

Yixi Tian

Postdoctoral Associate, Massachusetts Institute of Technology
Department of Materials Science and Engineering
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Education Experience

- School of Engineering and Applied Science, Columbia University**, New York, NY Sep. 2018 – Feb. 2022
Ph.D., Department of Earth & Environmental Engineering, GPA: 3.9/4.0
Thesis: Characterization, Stabilization, and Utilization of Waste-to-Energy Residues in Civil Engineering Applications
Advisors: Nickolas J. Themelis, A.C. (Thanos) Bourtsalas, Shiho Kawashima
- School of Engineering and Applied Science, Columbia University**, New York, NY Sep. 2016 – May 2018
M.S., Department of Earth & Environmental Engineering, GPA: 3.77/4.0
Thesis: Production of Structural Concrete from Waste-to-Energy Bottom Ash
Advisors: Nickolas J. Themelis, A.C. (Thanos) Bourtsalas, Shiho Kawashima
- School of Resource and Environmental Engineering, Hefei University of Technology**, Hefei, China Sep. 2012 – Jun. 2016
B.Eng., Department of Environmental Engineering, GPA: 88.14/100
Thesis: Technical Study of Palygorskite Clayey Dolomite for Removal of Lead Ions from Aqueous Solution
Advisor: Tianhu Chen

Research Interests

Materials processing, Sustainable Waste Management, Mineral & Metallurgical Engineering, Environmental Engineering/Materials, Resource/Metals Recovery, Cement & Concrete, Beneficial Uses of Industrial Residues in Civil Engineering Applications

Research Experience

- Postdoctoral Associate, Department of Materials Science and Engineering, Massachusetts Institute of Technology**, Cambridge, MA Advisor: Elsa A. Olivetti Oct. 2022 – Present
- Establishing the framework of metals recovery and beneficial uses of industrial residues (e.g., metallurgical slags, mining tailings) in different engineering scenarios. Optimizing the processes to achieve commercial viability that is also environmentally acceptable.
 - Exploring hydrometallurgical/pyrometallurgical processes combined with innovative recovery technologies for metal extraction/separation from waste materials to realize urban mining and circular economy.
 - Development of low-carbon cement from residues by sustainable approaches.
- Postdoctoral Research Scientist, Earth Engineering Center, Columbia University**, New York, NY Feb. 2022 – Sep. 2022
- Independently host a project about Waste-to-Energy (WTE) fly ash: chemical stabilization (chelation) of heavy metals for non-hazardous landfills and detoxifying dioxins for future beneficial uses in civil engineering applications. Routinely communicated with the sponsor industry company. Independently completion of the non-disclosure agreement and the research proposal.
 - Investigated the cementitious reactivity of different size fractions of coal bottom ash/fly ash as a cement substitute. Organized students to develop the research work.
 - Coordinated with the research team on projects related to plastics waste, municipal solid waste, materials flow analysis and techno-economic assessment.
- Research Associate, Earth Engineering Center, Columbia University**, New York, NY Jun. 2017 – Jan. 2022
- Focus on Waste-to-Energy (WTE) residues (bottom ash and fly ash). The study aimed to (i) comprehensively understand the characteristics and properties of WTE residues; (ii) provide practical and economic stabilization technologies to reduce the leachability of heavy metals in WTE residues and assess whether they can be further beneficially used as secondary materials; (iii) utilize the stabilized/processed WTE residues as secondary construction materials in civil

engineering applications, thus diverting materials from landfills and contributing to the circular economy; (iv) understand the mechanisms of physical and chemical transformation.

- Independent researcher. Set up the experimental system in the lab. Daily communication with the sponsor industry company. Completion of progress reports.

Researcher, Laboratory for Nano-mineralogy and Environmental Materials, Hefei University of Technology, Hefei, China
Jun. 2014 – Jul. 2016

- National College Students Innovation and Entrepreneurship Training Program, Team Leader
- Investigated the performance and mechanisms for removing heavy metal ions from aqueous solution by clayey dolomite in palygorskite clay deposit. The main removal mechanism is that lead ions are induced to deposit by clayey dolomite and, meanwhile, receive hydrocerussite as a by-product after dolomite dissolution.
- Devoted over 1000 hours to experimental work. Wrote proposals, accomplished academic reports, passed oral defense and succeeded in obtaining project approval, and finished two publications and two patents.

