

National Center for Agricultural Utilization Research

Plant Polymer Research

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Research Projects

- [Advanced Starch-Based Materials for Non-Food Applications](#)
- [Modification of Natural Polymers by Thermo-Mechanical Processing](#)
- [Determination of Structure-Property Relationships in Biological Macromolecules Using Biophysical Approaches](#)

Research Interests

- Development of novel products from agricultural commodities and coproducts
- Electroactive bioplastics
- Polymer electrolytes
- Starch graft copolymers using reactive extrusion or microwave assisted synthesis
- Structure-property relationships of natural polymers
- Green composites from degradable polymers and agricultural coproducts
- Controlled release from starch matrices
- Maillard reactions using reactive extrusion
- Biobased smart materials

Equipment & Instrumentation

Processing

- Werner-Pfleiderer ZSK 30 mm twin screw extruder
- Milacron Injection Molder with a variety of sample molds
- Brabender single screw extruder with rod, ribbon, blown film and sheet dies
- Haake Rheometer

Evaluation

- Tensile Properties (Instron)
- Electrical properties of polymers
 - Electro-Tech Systems (ETS) Model 487 Resistometer with Model 803B (film) and Model 808 (powder/liquid) cells
 - ETS Model 880 autoranging resistometer with model 841, 842, and 844 pressure pin probes
 - Ecopia Hall Effect Measurement System
 - Electrochemical Impedance Spectroscopy (PARSTAT 2273) with Gamry cells & software suites
- Environmental chamber (temperature/humidity)
- Melt Flow Index
- UV-VIS
- FT-IR
- SEM, AFM
- NMR
- Shimadzu HPLC-SEC system for water soluble polymers (20K-10M)

Work with Dr. Finkenstadt

Dr. Finkenstadt seeks collaboration with other scientists and is willing to host visiting scientists in her lab or participate in an exchange. Some programs that may provide funding:

- Grants.gov is a central storehouse for information on over 1,000 federal grant programs and access to approximately \$400 billion in annual awards
 - <http://www.grants.gov/>
- The Norman E. Borlaug International Agricultural Science and Technology Fellows Program
 - <http://www.fas.usda.gov/icd/borlaug/borlaug.htm>
- Selected International Grants, Exchanges, Fellowships, and Collaborative Research Opportunities in Agriculture
 - <http://www.fas.usda.gov/icd/grants/director.html>

Peer-Reviewed Publications

1. **Finkenstadt, V. L.**, Hendrixson, T. L. and Millane, R. P. Models of xyloglucan binding to cellulose microfibrils. *Journal of Carbohydrate Chemistry*. 14(4&5):601-611. 1995.
2. **Finkenstadt, V. L.** and Millane, R. P. Crystal structure of *Valonia* cellulose I β . *Macromolecules*. 31:7776-7783. 1998.
3. **Finkenstadt, V. L.** and Millane, R. P. Fiber diffraction patterns for general unit cells: the cylindrically projected reciprocal lattice, *Acta Crystallographica A*. 54:240-248. 1998.
4. **Finkenstadt, V. L.**, van der Plas, J. L. and Millane, R. P. CPRL: a program to plot the cylindrically projected reciprocal lattice for fiber diffraction patterns. *Journal of Applied Crystallography*. 32:551-553. 1999.
5. Willett, J. L. and **Finkenstadt, V. L.** Preparation of starch-graft-polyacrylamide copolymers by reactive extrusion. *Polymer Engineering and Science*. 43(10):1666-1674. 2003.
6. **Finkenstadt, V. L.** and Willett J. L. Electroactive materials composed of starch. *Journal of Polymers and the Environment*. 12(2):43-46. 2004.
7. **Finkenstadt, V. L.** and Willett, J. L. A direct-current resistance technique for determining moisture content in native starches and starch-based plasticized materials. *Carbohydrate Polymers*. 55:149-154. 2004.
8. **Finkenstadt, V. L.** Natural polysaccharides as electroactive polymers. *Applied Microbiology and Biotechnology*. 67:735-745. 2005.
9. **Finkenstadt, V. L.** and Willett J. L. Reactive extrusion of starch-polyacrylamide graft copolymers: effects of monomer/starch ratio and moisture content. *Macromolecular Chemistry and Physics*. 206:1648-1652. 2005.
10. **Finkenstadt, V. L.** and Willett J. L. Preparation and characterization of electroactive biopolymers. In *Biological and Synthetic Polymer Networks and Gels* (ed: F. Horkay and E. J. Amis). *Macromolecular Symposium*. 227:367-371. 2005.
11. **Finkenstadt, V.L.** and Willett, J.L. Characterization of functionalized electroactive biopolymers. In *Advances in Biopolymers: Molecules, Clusters, Networks, and Interactions* (ed: M. L. Fishman, P. X. Qi, and L. Wicker). 935:256-261. 2006.
12. Willett, J. L. and **Finkenstadt, V. L.** Initiator effects in reactive extrusion of starch-polyacrylamide graft copolymers. *Journal of Applied Polymer Science*. 99:52-58. 2006.
13. Willett, J. L. and **Finkenstadt, V. L.** Reactive extrusion of starch-polyacrylamide graft copolymers using various starches. *Journal of Polymers and the Environment*. 14(2):125-129. 2006.

