

# THOMAS J. ZOLPER Ph.D.

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## PROFILE

Mechanical engineering professor specializing in thermo-fluids design curriculum and related research areas. Doctoral research emphasized integrated chemical, rheological, and tribological modeling and design of synthetic silicone lubricants. Industrial experience includes four years of design/quality engineering and project management for an automotive supplier. Consulting experience includes energy efficiency advising for Illinois EPA, oil additive research for USDOE and ANL, and developing aquatic invasive species deterrent technologies for USGS and USACE. Academic experience at Northwestern University, Valparaiso University, and University of Wisconsin includes engineering course instruction and management of tribology, machining, and measurements laboratories.

## EDUCATION

<b>Northwestern University</b> , Evanston IL	December 2012
Doctor of Philosophy in Mechanical Engineering: GPA 3.89/4.00	
<b>Northern Illinois University</b> , DeKalb IL	May 2007
Master of Science in Mechanical Engineering: GPA 3.70/4.00	
<b>Northern Illinois University</b> , DeKalb IL	December 2004
Bachelor of Science in Mechanical Engineering, Minor in Physics: GPA 3.65/4.00	

## TEACHING EXPERIENCE

<b>University of Wisconsin</b> , Platteville WI	2014 – Present
<i>Associate Professor of Mechanical Engineering</i>	
<ul style="list-style-type: none"><li>• Provide classroom and laboratory instruction in Fluid Dynamics, Senior Design, Thermal Systems Lab and Energy Systems</li><li>• Advise students in course selection, career planning, job applications, project management and interview skills</li></ul>	
<b>Valparaiso University</b> , Valparaiso IN	2013 – 2014
<i>Visiting Assistant Professor of Mechanical Engineering</i>	
<ul style="list-style-type: none"><li>• Provide classroom instruction in Introduction to Engineering, Mechanics of Materials and Senior Design courses</li><li>• Lead laboratory sessions covering Instrumentation and Measurements as well as Manufacturing Processes</li></ul>	
<b>Northwestern University</b> , Evanston IL	2012
<i>Manufacturing Processes Lab Instructor and Tutor</i>	
<ul style="list-style-type: none"><li>• Lead students in lab sessions including engine teardown/assembly, casting processes, and injection molding</li><li>• Instruct undergraduate students in CNC machining, 3-D modeling and G-code development</li></ul>	
<b>Haldex Hydraulics</b> , Rockford IL	2005 - 2008
<i>Project/Design/Manufacturing/Quality Engineer</i>	
<ul style="list-style-type: none"><li>• Instruct lab technicians and assemblers on proper procedures for assembly and testing of pumps</li><li>• Direct machinists and assemblers on proper statistical data acquisition techniques</li></ul>	
<b>Northern Illinois University</b> , DeKalb IL	2004 - 2005
<i>Engineering Teacher's Assistant</i>	
<ul style="list-style-type: none"><li>• Prepare and perform recitations covering problems in Statics, Dynamics and related material</li><li>• Provide academic support for courses including Materials Science, Thermodynamics, Fluid Mechanics, and Heat Transfer</li></ul>	
<b>Northern Illinois University</b> , DeKalb IL	2003 – 2004
<i>Math/Physics/Engineering Tutor</i>	
<ul style="list-style-type: none"><li>• Tutor engineering and science peers in advanced mathematics, physics and engineering courses</li></ul>	

## Ph.D. DISSERTATION

**High Lubricity Siloxane Lubricant Design via Chemical-Rheological Analysis**, Northwestern University

- Lead a student-post-doctoral group on an industry supported lubricant design and synthesis project
- Construct a methodology to optimize data extraction of lubricant rheological and tribological properties
- Collaborate with Chemistry and Materials Science departments for the synthesis of energy efficient lubricants
- Explore the effects of molecular variations on the rheological and tribological properties of polymer lubricants
- Develop a molecular-rheological-tribological model based on nano-scale molecular polymer constituents
- Optimize lubricant tribological performance to minimize frictional losses in general lubricated machinery
- Explain molecular-rheological models, design of experiments and optimization algorithms to colleagues
- Present progress to fellow tribologists through peer review journal articles and conference presentations