Publications & Patents

- **Yixi Tian**. 2022. “Characterization, Stabilization, and Utilization of Waste-to-Energy Residues in Civil Engineering Applications.” Ph.D. dissertation. Columbia University. <https://doi.org/10.7916/6wgq-vx06>
- **Yixi Tian***, Nickolas J. Themelis, Diandian Zhao, A. C. (Thanos) Bourtsalas*, Shiho Kawashima. 2022. “Stabilization of Waste-to-Energy (WTE) fly ash for disposal in landfills or use as cement substitute.” *Waste Management* 150: 227-243. <https://doi.org/10.1016/j.wasman.2022.06.043>.
- **Yixi Tian***, A. C. (Thanos) Bourtsalas*, Shiho Kawashima, Xiaoxuan Teng, Nickolas J. Themelis. 2022. “Performance of Waste-to-Energy Fine Combined Ash/Filter Cake Ash-Metakaolin Based Artificial Aggregate.” *Construction and Building Materials* 327: 127011. <https://doi.org/10.1016/j.conbuildmat.2022.127011>
- **Yixi Tian***, A. C. (Thanos) Bourtsalas*, Shiho Kawashima, Siwei Ma, Nickolas J. Themelis. 2020. “Performance of Structural Concrete Using Waste-to-Energy (WTE) Combined Ash.” *Waste Management* 118: 180–89. <https://doi.org/10.1016/j.wasman.2020.08.016>.
- **Yixi Tian***, Nickolas J. Themelis, A. C. (Thanos) Bourtsalas*, Shiho Kawashima, Yuri Gorokhovich. 2023. “Systematic study of the formation and chemical/mineral composition of Waste-to-Energy (WTE) fly ash. *Materials Chemistry and Physics* 293: 126849. <https://doi.org/10.1016/j.matchemphys.2022.126849>.
- **Yixi Tian***, A. C. (Thanos) Bourtsalas*, Shiho Kawashima, Nickolas J. Themelis. 2023. “Using Waste-to-Energy fine combined ash as sand or cement substitute in cement mortar production.” *Journal of Civil Engineering Materials, Revisions & Under Review*.
- **Yixi Tian***, A. C. (Thanos) Bourtsalas, Nickolas J. Themelis, Shiho Kawashima. 2023. “The effects of water, acid, alkali washing on the transformation of Waste-to-Energy (WTE) bottom ash, fly ash, and combined ash.” Submission in progress.
- **Yixi Tian***, Shengwei Dai, Jianfeng Wang. 2023. “Environmental standards and beneficial uses of Waste-to-Energy (WTE) residues in civil engineering applications.” *Waste Disposal & Sustainable Energy, Revisions & Under Review*.
- A. C. (Thanos) Bourtsalas*, Tianxiao Shen, **Yixi Tian**. 2022. “A comprehensive assessment of products management in the United States.” *Energies* 15 (18): 6581. <https://doi.org/10.3390/en15186581>.
- A. C. (Thanos) Bourtsalas*, Isabela Yepes, **Yixi Tian**, Younghyun Kim, Lixin Qin. 2023. “Effect of China’s import ban on plastic waste trade of the U.S. fifty states.” *Resources, Conservation and Recycling*. Under Review.
- A. C. (Thanos) Bourtsalas*, **Yixi Tian**, Eva L. Grunblatt, Tiffany Kulu. 2023. “Impacts of solid waste management in New York City, using a net carbon approach.” Submission in progress.
- **Yixi Tian**, Hongwei Li, Jingjing Xie, Gao Qiu, and Tianhu Chen*. The Function and Mechanism of the Removal of the Lead Ions from Aqueous Solutions by Clayey Dolomite, *Acta Petrologica et Mineralogica*, Vol.36, No. 1: 104-109, Jan., 2017. <http://www.cqvip.com/QK/94932X/20171/671283826.html>
- Gao Qiu, Qiaolin Xie, Tianhu Chen*, Haibo Liu, Jingjing Xie, Hongwei Li, and **Yixi Tian**. Performance and Mechanisms for the Removal of Copper ions from Aqueous Solutions by Clayey Dolomite, *Geological Journal of China Universities*, December 2015, Vol 21, No.4, pp.616-622. <https://geology.nju.edu.cn/CN/Y2015/V21/I4/616>