14. Biswas, A., Willett, J. L., Gordon, S. H., **Finkenstadt, V. L.** and Cheng, H. N. Complexation and blending of starch, poly(acrylic acid), and poly(n-vinyl pyrrolidone). *Carbohydrate Polymers*. 65(4):397-403. 2006.
15. **Finkenstadt, V. L.**, Liu, L. S. and Willett, J. L. Evaluation of poly(lactic acid) and sugar beet pulp green composites. *Journal of Polymers and the Environment*. 15(1):1-6. 2007.
16. Liu, L. S., **Finkenstadt, V. L.**, Liu, C. K., Jin, T., Fishman, M. L. and Hicks, K. B. Preparation of poly(lactic acid) and pectin composite films intended for applications in antimicrobial packaging. *Journal of Applied Polymer Science*, 106(2):801–810. 2007.
17. **Finkenstadt, V. L.**, Liu, C. K., Evangelista, R., Liu, L. S. Cermak, S. C., Hojilla-Evangelista, M., and Willett, J. L. Poly(lactic acid) green composites using oilseed coproducts as fillers. *Industrial Crops and Products* 26(1):36–43. 2007.
18. Liu, L. S., **Finkenstadt, V. L.**, Liu, C. K., Coffin, D. R., Willett, J. L., Fishman, M. L. and Hicks, K. B. Green composites from sugar beet pulp and poly(lactic acid): structural and mechanical characterizations. *Journal of Biobased Materials and Bioenergy* 1:323–330. 2007.
19. Mohamed, A. A., **Finkenstadt, V. L.**, Palmquist, D. L. Thermal properties of extruded-injection molded poly(lactic acid) bio-based composites. *Journal of Applied Polymer Science*. 107(2):898-908. 2008.
20. **Finkenstadt, V. L.**, Liu, C. K., Cooke, P. H., Liu, L. S. and Willett, J. L. Mechanical property characterization of plasticized sugar beet pulp and poly(lactic acid) green composites using acoustic emission and confocal microscopy. *Journal of Polymers and the Environment*. Accepted August 6, 2007.
21. Mohamed, A. A., **Finkenstadt, V. L.**, Palmquist, D. L., Gordon, S. H., and Rayas-Duarte, P. Thermal properties of extruded and injection-molded poly(lactic acid)-based cuphea and lesquerella biocomposites. *Journal of Applied Polymer Science*. Accepted September 30, 2007.
22. **Finkenstadt, V. L.**, Mohamed, A. A., Biresaw, G., and Willett, J. L. Mechanical properties of green composites with poly(caprolactone) and wheat gluten. *Journal of Applied Polymer Science*. Submitted October 11, 2007. Revised January 3, 2008. Accepted January 6, 2008.
23. Willett, J. L. and **Finkenstadt, V. L.** Comparison of water soluble initiators in reactive extrusion of starch-polyacrylamide graft copolymers. *Journal of Applied Polymer Science*. Submitted September 19, 2007.
24. Mohamed, A. A., **Finkenstadt, V. L.**, Gordon, S. H., Biresaw, G., Palmquist, D. L., and Rayas-Duarte, P. Thermal properties of extruded injection-molded polycaprolactone/gluten bioblends characterized by TGA, DSC, SEM and infrared photoacoustic spectroscopy. *Polymer Degradation and Stability*. Submitted December 17, 2007.

