

Navin Kumar, Ph.D.
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Personal Summary

I am a postdoctoral researcher at Oak Ridge National Laboratory (ORNL) with research experience in the areas of latent heat thermal energy storage systems (LHTESS), thermal-fluid analysis of heat exchanger performance, material thermal characterization techniques, refinement of phase change materials performance, absorption and desorption, dehumidification, and two-phase heat transfer. My research interest is in thermal management, thermal energy storage, heat transfer, HVAC, energy, and energy policies.

Education

Texas A&M University PhD Candidate in Mechanical Engineering Concentration: Heat Transfer, Fluid Mechanics, Thermodynamics. PHD Qualifying Exam: Heat Transfer, Fluid Mechanics	College Station, TX Summer 2014 – Spring 2018 CGPA: 3.846/4.0
Embry-Riddle Aeronautical University Bachelor of Science in Aerospace Engineering (<i>Magna cum Laude</i>) Concentration: Aerodynamics and Propulsion	Daytona Beach, FL Fall 2010 - Spring 2013 CGPA: 3.82/4.0

Professional Experience

Postdoctoral Researcher Oak Ridge National Laboratory U.S Department of Energy Laboratory <ul style="list-style-type: none">• Research and develop new low-cost (< \$4/kWh) salt hydrate phase change materials for latent heat storage system• Develop non-vapor compression heat pump system based on absorption and desorption concept• Develop membrane/ionic liquid dehumidification for building energy• Building energy efficiency and peak demand utilization	Oak Ridge, TN Feb 2019 - Current
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Research and Product Development Viking Cold Solutions <ul style="list-style-type: none">• New formulation of subzero salt-based eutectic phase change material – mainly nitrate and chlorides eutectic• New latent heat storage system design – Improve current design for heat transfer enhancement• Improve their current prediction model on load shifting and demand response in cold storage– future improvement in control algorithms	Houston, TX April 2018 – Feb 2019
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Graduate Researcher Multi-Phase Flow and Heat Transfer Laboratory Dept. of Mechanical Engineering, Texas A&M University Advisor: Dr. Debjyoti Banerjee Advance Research in Dry Cooling –ARID (Department of Energy, U.S) Collaborate: Dr. Mangle Raj (University of Cincinnati), Dr. Arun Muley (Boeing), Dr. Van Carey (UCB) <ul style="list-style-type: none">• Reduce interdependency between water and energy• Move towards dry-cooling methods with the same cost per unit was wet-cooling• Application of Phase Change Materials (PCM) in air-cooled system• Characterization of thermal physical properties of (PCM) (i.e. Salt Hydrates and Paraffin)• Thermal energy storage system design: Customized Offset-Fin Compact Heat Exchanger System with heat transfer enhancement technique• 3D Printed Shell-and Tube Heat Exchanger• Experimental validation of latent heat thermal energy storage systems	College Station, TX June 2014 - Dec 2018
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Undergraduate Research Assistant
Dept. of Aerospace Engineering
Embry Riddle Aeronautical University

Daytona Beach, FL
Spring 2012 - Spring 2013

- AIAA Aircraft Propulsion Design (Gas Turbine Design)
- Design and optimization of high efficiency Compressor Stages for gas turbines

Journal Publication and Book Chapter [Citations: 47, Impact Factor: 3]

- **Kumar, Navin**; Banerjee, Debjoyti., “Phase Change Materials”. Book: “Handbook of Thermal Science and Engineering,” Springer International Publishing, (2018). DOI: 10.1007/978-3-319-26695-4_53
- **Kumar, Navin**; Banerjee, Debjoyti., “A Comprehensive Review of Salt Hydrates as Phase Change Materials (PCMs),” International Journal of Transport Phenomena, vol.14. (IF: 1.7)
- **Kumar, Navin**; Banerjee, Debjoyti; Chavez Jr, Reynold., “Exploring Additives for Improving the Reliability of Zinc Nitrate Hexahydrate as a Phase Change Material (PCM),” J. Energy Storage, vol. 20, 2018. DOI: 10.1016/j.est.2018.09.005 (IF: 3.762)
- **Kumar, Navin**; Hirschey, Jason; LaClair, Tim; Gluesenkamp, Kyle; Graham, Samuel., “Review of Stability and Thermal Conductivity Enhancements for Salt Hydrates,” J. Energy Storage, vol. 24, 2019. DOI: 10.1016/j.est.2019.100794 (IF: 3.762)
- **Kumar, Navin**; Banerjee, Debjoyti., “Thermal Cycling of Calcium Chloride Hexahydrate with Strontium Chloride as a Phase Change Material for Latent Heat Thermal Energy Storage Applications in a Nondifferential Scanning Calorimeter Set-up,” J. Thermal Sci. Eng. Appl, vol. 11, 2019. DOI: 10.1115/1.4042859 (IF: 2.244)
- Helms, Dre; Carey, Van; **Kumar, Navin**; Banerjee, Debjoyti; Muley, Arun; Stoia, Michael., “Comparison of Model Predictions Performance Test Data for a Prototype Thermal Energy Storage Module,” J. Energy Resour, Technol, vol. 143, 2021. DOI: 10.1115/1.4047607 (IF: 3.283)
- **Kumar, Navin**; Chavez Jr, Reynold; Banerjee, Debjoyti; Muley, Arun; Stoia, Michael., “Experimental Analysis of Salt Hydrate Latent Heat Thermal Energy Storage System with Porous Aluminum Fabric and Salt Hydrate Phase Change Material with Enhanced Stability and Supercooling,” J. Energy Resour, Technol, vol. 144, 2021. (IF: 3.283)