- Patent for Invention: Qiaoqin Xie, Tianhu Chen, Gao Qiu, Jingjing Xie, Yuke Zhu, Hongwei Li, and **Yixi Tian**. Method for treating heavy metal wastewater. State Intellectual Property Office, China. Application No.: CN:201510582084:A, Publication No.: CN105110445A.
- Patent for Invention: Hongwei Li, **Yixi Tian**, Tianhu Chen, Jingjing Xie, Hanlin Wang, and Peng Cheng. Heavy metal wastewater treatment material and method thereof. State Intellectual Property Office, China. Application No.: CN:201610224584:A, Publication No.: CN105858832A.

Invited Presentations & Projects

Academic Conference:

- Study of the stabilization/utilization technologies for Waste-to-Energy residues, oral presentation, WTER-2022 biennial conference, Oct. 2022
- Performance of Structural Concrete Using Waste-to-Energy (WTE) combined ash, Use of Bottom Ash as a Concrete SCM session, American Concrete Institute (ACI) Convention, oral presentation, Mar. 2022
- Energy Harvesting from Infrastructure and Ocean Systems (EHIOS), Engineering Conferences International (ECI), oral and poster presentation, Nov. 2019

Earth and Environmental Engineering department symposium, Columbia university

- The Beneficial Utilization of Waste-to-Energy residues, oral presentation, Oct. 2019
- The Performance and Utilization from Waste to Energy Residues, poster presentation, Oct. 2018
- Production of Structural Concrete from Waste to Energy Bottom Ash, oral presentation, Oct. 2017

Teaching Experience

Teaching Assistant, Columbia University, New York, NY Sep. 2018 – Dec.2018, Jan.2019 – Dec. 2021

- The courses in the Department of Earth and Environmental Engineering: Thermal Treatment-Waste/Biomass, Solid and Hazardous Waste Management, Industrial Ecology-Earth Resource, Teaching Lab Fall and Spring
- Activities: Assisted the instructor with daily coursework. Organized the students with activities and presentations. Helped students with coursework projects. Provided homework sessions, midterm, and final exam reviews. Graded homework, final reports, and exams. Designed the teaching lab experiments, provided a guest lecture for the lab course, and organized students for the daily lab.

Teaching Lab Supervisor and Guest Lecturer, Columbia University, New York, NY Jul. 2022 – Sep. 2022

- Teaching lab equipment and supplies maintenance. Designed new teaching lab courses and was in charge of equipment purchase/lab setup.
- Instructed the lab classes for high-school students from the Summer High School Academic Program for Engineers (SHAPE, School of Engineering and Applied Science).
- Guest lecture: Case Study-Characterization of Industrial Residues for Separation Science and Technology class (Department of Earth and Environmental Engineering).

Research mentor, Columbia University, New York, NY Sep. 2018 – Sep. 2022

- Summer Undergraduate Research Experience (SURE, School of Engineering and Applied Science) program. Independently instructed students to develop experimental research, analyze results, and prepare posters.
- Mentored seven MS, three undergraduate, and two high school students. Host group meetings, organize students to develop experimental and analytical research activities, and instruct the writing of their research reports. The mentoring work helped three MS students to receive Ph.D. offers.

Professional Services and Experience

Journal Guest Editor & Peer Reviewer

- Guest Editor: Waste Disposal & Sustainable Energy, special issue “Thermal processing of post-recycling urban wastes (WTE)”. Jun. 2022 – Present

- Peer Reviewer: International Journal of Industrial Chemistry (2021), Journal of Materials in Civil Engineering (2022)
- Consultant, Global WTERT Council Inc.** Sep. 2018 – Present
- Consultant and webmaster for Global WTERT council: <http://gwcouncil.org/>. Communicate with industries. Explore the global collaboration for Waste-to-Energy technologies and residues utilization.
- Student Activities Services, Columbia University, New York, NY** 2018-2019, 2022
- Committee member for organizing the symposiums, communicated with keynote speakers, reviewed the abstracts, and assisted as a photographer.
- Industrial Experience, Hefei University of Technology, Hefei, China** Jun. 2015
- Anhui Conch Cement Company dry cement clinker production line to survey its pollution distribution
 - Flue gas desulfurization system of Masteel No.2 ironmaking plant, Maanshan energy plant sewage treatment station, and Magang Coking Co., Ltd

