Export of Nitrogen, Phosphorus and Carbon from Developing Catchments in the Upper Piedmont Physiographic Province" (May 2008).
30. Rombardo, F., "The Formation and Speciation of Disinfection By-Products in the Presence of Chlorine and Chloramines," (August 2002).
31. Sawyer, D. A, "Optimization of a Textile Wastewater Treatment Plant: Pilot- and Full-Scale Experiences," (May 1999).
32. Selbes, M. "Leaching of Dissolved Organic and Selected Inorganic Constituents from Scrap Tires." (August 2009).
33. Shaikh, Z., "Adsorption of Selected Aromatic Compounds from Aqueous Solutions by Virgin and Modified Activated Carbon Fibers: An Investigation of Adsorption Mechanisms and the Role of Carbon Surface Chemistry and Pore Size Distribution," (August 2005).
34. Shao, T. "Factors Influencing the Adsorption of Synthetic Organic Compounds by Carbon Nanotubes in Aquatic Environments," (August 2010).
35. Smith, J., "The UV Oxidation of Natural Organic Matter and a Technique to Measure the Organic Nitrogen Concentration in Natural Waters," (December 2003).
36. Snyder, S.E., "Application of Material Balance Concept in Waste Minimization Assessment of a Latex Based Coating Production Process," (May 1999).
37. Soto, V. "Temperature Effects on DBP Formation," (August 2012).
38. Soyluoglu, M. "Removal of Bromide from Natural Waters: Bromide-Selective vs. Conventional Ion Exchange Resins," (December 2019).
39. Steinhilber, D. J., "Solution for Disinfection Difficulties in Western Carolina Regional Sewer Authority Wastewater Treatment Plants," (May 2001).
40. Sutton, K.M., "The Role of GAC Surface Chemistry on the Competitive Adsorption and Preloading Effects between Natural Organic Matter and Priority Pollutants," (May 1999).
41. Suber, H., "Factors Affecting the Determination of SUVA in Natural Waters," (December 1999).



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Master Graduates continued

42. Thierbach, R., "Removal of Natural Organic Matter from Water Using Geothite and Hydrogen Peroxide," (December 1999).
43. Yadav, A., "Approaches to Mitigate the Impact of Dissolved Organic Matter on the Adsorption of Synthetic Organic Contaminants by Activated Carbon" (August 2007).
44. Yu, M. "The Effects of Temperature on THM and HAA Formation" (December 2012).
45. Zang, B. "Removal of TiO₂ by Conventional Water Treatment Processes" (August 2013).
46. Zhou, Y. "Adsorption of Halogenated Aliphatic Contaminants by Graphenes" (August 2014).

Current Graduate Advising (n=4)

1. Erdem, U (Ph.D.)
2. Soyluoglu, M. (Ph.D.)
3. Yildirim, H. (Ph.D.)

Postdoctoral Research Associates (n=26)

1. Abdallah, A.M. "Nanobubble and Microwave Projects" (2020)
2. Ates, N. "Formation of Nitrosamines in Drinking Waters," (2011-2012).
3. Ateia, M. "PFAS and Microplastics" (2017-2019).
4. Chen, H. "Wildfires, PFAS and Microplastics" (2019-present).
5. Dastgheib, S. "Novel Uses of Activated Carbon Fibers for Removal of Organic Pollutants from Aqueous Solutions and Preparation Surface Modified Activated Carbons and Carbon Fibers," (2001-2004).
6. Ersan, G. "Modeling of DBP Formation" (2017-2018)
7. Ersan, M.S. "Wildfire and Desalination Projects" (2017- 2018)
8. Genceli, E. "Investigation of Activated Carbon and Carbon Fiber Sorption Kinetics" (2004).
9. Ghafari, M. "Nanobubble and Microwave Projects" (2019-2020)
10. Guo, Y. "Modification of Activated Carbon Surfaces for Removal of Dissolved Organic Matter, Synthetic Organic Chemicals and Arsenic from Water and Wastewater" (2004-2007).
11. Hepplewhite, C. "NOM Isolation and Characterization, and Measurement of Dissolved Organic Nitrogen in Natural Waters," (2001-2003).
12. Hur, J. "A Watershed Approach to Characterize the Influence of Land Use Change on Aquatic Resources," (2004-2005)
13. Kaplan, S. "Control of C-DBPs and N-DBPs" (2010-2011).
14. Kanan, A. "DBP Formation and Control" (2019-2020)
15. Kim, D. "C-DBP and N-DBPs: Formation and Control" (2011-present)



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Postdoctoral Research Associates continued

16. Liu, C. "DBP Formation and Desalination" (2015-2020).
17. Olivares, C.L. "Wildfire project" (2016-2017)
18. Perez, G., "Monitoring of Chemical and Microbial Water Quality in SJWD and Easley Reservoirs," (1997-2002).
19. Sevimli, M. "Disinfection By-Product Formation In the presence of Chlorine and Chloramines," (2001-2002).
20. Shan, J. "Formation and Control of C-DBPs and N-DBPs" (2009-2011).
21. Song, H. "A Watershed Approach to Characterize the Influence of Land Use Change on Aquatic Resources," (2004-2007).
22. Uzun, H. "Wildfire project" (2016-2017)
23. Wang, Q. "Adsorption of Organic Compounds by Carbon Nanotubes and Graphenes" (2011-2012).
24. Yilmaz, O. "Life Cycle Assessment Studies" (2012-2014).
25. Zaeker, Y. "Nanobubble and Microwave Projects" (2020-present)
26. Zhang, S. "Adsorption of Synthetics Organic Contaminants by Carbonaceous Adsorbents" (2007-2011).