Peer-Reviewed Conference Publication

- **Kumar, Navin**; Banerjee, Debjoyti., “Characterization Phase Change Materials (PCM) Using T-History Method”. In ASME 2016 Heat Transfer Summer Conference collocated with the ASME 2016 Fluids Engineering Division Summer Meeting and the ASME 2016 14th International Conference on Nanochannels, Microchannels, and Minichannels (July,16). DOI: 10.1115/HT2016-7310.
- **Kumar, Navin**; Banerjee, Debjoyti., “Experimental Validation of Numerical Prediction for the Transient Performance of a Thermal Energy Storage (TES) Platform Realized by Integrating Heat Exchanger (PHX) with Phase Change Materials (PCM)”. In ASME 2016 Heat Transfer Summer Conference collocated with the ASME 2016 Fluids Engineering Division Summer Meeting and the ASME 2016 14th International Conference on Nanochannels, Microchannels, and Minichannels (July,16). DOI: 10.1115/HT2017-5045
- **Kumar, Navin**; Banerjee, Debjoyti., “Experimental Validation of Numerical Predictions for the Transient Performance of a Simple Latent Heat Storage Unit (LHSU) Utilizing Phase Change Material (PCM) and 3-D Printing. Paper”. In ASME 2016 Heat Transfer Summer Conference collocated with the ASME 2016 Fluids Engineering Division Summer Meeting and the ASME 2016 14th International Conference on Nanochannels, Microchannels, and Minichannels (July,16). DOI: 10.1115/HT2017-5045
- Ma, Binjian; **Kumar, Navin**; Kuchibhotla, Aditya; Banerjee, Debjoyti., “Estimation of Measurement Uncertainties for Thermal Conductivity of Nanofluids Using Transient Plane Source (TPS) Technique”. In 17th IEEE Intersociety Conference on Thermal and Thermomechanical Phenomena in Electronic Systems (ITherm) (May,18). DOI: 10.1109/ITHERM.2018.8419622
- **Kumar, Navin**; Banerjee, Debjoyti., “Experimental Measurement of Corrosion Involving Inorganic (Salt Hydrates) Phase Change Materials (PCM) for Thermal Energy Storage (TES) Applications”. 17th IEEE Intersociety Conference on Thermal and Thermomechanical Phenomena in Electronic Systems (ITherm), (May,18). DOI: 10.1109/ITHERM.2018.8419547
- Ma, Binjian; **Kumar, Navin**; Kuchibhotla, Aditya; Banerjee, Debjoyti., “Experimental Measurement of the Effect of Particle Concentration on the Specific Heat Capacity of Silica Nanofluids”. In 17th IEEE Intersociety

Conference on Thermal and Thermomechanical Phenomena in Electronic Systems (ITherm) (May,18). DOI: 10.1109/ITHERM.2018.8419554

- **Kumar, Navin**; Chavez, Reynaldo; Banerjee, Debjoyti., “Experimental Validation of Thermal Performance of a Plate heat Exchanger (PHX) with Phase Change Materials (PCM) for Thermal Energy Storage (TES)”. In 17th IEEE Intersociety Conference on Thermal and Thermomechanical Phenomena in Electronic Systems (ITherm) (May,18). DOI: 10.1109/ITHERM.2018.8419529
- Helms, Dre; Carey, Van; **Kumar, Navin**; Banerjee, Debjoyti; Muley, Arun; Stoia, Michael., “Comparison of Model Predictions and Performance Test Data for a Prototype Thermal Energy Storage Module”. In *Heat Transfer Summer Conference* (Vol. 59315, p. V001T13A007). American Society of Mechanical Engineers (July 19). DOI: 10.1115/HT2019-3512
- **Kumar, Navin**; Li, Yuzhan; LaClair, Tim; Gluesenkamp, Kyle., “Standard Characterization Techniques for Inorganic Phase Change Materials”. In 19th IEEE Intersociety Conference on Thermal and Thermomechanical Phenomena in Electronic Systems (ITherm) (July 2020).
- **Zhiming, Gao**; Kumar, Navin; Yang, Zhiyao; Gluesenkamp, Kyle; Abu-Heiba, Ahmad; Baxter, Van; “Modelling and Simulation of a Membrane-Based Heat and Mass Exchanger (HMX) Recovering Latent Heat of Dehumidification”. In ASHARE 2020 Virtual Conference.
- **Zhiming, Gao**; Kumar, Navin; Yang, Zhiyao; Gluesenkamp, Kyle; Abu-Heiba, Ahmad; Baxter, Van; “An advanced membrane-based HMX model and its application in utilizing sensible and latent heat removed in space cooling”. U.S Department of Energy Office of Scientific and Technical Information.
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Invited Presentations