## PROFESSIONAL EXPERIENCE

- Independent Consultant**, Evanston, IL and Platteville, WI 2011 - Present  
*Petroleum Engineering, Invasive Species Management, Multiphase Flow, Non-Newtonian Fluids and Tribological Research*
- Develop procedures, training, and repair methods for friction, wear, and film formation equipment (Northwestern Univ.)
  - Recommend molecular structures and test conditions lubricant and additive research (Argonne Nat'l Lab and Northwestern)
  - Augment and prescribe tests for molecular-rheological modeling of polymer syntheses (Argonne Nat'l Lab and Valvoline)
  - Specify data acquisition and control equipment for large two-phase fluid-mechanical equipment (USGS/USACE)
  - Develop fluid machinery to apply piscicides and molluscicides to control aquatic invasive species (USGS/USACE)
- Northwestern University**, Evanston IL 2014  
*Visiting Scholar (May-August 2014)*
- Support additive research with Northwestern University, Argonne National Lab, Valvoline and General Motors
  - Develop computational methods to extract important fluid parameters and compose related journal articles
- Northwestern University**, Evanston IL 2008 – 2013  
*Tribology Laboratory Manager and Researcher*
- Maintain, calibrate, and repair tribological test equipment and upgrade supporting facilities
  - Develop and implement safety procedures and maintain chemical and emergency records
  - Direct undergraduate engineering students in undertaking different tribological research and experiments
  - Instruct post-doctoral students and visiting scholars on the tribology laboratory test equipment
  - Develop and apply to patent low friction, high stability lubricants for industrial and automotive use
  - Assist in the development and preparation of successful research proposals for Ashland, Valvoline and Dow Corning
- Haldex Hydraulics**, Rockford IL 2005 – 2008  
*Project/Design/Manufacturing/Quality Engineer*
- Design, prototype, and test electro-mechanical fuel and hydraulic pumps for a variety of manufacturers
  - Work with major OEM's to design parts and production processes to DVP&R requirements in the AIAG system
  - Lead teams of employees to perform failure analysis and corrective actions for mass production assemblies
  - Use statistical process control, FMEA's, and capability studies to improve part production to industry standards
- Illinois Environmental Protection Agency**, Springfield IL 2003 – 2004  
*Pollution Prevention Intern-Consultant*
- Evaluate machinery and production methods in a variety of industries to enhance energy efficiency
  - Research and develop manufacturing process enhancements to minimize waste and prevent pollution
  - Present process improvement recommendations to a meeting of agency and company representatives

## RESEARCH PUBLICATIONS

- **Zolper, T.J.** and Luoma, J., 2020, "*Rheological Characterizations of Zequanox®*, a Biological Agent Used to Control Invasive *Dreissenid* Mussels" *Biofluids*, **In Composition**.
- **Zolper, T.J.**, Bair, S., and Horne, K., 2020, "*Revisiting the ASME Pressure-Viscosity Report Using the Tait-Doolittle Equation*" *Journal of Tribology*, **Accepted**.
- **Zolper, T.J.**, He, Y., Delferro, M., Shiller, P., Doll, G., LotfizadehDehkordi, B., Ren, N., Lockwood, F., Marks, T.J., Chung, Y.W., Greco, A., Erdemir, A., and Wang, Q., 2020, "*Use of Shear Viscometer and Elastohydrodynamic Film Thickness Measurements to Determine the Power-Law Exponent and Pressure-Viscosity Index*" *Journal of Tribology*, **In Composition**.
- **Zolper, T.J.**, Cupp, A., Smith, D., and Jackson, P.R., 2020, "*Investigating the Performance of Liquid-to-Liquid Injection Manifolds in River Locks to Prevent the Spread of Aquatic Invasive Species*" *Journal of Fluids Engineering*, **In Review**.
- **Zolper, T.J.**, Cupp, A., and Smith, D., 2019, "*Investigating the Mixing Efficiencies of Liquid-to-Liquid Chemical Injection Manifolds For Aquatic Invasive Species Management*" *Journal of Fluids Engineering*, **141(3)**, 031302.
- **Zolper, T.J.**, He, Y., Delferro, M., Shiller, P., Doll, G., LotfizadehDehkordi, B., Ren, N., Lockwood, F., Marks, T.J., Chung, Y.W., Greco, A., Erdemir, A., and Wang, Q., 2017, "*Investigation of Shear-Thinning Behavior on Film Thickness and Friction Coefficient of Polyalphaolefin Base Fluids With Varying Olefin Content*" *Journal of Tribology*, **139 (3)**, 021504.
- He, Y., **Zolper, T.J.**, Liu, P., Zhao, Y., He, X., Shen, X., Sun, H., Duan, Q., and Wang, Q., 2015, "*Elastohydrodynamic Lubrication Properties and Friction Behaviors of Several Ester Base Stocks*" *Friction*, **3 (3)**, pp. 243-255.
- **Zolper, T.J.**, Shiller, P., Jungk, M., Marks, T.J., Chung, Y.W., Greco, A., Doll, G., LotfizadehDehkordi, B., and Wang, Q., 2015, "*Correlation of Polysiloxane Molecular Structure to Shear-Thinning Power-Law Exponent Using Elastohydrodynamic Film Thickness Measurements*" *Journal of Tribology*, **137 (3)**, 031503.
- **Zolper, T.J.**, Jungk, M., Marks, T.J., Chung, Y.W., and Wang, Q., 2014, "*Modeling Polysiloxane Volume and Viscosity Variations with Molecular Structure and Thermodynamic State*" *Journal of Tribology*, **136 (1)**, 011801.