Additional Publications

25. **Finkenstadt, V. L.** X-ray diffraction and molecular modeling studies of cellulose and its interaction with xyloglucan. Purdue University. 144 pp. December 1997. (Ph.D. Dissertation)
26. **Finkenstadt, V. L.** and Willett, J. L. Research and development of aviation safety materials. Department of Transportation-Federal Aviation Administration. December 2000. (confidential technical report)
27. **Finkenstadt, V. L.** and Willett, J. L. Fast ion conductors made of starch-based polymeric materials doped with metal halides. *Polymeric Materials: Science and Engineering*. 85:619-620. 2001.
28. Finkenstadt, S. L., and **Finkenstadt, V. L.** The Myers-Briggs Type Indicator (MBTI): a matrix for evaluating effective alternative teaching methods with diverse student populations. In CONFICHEM - Non-traditional teaching methods: methods other than lecture and assessment. March 28 - May 9, 2003. (online conference)
<http://www.ched-ccce.org/confchem/2003/a/>
29. **Finkenstadt, V.L.** and Dewey, H. H. Work-based experience in polymer chemistry. In CONFICHEM - Non-traditional teaching methods: methods other than lecture and assessment. March 28 - May 9, 2003. (online conference)
<http://www.ched-ccce.org/confchem/2003/a/>
30. Willett, J. L. and **Finkenstadt, V. L.** Reactive extrusion of starch-polyacrylamide graft copolymers. *Society of Plastics Engineers. ANTEC2004*:336-338. 2004.
31. **Finkenstadt, V. L.** and Willett J. L. Direct current electroactivity via ion-conduction in thermoplastic starch and other biopolymers. *Proceedings of the 33rd United States-Japan Cooperative Research in Natural Resources (Food & Agriculture)*. Honolulu, Hawaii. pp 59-63. December 14-18, 2004.
32. **Finkenstadt, V.L.** and Willett, J. L. Mechanical and electrical properties of thermoplastic starch composites using carbon black as a conductive filler. *Proceedings of 34th United States-Japan Cooperative Research in Natural Resources (Food & Agriculture)*. Mt. Fuji, Japan. pp 106-109. October 21-27, 2005.
33. Onwulata, C. I., Liu, L. S., **Finkenstadt, V. L.**, Willett, J. L. Extruded and injection molded biopolymers: properties of polylactic acid – sugar beet pulp blends, and whey protein/corn gluten meal. *Proceedings of 34th United States-Japan Cooperative Research in Natural Resources (Food & Agriculture)*. Mt. Fuji, Japan. pp 99-105. October 21-27, 2005.
34. Kenar, J. A., **Finkenstadt, V. L.**, Cermak, S. C. American Chemical Society Great Lakes Regional Meeting Features Joint Programming with AOCS. *Inform*. 16(2):118-119. 2005. (popular publication)
35. Mohamed, A. A., **Finkenstadt, V. L.**, Thermal properties of extruded-injection molded poly(lactic acid) and fiber composites. In: *Proceedings of the 34th North American Thermal Analysis Society Meeting*. Bowling Green, Kentucky. August 4-7, 2006.

36. **Finkenstadt, V. L.**, Liu, C. K., Evangelista, R., Liu, L. S. Cermak, S. C., Hojilla-Evangelista, M., and Willett, J. L. Green composites of poly(lactic acid) and oilseed co-products. Proceedings of 35th United States-Japan Cooperative Research in Natural Resources (Food & Agriculture). Rohnert Park, California. pp 21-24, October 21-27, 2006.
37. Liu, L.S., Liu, C., **Finkenstadt, V.L.**, Jin, Z.T., Fishman, M.L., Hicks, K.B. Pectin films for various applications. Proceedings of 35th United States-Japan Cooperative Research in Natural Resources (Food & Agriculture). Rohnert Park, California. pp 31-34, October 21-27, 2006.
38. Mohamed, A., Biresaw, G., **Finkenstadt, V.L.** Thermal properties of poly (lactic acid) based bio-composites. Adhesion Society. Tampa, Florida. pp 495-497. February 20, 2007.
39. Mohamed, A. A., **Finkenstadt, V. L.**, Palmquist, D. L. Thermal properties of extruded-injection molded poly(lactic acid) and milkweed composites. In: Proceedings of the 35th North American Thermal Analysis Society Meeting. East Lansing, Michigan. p. 76. August 26-29, 2007.