- Gluesenkamp, Kyle R; **Kumar, Navin.**, (2019). “Challenges with Current Characterization Techniques,” U.S Department of Energy’s Thermal Building Workshop, Lawrence Berkeley Lab, California, USA, November 19-20th, 2019.
- Gluesenkamp, Kyle R; **Kumar, Navin**; LaClair, Tim., (2020). “Economic value of HVAC-mediated thermal storage under TOU tariffs,” IEA HPT Annex 55 Experts Meeting (web meeting), June 25th, 2020.
- Gluesenkamp, Kyle R; **Kumar, Navin.**, (2020). “U.S Department of Energy’s Thermal Energy Storage Webinar: Novel Materials in Thermal Energy Storage for Buildings (Webinar), August 5th, 2020. Link: <https://www.ibpsa.us/thermal-energy-storage-webinar-novel-materials-thermal-energy-storage-buildings>

Poster Presentations

- **Kumar, Navin**; Banerjee, Debjoyti., Alternative Approaches for Analyzing Heat Flux Data in Pool Boiling Experiments. Poster Presented at ASME IMECE Conference, Houston, Texas (November,15)
- **Kumar, Navin**; Banerjee, Debjoyti., Molten Salt Nanofluid, and Phase Change Materials for Enhanced Thermal Energy Storage. Poster Presented at Micro & Nanoscale Phase Change Heat Transfer Gordon Research Conference, Galveston., Texas (January 2017)
- **Kumar, Navin**; Banerjee, Debjoyti., Phase Change Materials (PCM) for Thermal Energy Storage (TES): Applications in Energy-Water Nexus and Energy Recovery, Texas A&M Energy Conference (August 2016)

Patents and Provisional

- **Kumar, Navin**; Chavez Jr, Reynold; Banerjee, Debjoyti., “Exploring Additives for Improving the Reliability of Zinc Nitrate Hexahydrate as a Phase Change Material (PCM)”. Patent Filed: Apr 12, 2018, Provision Patent Application, and Issue Number: 62/656,964
- Li, Yuzhan; **Kumar, Navin**; LaClair, Tim; Goswami, Monojoy; Rios, Orlando; and Gluesenkamp, Kyle., Stable Salt Hydrate-based Thermal Energy Storage Materials, U.S. Provisional Patent filed 04/15/2020 Application Number 63/010,081

Teaching Activities

Instructor

Dept. of Mechanical Engineering, Texas A&M University

- MEEN 464 Heat Transfer Lab (31 Students)

Spring 2016

Teaching Assistant

Dept. of Mechanical Engineering, Texas A&M University

- MEEN 414, Principles of Turbomachinery (12 Students) Spring 2015
- MEEN 404, Engineering Laboratory, (28 Students) Summer 2015
- MEEN 461, Heat Transfer (59 Students) Summer 2015
- MEEN 421, Thermal Fluids Science (92 Students) Fall 2015
- MEEN 315, Principle of Thermodynamics (165 Students) Fall 2016

Teaching Development

Center for Teaching Excellence, Texas A&M University
Certification in Teaching Assistant Institute (TAI)

Spring 2016

Center for Teaching Excellence, Texas A&M University
STEM- Teaching Professional Development (ENGR 677-600)

Spring 2017

Center for Teaching Excellence, Texas A&M University
Motivating Instructional Strategies for Teaching Assistants

Spring 2017

Skills and Programming

- Heat Exchanger design and thermos-fluid analysis (Experience: 3 years)
- Thermal Energy Storage and management design (Experience: 3 years)
- Experimental Experience: LabVIEW, uncertainty measurement, design of experiment, temperature, flow, pressure measurement
- Thermal Physical Properties Analyze Instrumentations (Experience: 3 Years)
 - Differential Scanning Calorimetry (Specific Heat Capacity, Latent Heat, Melting Point)
 - Thermogravimetric Analyzers (Decomposition and Degradation points)
 - Hot-Disk Method & Hot-Wire Method (Transient Thermal Conductivity)
 - Scanning Electron Microscope (JEOL JSM 7500F)
 - T-History (In-House comparison technique for thermal characterization)
 - XRD (X-ray Crystallography)
 - FTIR (Fourier Transformation Infrared Spectroscopy)
- MATLAB (Math Works – 5 years) & LabVIEW (5 years)
- SolidWorks (CAD- 3 years)

Affiliations

Sigma Gamma Tau Honors Society, 2012-Current

Tau Beta Pi Engineering Honors Society, 2012-Current

American Institute of Aeronautics and Astronautics (AIAA), 2010-Current

American Society of Mechanical Engineers (ASME), 2014-Current