- **Zolper, T.J.**, Jungk, M., Marks, T.J., Chung, Y.W., and Wang, Q., 2013, “*A Model to Relate Chemical Structure to Tribological Performance*”, Proceedings of the 5<sup>th</sup> World Tribology Conference, Torino, Italy, paper 307.
- **Zolper, T.J.**, Seyam, A., Li, Z., Chen, C., Jungk, M., Stammer, A., Marks, T.J., Chung, Y.W., and Wang, Q., 2013, “*Friction and Wear Protection Performance of Synthetic Siloxane Lubricants*” Tribology Letters, **51**, pp. 365-376.
- **Zolper, T.J.**, Seyam, A., Chen, C., Jungk, M., Stammer, A., Stoegbauer, H., Marks, T.J., Chung, Y.W., and Wang, Q., 2013, “*Energy Efficient Siloxane Lubricants Utilizing Temporary Shear-thinning*” Tribology Letters, **49**, pp. 525-538.
- **Zolper, T.J.**, Li, Z., Jungk, M., Stammer, A., Stoegbauer, H., Marks, T.J., Chung, Y.W., and Wang, Q., 2013, “*Traction Characteristics of Siloxanes with Aryl and Cyclohexyl Branches*” Tribology Letters, **49**, pp. 301-311.
- **Zolper, T.J.**, 2012 “*Understanding Siloxane-Based Lubricants and Developing a Polymer Chemistry-Based Rheological-Tribological Model*” Ph.D. Dissertation, Northwestern University.
- **Zolper, T.J.**, Li, Z., Chen, C., Jungk, M., Marks, T.J., Chung, Y.W., and Wang, Q., 2012, “*Lubrication Properties of Poly-alpha-olefin and Polysiloxane Lubricants: Molecular Structure-Tribology Relationships*” Tribology Letters, **48**, pp. 355-365.
- **Zolper, T.J.**, Li, Z., Marks, T.J., Chung, Y.W., and Wang, Q., 2010, “*Chemical Analysis and EHL Characterization of Several Synthetic Lubricants*”, Proceedings of the TAE 17<sup>th</sup> International Tribology Colloquium, Ostfildern, Germany, pp. 315-318.
- **Zolper, T.J.**, 2007, “*Theoretical and Experiment Analysis of Flow Characteristics of a Spatial Vortex*”, Master’s Thesis, Northern Illinois University.