Presentations at Scientific Meetings (Abstracts)

- A1. Hendrixson, T. L., **Finkenstadt, V. L.** and Millane, R. P. Structure and interactions of glucomannans and xyloglucans. Seventeenth International Carbohydrate Symposium. Ottawa, Canada. July 17-22, 1994.
- A2. **Finkenstadt, V. L.**, Hendrixson, T. L. and Millane, R. P. Molecular modeling of xyloglucan-cellulose interactions, 209th National American Chemical Society Meeting. Anaheim, CA. April 2-7, 1995.
- A3. Millane, R. P. and **Finkenstadt, V. L.** Structures and interactions of cellulose-related polysaccharides. Frontiers in Carbohydrate Research - 5. Purdue University. West Lafayette, IN. May 21-22, 1996.
- A4. **Finkenstadt, V. L.** and Millane, R. P. Comparison of the monoclinic and triclinic crystal structures of native cellulose. American Crystallographic Association. St. Louis, MO. July 20-26, 1997.
- A5. **Finkenstadt, V. L.** and Millane, R. P. Monoclinic and triclinic cellulose crystal structures. Third Workshop on Fiber Diffraction from Biological Macromolecules. Prestonsburg, KY. October 5-8, 1997.
- A6. Millane, R. P. and **Finkenstadt, V. L.** Refinement of cellulose I α and I β against X-ray fiber diffraction data. 1998 American Crystallographic Association. Arlington, VA. July 18-23, 1998.
- A7. **Finkenstadt, V. L.** and Millane, R. P. The structure of *Valonia* cellulose I α /I β from x-ray fiber diffraction data. Nineteenth International Carbohydrate Symposium. San Diego, CA. August 9-14, 1998.
- A8. **Finkenstadt, V. L.** and Willett J. L. The effect of borate cross-linking on the physical properties of starch-based polymers. 35th Midwest Regional Meeting of the American Chemical Society. St. Louis, MO. October 11-13, 2000.
- A9. **Finkenstadt, V. L.** and Willett J. L. Peer mentoring at the National Center for Agricultural Utilization Research (USDA). 35th Midwest Regional Meeting of the American Chemical Society. St. Louis, MO. October 11-13, 2000.
- A10. **Finkenstadt, V. L.** and Willett J. L. Fast ion conductors made out of starch-based polymeric materials doped with metal halides. 222nd National Meeting of the American Chemical Society. Chicago, IL. August 26-30, 2001.
- A11. **Finkenstadt, V. L.** and Willett J. L. Effect of stearate salts on the mechanical properties of starch polymeric materials. 34th Great Lakes Regional Meeting of the ACS. Minneapolis, MN. June 2-4, 2002.
- A12. **Finkenstadt, V. L.**, *Hitt, H. C.* and Willett, J. L. Controlled release using starch as a floating dosage matrix. 224th National Meeting of the American Chemical Society. Boston, MA. August 18-22, 2002.