Visiting Students & Scholars (n=20)

1. Akarsu, Y. from Sakarya University, Turkey, July-August 2010
2. Ates, N. from Middle East Technical University, Turkey, May – October 2007
3. Aurelien, T. from University of Poitiers, France, June – September 2008
4. Caillet, V. from University of Poitiers, France, June – September 2007
5. Calice, S. from Università della Basilicata, Italy, February – July 2019
6. Cebeci Sarioglu M. from Sivas University, June-August 2011
7. Chen, W. from University of Poitiers, France, June – September 2010
8. Ersan G. from Istanbul University, August 2011-August 2014
9. Gagliano, E. from University of Catania, Italy, January – July 2020
10. Hu, W., from Curtin University, Australia, February-July 2019
11. Inizan, S. from University of Poitiers, France, June – September 2006
12. Ipek, U. from Firat University, Turkey, March-May 2011
13. Kaplan, S. from Suleyman Demirel University, Turkey, August 2006 – August 2009
14. Ren, Y. from China, September 2013-September 2016
15. Saatci, Y. from Firat University, Turkey, March-May 2011
16. Saglam, A. from Hacettepe University, Turkey, September 2007 – March 2008
17. Selbes, M. from Middle East Technical University, Turkey, May 2006 – May 2007
18. Yilmaz, O. from Middle East Technical University, Turkey, May 2011 – July 2012
19. Yigit, C. from Middle East Technical University, Turkey, September 2011 – February 2012
20. Ying, H. from University of Poitiers, France, June – September 2010



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7. TEACHING

Courses Taught

- EE&S 802, Environmental Engineering Principles, F 96, F 97, F 98, S 99, F99, F00, F04, F05, F06, F07
- EE&S 803, Physicochemical Operations in Water and Wastewater Treatment Systems, Sp 97, Sp 98, Sp 99, Sp 00, Sp 01, Sp 02, Sp 03, Sp 04, Sp 05, Sp 06, Sp 07, Sp 08, Sp 09, Sp 10, Sp 11, Sp 12, Sp 13, Sp 14
- EE&S 805, Laboratory in Water and Wastewater Treatment Operations, Sp 98, Sp 99, Sp 00, Sp 02, Sp 05, Sp 06, Sp 07, Sp 08, Sp 09, Sp 10, Sp 11, Sp 12, Sp 13, Sp 14, Sp 15
- EE&S 807, Physicochemical Operations in Hazardous Waste Treatment Systems, F 97
- EE&S 806, Process and Facility Design for Environmental Control Systems: Drinking Water Treatment Design Module, F 98, F 99, F00, F01, F02, F03, F04, F05, F06, F07, F09, F10, F11, F12, F13, F14
- EE&S 861, Environmental Engineering and Science Seminars, F 97, Sp 98, F02, Sp 03

New Course Development

- EE&S 802, Environmental Engineering Principles,
- EE&S 803, Physicochemical Operations in Water and Wastewater Treatment Systems,
- EE&S 805, Laboratory in Water and Wastewater Treatment Operations,
- EE&S 806, Process and Facility Design for Environmental Control Systems: Drinking Water Treatment Design Module,
- EE&S 807, Physicochemical Operations in Hazardous Waste Treatment Systems,
- EE&S 861, Environmental Engineering and Science Seminars



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8. UNIVERSITY AND PUBLIC SERVICE

Committees

Department:

Member, Advisory Committee (1996-present)
Member, Post-Tenure Review Committee (2004)
Coordinator, Faculty Task Group (2005)
Member, Research Funding Committee (2005)
Member, Instrumentation Infrastructure and Laboratories Work Groups (2005)
Member, Faculty Work Group (2005)
Member, Faculty Search Committee (2005-2006)
Member, Web Site Committee (2007-2008)

College:

Dean Advisory Committee (2005)
Curriculum Committee (2006-2008)
Achievement/Collaboration Award Committee (2007-2008)
College Leadership Council (2008-present)
Member, Civil Engineering Department Chair Search Committee (2012-2013)
Member, General Engineering Director Search Committee (2013-2014)

University:

Reviewer, Strategic Hires Pre-proposals (2012)
Member, Graduate School Dean Search Committee (2013-2014)
Member, Director of International Partners and Initiatives Search Committee (2014)
Member, President's Executive Leadership Team (2016-)

Board representation: SCFCA, SC Smart-State Endowed Chair, SC EPSCoR (Experimental Program to Stimulate Competitive Research), South Carolina Research Authority, South Carolina Universities Research and Education Foundation, Southeastern Universities Research Association, and Oak Ridge Associated Universities