### **SELECTED CONFERENCE PRESENTATIONS**

- *Investigating the Mixing Efficiencies of Liquid-to-Liquid Chemical Injection Manifolds for Aquatic Invasive Species Management*, ASME/JSME/KSME Joint Fluids Engineering Conference, San Francisco, CA, July 2019
- *Use of Spray-Atomization and Cyclone Collection to Generate Algae-Sized Food Particles to Deter the Spread of Invasive Carp through US Waterways*, ASME/JSME/KSME Joint Fluids Engineering Conference, San Francisco, CA, July 2019
- *Innovative Maritime Equipment to Uniformly Distribute Molluscicide Over Expansive Areas of Zebra Mussel Infested Waterways*, ASME/JSME/KSME Joint Fluids Engineering Conference, San Francisco, CA, July 2019
- *Rheological Characterizations of Zequanox®, a Biological Agent Used to Control Invasive Dreissenid Mussels*, ASME/JSME/KSME Joint Fluids Engineering Conference, San Francisco, CA, July 2019
- *An Analytical Review of the ASME Pressure-Viscosity Report from the Perspective of the Tait-Doolittle Equation*, STLE Annual Conference, Minneapolis, MN, May 2018
- *Use of Elastohydrodynamic Film Thickness Measurements to Approximate the Power-Law Exponent and Pressure-Viscosity Index of Polyalphaolefin-Olefin Copolymer Mixtures*, STLE Annual Conference, Dallas, TX, May, 2015
- *Use of Elastohydrodynamic Film Thickness Measurements to Determine the Power-Law Exponent of Several Polysiloxane Lubricants*, STLE Annual Conference, Dallas, TX, May, 2015
- *An Integrated Model to Predict Siloxane Tribological Performance from Chemical Structure*, University of Wisconsin Office of Research and Sponsored Programs Faculty and Staff Research Day, Platteville, WI, September 2014
- *Understanding Lubricant Rheology and Tribology*, STLE Annual Conference, Lake Buena Vista, FL, May, 2014
- *Siloxanes, from Molecular Structure to Rheology*, STLE Annual Conference, Lake Buena Vista, FL, May, 2014
- *A Model to Relate Siloxane Chemical Structure to Tribological Performance*, World Tribology Congress, Torino, Italy, September, 2013
- *Relating Siloxane Chemical Structures to Rheological Properties*, Chongqing University – Northwestern University Symposium on Advanced Mechanics, Chongqing, China, June, 2013
- *Optimization of Siloxane Molecular Structure for Diverse Tribological Applications*, STLE Annual Conference, Detroit, MI, May, 2013
- *A Chemical-Rheological-Tribological for Design of Siloxane-Based Lubricants*, CSET semiannual meeting, Evanston, IL December 2012
- *Traction Fluids Utilizing Siloxanes with Ring-Shaped Branch Structures*, ASME/STLE International Joint Tribology Conference, Denver, CO, October, 2012
- *Siloxane Lubricants Utilizing Temporary Shear Thinning*, ASME/STLE International Joint Tribology Conference, Denver, CO, October, 2012
- *Boundary Friction and Wear of Several Synthetic Lubricants*, STLE Annual Conference, St. Louis, MO, May, 2012
- *Molecular Structure to Rheological Performance in Synthetic Lubricants*, Invited Speaker, Dow-Corning Chemical Company, Wiesbaden, Germany, June, 2011
- *Chemical and Rheological Properties of Several Synthetic Lubricants*, STLE Annual Conference, Atlanta, GA, May, 2011
- *Use of Molecular Structure to Project Viscosity, Film Formation and Traction Coefficient*, STLE Chicago monthly technical meeting, Willowbrook, IL, February 2011

- *Investigation of the Material and Rheological Properties of Polyalphaolefins (PAO) and their Relation to Molecular Structure*, CSET semiannual meeting, Evanston, IL, April 2010
- *Chemical Analysis and EHL Characterization of Several Synthetic Lubricants*, TAE 17<sup>th</sup> International Tribology Colloquium, Ostfildern, Germany January 2010
- *Investigation of the Pressure-Viscosity Coefficient of Hydrocarbon and Siloxane Lubricants using EHL Data and Physical Properties*, CSET semiannual meeting, Evanston, IL Fall 2009
- *Elastohydrodynamic Characterization of Squalane with Lubricant/Fluid Rheology*, CSET semiannual meeting, Evanston, IL April 2009
- *Thermal and Electrical Energy Improvements for Industrial Cleaning Applications*, IEPA P2 Presentation, Pontiac, IL August 2004
- *A Summary of Energy Efficiency Recommendations to Industries*, IEPA P2 Presentation, Arlington Heights, IL August 2003