Core Courses Enrolled & Projects

Core Courses Enrolled

- *Ph.D.* Energy Sources and Conversion, Energy Harvesting, Numerical Methods in Geotechnics, CO₂ Utilization and Conversion, Photovoltaic Systems Engineering, Industrial Ecology-Earth Resource, Engineering Separations.
- *M.S.* Thermal Treatment-Waste/Biomass, Environmental Biochemical Processing, Particle Technology, Air Pollution Prevention/Control, Industrial Catalysis, GIS-Resource Environmental Infrastructure, Aquatic Chemistry, Surface and Colloid Chemistry
- *B.Eng.* Solid Waste Treatment and Disposal Engineering, Reinforced Concrete, Construction Technology, Control Engineering of Water Pollution, Industrial Wastewater Treatment Technology, Environmental Materials, Principles of Environmental Engineering, Microbiology, Ecological Rehabilitation Engineering, Pollution and Prevention of Ground Water, Control Engineering of Gas Pollution, Physical Pollution and Control Engineering, Pumping Station and Pipeline Engineering, Environmental Law, Environmental Economics, Economic and Cost Management, Fluid Mechanics, Mechanics of Materials, Theoretical Mechanics, Physical Chemistry, Analytical Chemistry, Organic Chemistry, Inorganic Chemistry.

Projects

- *Ph.D.* Life Cycle Assessment for Apple Production in Organic farming and Integrated Farming, Life Cycle of Lightweight Aggregate, Performance and Scenarios Assessment of Self-heated Pavement for Enhancing Sustainability, Techno-economic assessment: Methanol Production Plant from CO₂ Hydrogenation by Using Solar Power (Shell Renewable Energy Competition-Best Project Award)
- *M.S.* ArcGIS-Potential Impact of Vesuvius on Population in Campania (Italy); Evil Twin Brewery Water Resource Recovery Facility-A Comparison of Two Systems; Transforming South Oak Creek CPP into a Waste-to-Energy Facility
- *B.Eng.* Sewage Treatment Plant with the Obel Oxidation Ditch; Design an Acid Mist Control System for a Metal Product Factory.

Awards & Honors

- Herbert H. Kellogg Fellowship (Awarded to students of mineral engineering and chemical metallurgy), Columbia University, 2021
- Earth Engineering Center Fellowship, Columbia University, 2018-2021
- Earth and Environmental Engineering department teaching assistant scholarship, Columbia University, 2019-2021
- Floyd Hasselriis Educational Award, ASME (The American Society of Mechanical Engineers), 2018
- University Excellent Graduation Thesis, Hefei University of Technology, 2016
- Third-class Scholarship for Academic Performance, Hefei University of Technology, 2015
- Single Scholarship for Social Activity, Hefei University of Technology, 2014

Technical Skills & Certificates

- PANalytical XPert3 Powder X-ray Diffraction (XRD), qualitative and quantitative analysis (Highscore Plus)
- TA Instruments Q50 Thermogravimetric Analyzer
- TAM Air Isothermal Calorimeter analysis
- Inductively coupled plasma-optical emission spectrometry (ICP-OES) and inductively coupled plasma-mass spectrometry (ICP-MS)
- Atomic Absorption Spectroscopy (AAS)
- Thermo Scientific Dionex ion chromatography (IC) system
- X-ray Fluorescence (XRF) spectrometry
- PHI 5500 X-ray photoelectron spectroscopy (XPS)
- UV-Vis Spectrophotometer
- Zeiss Scanning electron microscopy (SEM) and energy dispersive X-ray spectroscopy (EDS).
- Transmission electron microscopy (TEM)
- Keyence VHX-5000 Digital Microscopy
- Micromeritics ASAP 2020 HV BET analyzer
- Instron 600DX 135k Universal Testing Machine, Robert A.W. Carleton Strength of Materials Laboratory
- C-14 Laboratory Certificate of Fitness (FDNY)
- OriginLab, OpenLCA, SimaPro, ArcGIS, AutoCAD, Biowin
- French Horn (Grading Test Level 7 Certificate, China Conservatory of Music)