- A13. **Finkenstadt, V. L.** and Willett, J. L. Electroactive polymers composed of starch. 10th Annual Meeting of the BioEnvironmental Polymer Society. Albuquerque, NM. September 10-14, 2002.
- A14. **Finkenstadt, V. L., Hitt, H. C.** and Willett, J. L. Controlled release using starch as a floating dosage matrix. OSF Health Summit. Peoria, IL. October 23, 2002.
- A15. Willett, J. L. and **Finkenstadt, V. L.** Preparation of starch graft copolymer by reactive extrusion. 225th National Meeting of the American Chemical Society. New Orleans, LA. March 23-27, 2003.
- A16. **Finkenstadt, V. L.** Stepping into the future. 35th Great Lakes Regional Meeting of the American Chemical Society. Chicago, IL. May 31 – June 2, 2003
- A17. **Finkenstadt, V. L.** and Willett, J. L. A resistance technique for measuring moisture content in native starches and starch-based plasticized materials. 35th Great Lakes Regional Meeting of the American Chemical Society. Chicago, IL. May 31 – June 2, 2003.
- A18. Willett, J. L. and **Finkenstadt, V. L.** Initiator effects in reactive extrusion of starch-polyacrylamide graft copolymers. Bioenvironmental Polymer Society Meeting. Denver, CO. August 10-13, 2003.
- A19. **Finkenstadt, V. L.** and Willett, J. L. Starch-based functional polymers. 226th National Meeting of the American Chemical Society. New York, NY. September 7-11, 2003.
- A20. Willett, J. L. and **Finkenstadt, V. L.** Preparation of starch graft copolymer by reactive extrusion. International Conference on Biobased Polymers (ICBP2003). Saitama, Japan. November 12-14, 2003.
- A21. Willett, J. L. and **Finkenstadt, V. L.** Preparation of starch graft copolymer by reactive extrusion. American Institute of Chemical Engineers National Meeting. San Francisco, CA. November 16-21, 2003.
- A22. **Finkenstadt, V.L.** and Willett, J. L. Natural polymers as matrices for electroactive materials. 227th National Meeting of the American Chemical Society. Anaheim, CA. March 28 – April 1, 2004.
- A23. Willett, J. L. and **Finkenstadt, V. L.** Reactive extrusion of starch-polyacrylamide graft copolymers. ANTEC 2004. Society of Plastic Engineers. Chicago, IL. May 16-20, 2004.
- A24. Willett, J. L. and **Finkenstadt, V. L.** Reactive extrusion of starch-polyacrylamide graft copolymers. 8th World Conference on Biodegradable Polymers and Plastics. Seoul, Korea. June 1-4, 2004.
- A25. Willett, J. L. and **Finkenstadt, V. L.** Reactive extrusion of starch: continuous production of starch graft copolymers. Institute of Food Technologists. Las Vegas, NV. July 12-16, 2004.

- A26. **Finkenstadt, V.L.** and Willett, J. L. Preparation and characterization of functionalized electroactive biopolymers. Polymer Networks. Bethesda, MD. August 15-19, 2004.
- A27. **Finkenstadt, V.L.** and Willett, J. L. Preparation and characterization of functionalized electroactive biopolymers. 228th National Meeting of the American Chemical Society. Philadelphia, PA. August 22-26, 2004.
- A28. Willett, J. L. and **Finkenstadt, V. L.** Processing and properties of starch-polyacrylamide graft copolymers prepared using reactive extrusion. 228th National Meeting of the American Chemical Society. Philadelphia, PA. August 22-26, 2004.
- A29. *Parsons, J. D.*, Willett, J. L. and **Finkenstadt, V. L.** Comparison of molecular weight of starch-graft-polyacrylamide produced by batch reaction and reactive extrusion. 36th Great Lakes Regional Meeting of the American Chemical Society. Peoria, IL. October 18-20, 2004.
- A30. *Haig, R. L., Parsons, J. D.* and **Finkenstadt, V. L.** Enzyme digestion of starch-graft-copolymers. 36th Great Lakes Regional Meeting of the American Chemical Society. Peoria, IL. October 18-20, 2004.
- A31. Berfield, J. L., Biswas, A., *Parsons, J. D.*, and **Finkenstadt, V. L.** Preparation of starch-graft-poly(itaconic acid) copolymers. 36th Great Lakes Regional Meeting of the American Chemical Society. Peoria, IL. October 18-20, 2004.
- A32. Willett, J. L. and **Finkenstadt, V. L.** Effect of process parameters in reactive extrusion of starch. Bioenvironmental Polymer Society Meeting. Monterrey, Mexico. December 5-10, 2004.
- A33. **Finkenstadt, V.L.** and Willett, J. L. Natural polymers as electroactive biomaterials. Bioenvironmental Polymer Society Meeting. Monterrey, Mexico. December 5-10, 2004.
- A34. **Finkenstadt, V. L.** and Willett J. L. Direct current electroactivity via ion-conduction in thermoplastic starch and other biopolymers. 33rd United States-Japan Cooperative Research in Natural Resources (Food & Agriculture). Honolulu, Hawaii. December 14-18, 2004.
- A35. **Finkenstadt, V.L.** Edging into the synthetic electroactive polymer (EAP) market: solid polymer electrolytes using renewable biomaterials. 229th National Meeting of the American Chemical Society. San Diego, CA. March 13-17, 2005.
- A36. **Finkenstadt, V.L.** and Willett, J. L. Mechanical and electrical properties of starch composites using carbon black as a conductive filler. 230th National Meeting of the American Chemical Society. Washington, DC. August 28-September 1, 2005.
- A37. **Finkenstadt, V.L.** Biopolymers as electroactive bioplastics. American Association of Cereal Chemists (AACC). Orlando, FL. September 11-13, 2005.