## **PATENTS AND APPLICATIONS**

- United States Patent No. 9,765,278 “Energy Efficient Temporary Shear-Thinning Siloxane Lubricants”
- United States Patent No. 9,896,640 “Method of Reducing Friction and Wear Between Surfaces Under a High Load Cond.”
- United States Provisional Patent No. 2015-0307808 “Siloxane Traction Fluids with Ring-Shaped Branch Structures”
- United States Provisional Patent No. 2019-0176116 “Microparticle Generation System” (T170040)
- United States Provisional Patent No. 2019-0021302 “Variable Volume Flow Injection Nozzle” (T170029)
- Provisional Application: “Chemical Injector and Mixer” (T180004)
- Provisional Application: “Floor Manifold Injector and Mixer” (T180005)
- Provisional Application: “Wall Manifold Injector and Mixer” (T180006)

## **RESEARCH PROPOSALS**

- Roy, B. and Zolper, T.J., 2020, "*Instrument Proposal for a Modular Compact Rheometer (MCR 302) from Anton-Parr*", Submitted to University of Wisconsin System Dairy Innovation Hub, \$50,000. Accepted.
- Roy, B. and Zolper, T.J., 2020, "*Measuring the Rheological Properties of Ice-Cream to Predict its Mouth-Feel Sensations*", Submitted to University of Wisconsin System Dairy Innovation Hub, \$77,843. Accepted.
- Zolper, T.J., 2019, "*Carbon Dioxide Fish Barrier Project: Engineering and Economic Assessment*", Submitted to United States Geological Survey, \$49,761. Accepted.
- Zolper, T.J., 2019, "*Use of Carbon Dioxide to Prevent Biofouling by Dreissenid Mussels*", Submitted to United States Geological Survey, \$10,008. Accepted.
- Zolper, T.J., 2018, "*Carbon Dioxide Fish Barrier Project: Engineering and Economic Assessment*", Submitted to United States Geological Survey, \$73,377. Declined.
- Zolper, T.J., 2018, "*Upgrade of water heating and chilling equipment for accelerated temperature change and precision temperature control*", \$14,000. Declined.
- Zolper, T.J., 2017, "*Development of Carbon Dioxide-to-Water Infusion Technologies to Deter the Spread of Aquatic Invasive Species*", Submitted to United States Geological Survey, \$108,884. Accepted.
- Zolper, T.J., 2016, Four combined grants Submitted to United States Geological Survey, Total \$65,525. Accepted.
  - "*Research Support for Furthering Restoration via a New Approach to Invasive Mussel Control*" \$14,000. Accepted.
  - "*Research Supporting Control of Invasive Carp –Spray Atomizer for Microparticle Creation*" \$22,400. Accepted.
  - Faculty salary (1 month) and travel, \$12,232. Accepted.
  - Shear viscometer and supplies, \$12,000. Accepted.
- Zolper, T.J., 2016, "*Research for the Assessment of Carbon Dioxide as a Tool to Control Movement of Bigheaded Carps*", Submitted to United States Geological Survey, \$14,000. Accepted.
- Zolper, T.J., 2015, "*Optimizing the Chemical Structures and Rheological Properties of Siloxanes for Lubricity and Load-Carrying Capacity*", Submitted to Dow Corning Corporation, \$160,000. Declined.
- Zolper, T.J., 2015, "*Renewable Energy Numeration Using Effluent Waste*", Submitted to the National Science Foundation, \$1,000,000. Declined.
- Zolper, T.J., 2015, "*Cost Effective Determination of Lubricant Properties that Influence Film Formation and Energy Efficiency*", Submitted to the University of Wisconsin Scholarly Activity Improvement Fund, \$4000. Approved.
- Zolper, T.J., 2015, "*Enhancing the Power Transfer Density and Material Durability of Continuously Variable Transmissions for Efficient Power Utilization*", Submitted to the University of Wisconsin grant proposal writing fund, \$4000. Approved.
- Zolper, T.J., 2014, "*Quantitative Evaluation of Biogas for Renewable Electric Power Generation*", Submitted to the University of Wisconsin New Faculty Start-Up Program, \$10000. Approved.