- A38. Onwulata, C. I., Liu, L. S., **Finkenstadt, V. L.**, Willett, J. L. Extruded and injection molded biopolymers: properties of polylactic acid – sugar beet pulp blends, and whey protein/corn gluten meal. 34th United States-Japan Cooperative Research in Natural Resources (Food & Agriculture). Mt. Fuji, Japan. October 21-27, 2005.
- A39. **Finkenstadt, V.L.** and Willett, J. L. Mechanical and electrical properties of thermoplastic starch composites using carbon black as a conductive filler. 34th United States-Japan Cooperative Research in Natural Resources (Food & Agriculture). Mt. Fuji, Japan. October 21-27, 2005.
- A40. **Finkenstadt, V.L.**, Cermak, S.C. and Willett, J. L. Preparation and characterization of PLA green composites using agricultural co-products as fillers. 231st National Meeting of the American Chemical Society. Atlanta, GA. March 26-30, 2006.
- A41. **Finkenstadt, V.L.** Polylactic acid: a biodegradable commodity plastic. Biotechnology Industry Organization (BIO2006). Chicago, IL. April 11-12, 2006.
- A42. **Finkenstadt, V. L.**, Liu, C. K., Evangelista, R., Liu, L. S. Cermak, S. C., Hojilla-Evangelista, M., and Willett, J. L. Green composites using PLA and agricultural co-products. 10th Green Chemistry and Engineering Conference. Washington, DC. June 24-26, 2006.
- A43. Mohamed, A. A., **Finkenstadt, V. L.**, Thermal properties of extruded-injection molded poly(lactic acid) and fiber composites. 34th North American Thermal Analysis Society Meeting. Bowling Green, KY. August 4-7, 2006.
- A44. **Finkenstadt, V. L.**, Liu, C. K., Evangelista, R., Liu, L. S. Cermak, S. C., Hojilla-Evangelista, M., and Willett, J. L. Preparation and characterization of PLA green composites using agricultural co-products as fillers. World Conference & Exhibition on Oilseed/Vegetable Oil Utilization. Istanbul, Turkey, August 14-16, 2006.
- A45. Liu, L. S., **Finkenstadt, V. L.**, Liu, C. K., Coffin, D. R., Willett, J. L., Fishman, M. L. and Hicks, K. B. Sugar beet pulp and poly(lactic acid) green composites. Industrial Products from Renewable Materials Symposium. 232nd National Meeting of the American Chemical Society. San Francisco, CA. September 10-14, 2006.
- A46. **Finkenstadt, V. L.**, Liu, C. K., Evangelista, R., Liu, L. S. Cermak, S. C., Hojilla-Evangelista, M., and Willett, J. L. Green composites of poly(lactic acid) and oilseed co-products. 35th United States-Japan Cooperative Research in Natural Resources (Food & Agriculture). Rohnert Park, CA. October 21-27, 2006.
- A47. Liu, L.S., Liu, C., **Finkenstadt, V.L.**, Jin, Z.T., Fishman, M.L., Hicks, K.B. Pectin films for various applications. 35th United States-Japan Cooperative Research in Natural Resources (Food & Agriculture). Rohnert Park, CA. October 21-27, 2006.
- A48. Mohamed, A., Biresaw, G., **Finkenstadt, V.L.** Thermal properties of poly (lactic acid) based bio-composites. Adhesion Society. Tampa, FL. pp 495-497. February 18-20, 2007.

- A49. Mohamed, A. A., **Finkenstadt, V. L.**, Palmquist, D. L. Thermal properties of extruded-injection molded poly(lactic acid) and milkweed composites. In: Proceedings of the 35th North American Thermal Analysis Society Meeting. East Lansing, MI. August 26-29, 2007.
- A50. **Finkenstadt, V.L.** Utilization of agricultural “waste” products in value-added products for sustainability. Engineering a Sustainable Future. Cleveland Engineering Society. Cleveland, OH. October 3, 2007
- A51. **Finkenstadt, V. L.**, Liu, C. K., Liu, L. S. and Willett, J. L. Evaluation of PLA and agricultural coproducts as green composite materials. International Symposium on Polymers and the Environment (Bioenvironmental Polymer Society). Vancouver, WA. October 17-19, 2007.

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