## **PROFESSIONAL SERVICE/MEMBERSHIP**

**Journal Reviewer:** ASME Journal of Tribology (2015-2020), Physics of Fluids (2017), Lubricants (2015), Soft Matter (2014), Tribology Letters (2015-2019), Tribology Transactions (2017), Nature Scientific Reports (2015), Bentham Sciences (2019) Royal Society of Chemistry (2017), American Chemical Society (2012-2018), Coatings (2019), Metals (2019) and Materials (2019)

**Faculty Adviser:** Society of Automotive Engineers (SAE) and Pi Tau Sigma Honor Society (2016-2020)

**Women in Engineering, Math and Science (WEMS):** Career Day presenter 2014-2016

**Society of Tribologists and Lubrication Engineers (STLE)**

**Order of the Engineer Member and Annual Participant**

**American Society of Mechanical Engineers (ASME)**

**American Society of Engineering Educators (ASEE)**

## **AWARDS**

<b>ASME Journal of Tribology Best Paper Award</b>	2015
Award for literature review and novel technique to extract important rheological property	
<b>STLE Early Career Junior Faculty Award</b>	2015
Award for innovative research and contributions to the field of tribology	
<b>Predictive Science and Engineering Design Fellowship</b>	2012
Award for interdisciplinary research using computer modeling with performance predictive capabilities	
<b>Terminal Year Cabell Fellowship</b>	2011
Award for doctoral candidates with conference presentations, publications and high academic achievement	
<b>STLE Chicago Chapter 2010 Fellowship</b>	2010
Award for original research on advanced low-friction lubricant development and synthesis	
<b>Graduated Cum Laude, Dean's List and Honor Roll</b>	2004-2007
Repeatedly attained academic recognitions throughout undergraduate and graduate studies	
<b>Professional Engineer in Training (EIT)</b>	2004
Passed the Engineer in Training exam in preparation for the Professional Engineer (PE) exam	
<b>Edwards &amp; Kelcey ACEC/Illinois State Scholarship</b>	2004
Annual scholarship for engineering students with high academic achievement and strong work history	

## **QUALITY ENGINEERING TRAINING**

- AIAG Automotive Standards and Methodology: Proposal Prototype Production
- Advanced Product Quality Planning (APQP), Pre-Production Planning and Approval Process (PPAP)
- Design, Process, Interface Failure Modes Effects Analysis (D/P/IFMEA)
- Geometric Design and Tolerance (GD&T)
- Measurements Systems Analysis (MSA), Initial Sample Inspection Result (ISIR)
- Statistical Process Control (SPC) and Document/Data Control
- Deviations, Quality Checks/Alerts, PSW, RMR, PCN, CMM reading and interpretation

## **PROFESSIONAL TRAINING**

- CITI Training: Conflict of Interest and Engineering Responsible Conduct in Research: February 23, 2016
- Proposal Writing Institute: Council for Undergraduate Research, Minneapolis, MN: July 16-20, 2015
- Grant Writing Workshop, University of Wisconsin, Platteville, WI: January 6-7, 2015
- Wind Turbine Tribology Seminar, Argonne National Laboratory, Lemont, IL: October 29-31, 2014
- Six Sigma Green Belt Training, via CAT, Rockford, IL: June-November 2007
- NERAC Training, Rockford, IL: July 23, 2007
- Infinity QS Training and Administration, Entre, Rockford, IL: April 30-May 2, 2007
- Noise and Vibration Analysis, Bruel and Kjaer, Rockford, IL: March 26, 2007
- Caterpillar Global SPC Limited Production, Packard Plaza, Peoria, IL March 9, 2007
- SKF/CR Seal Technology Training, Elgin, IL: April 24-25, 2006
- Corrective Action Training, TRN, Rockford, IL: March 26-30, 2006
- Solid Works I & II Training, CATI, Rockford, IL: February 13-28, 2006
- Energy Efficiency Training, U.S. DOE, Pontiac, IL: June 25-27, 2003
- Pollution Prevention Training, IEPA, Springfield, IL: May 19-22, 2003