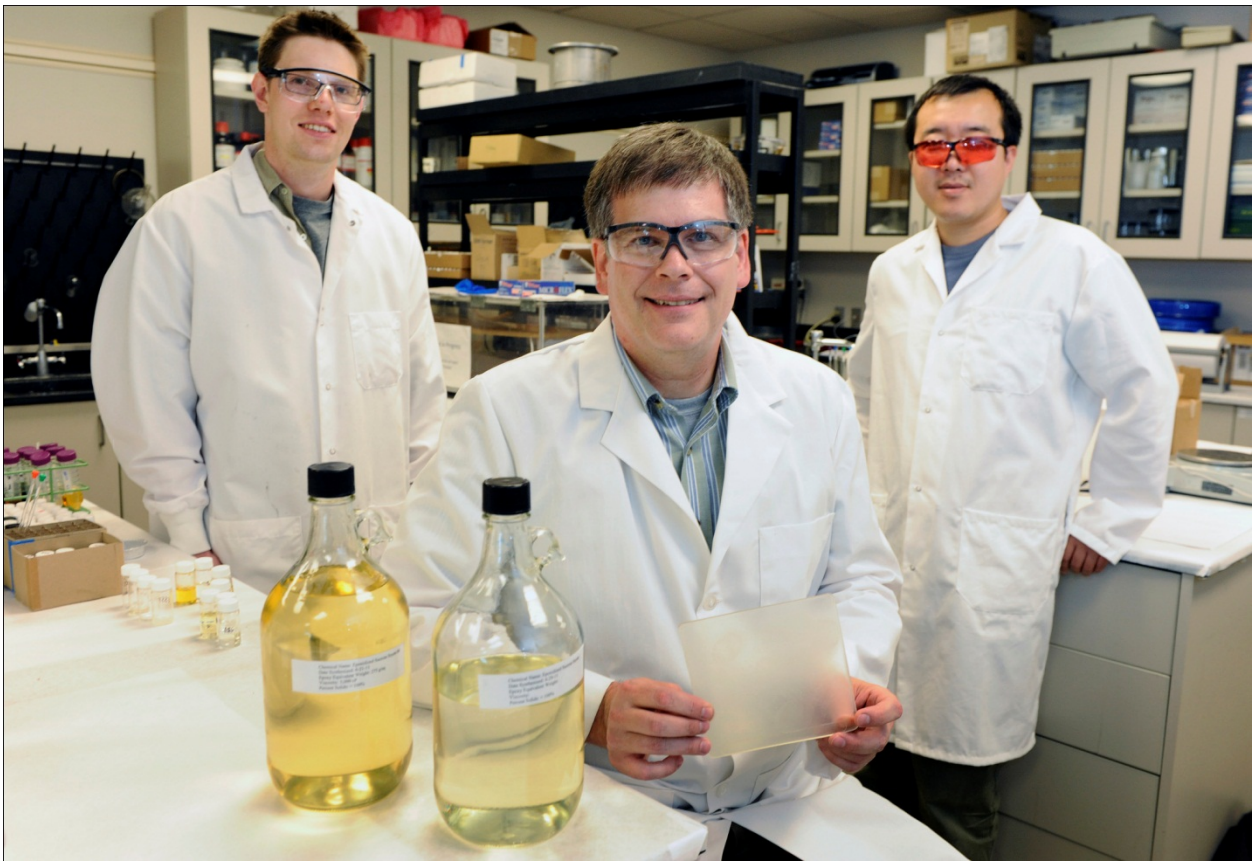
NDSU RESEARCHERS DEVELOP REVOLUTIONARY BIOBASED TECHNOLOGY FROM AGRICULTURAL CROP MATERIALS



Dr. Dean Webster, North Dakota State University, Fargo, (center) and graduate students T.J. Nelson and Xiao Pan are among a research group that developed a family of resins from renewable raw materials. Photo credit: Dan Koeck, NDSU

Aug. 10, 2011, Fargo, N.D., USA — Several agricultural crops could play a significant role in biobased resins and coatings recently developed by researchers at North Dakota State University. Scientists at NDSU have developed biobased resins that may prove to be a "game changer" in coatings and resin technology.

The NDSU researchers have developed a family of resins from renewable raw materials, creating resins that eliminate hazardous components such as formaldehyde and bisphenol-A. The resins are based on sucrose and vegetable oils, and can be varied to perform in many applications and industries, according to Dean Webster, professor in the NDSU Department of Coatings and Polymeric Materials. Webster's research group includes NDSU graduate students Xiao Pan and T. J. Nelson, undergraduate student Adlina Paramarta and Partha Sengupta, former postdoctoral researcher at NDSU.

The resins developed by the NDSU research group can be made from from sugarbeets, plus oils from soybeans, flax and sunflowers. When cured, the patent-pending resins show:

- Significantly improved properties over current biobased materials and processes
- Mechanical properties comparable to petrochemical-based materials
- Dramatically increased renewable material content

“These NDSU-developed technologies achieve what few biobased materials have before,” said Webster. “They have vastly improved mechanical properties, reduced hazardous chemical content and are made from readily available materials and common processes. The technologies have the potential for significantly impacting biobased material markets.” The bio-renewable chemicals market is projected to reach $5 billion by 2015.

The new resins developed at NDSU could further reduce reliance on petrochemical-based materials, one of the main components in many coatings formulations. Dr. Webster’s research group found that the epoxidized sucrose ester resins they developed result in materials that are two- to-four times as functional as vegetable oil-based resins.

One novel ultraviolet light curable coating developed by Webster’s group cures approximately 10 times faster than existing UV-curable biobased coatings. Another in the family of biobased resins developed at NDSU exhibits properties that make it ideally suited for bio-composite materials, baking enamels and structural adhesives. Another resin demonstrates more hardness and resistance to solvents than petrochemical-based coatings.

“Interest in the use of renewable feedstocks in the synthesis of polymers is rapidly increasing, driven by consumer demand for ‘green’ products as well as the tightening of the supply of petrochemicals,” said Webster. “However, consumers are requiring that the biobased materials have physical properties that match or exceed current high performance materials.”

Laboratory research at NDSU has shown that the green technology resins developed at NDSU are far superior to existing biobased materials and comparable to petrochemical-based materials. The newly-developed resins could be used in a variety of settings including construction, architectural, biomedical, marine and electronics industries. The technology may have wide-ranging applications in areas where thermally cured materials are used, such as in protective coatings, structural adhesives, and composites. The resins are synthesized using raw materials, reagents and processes common to industry.

“They have the potential to provide a revolutionary impact in some applications replacing widely-used petrochemical-based epoxy compounds,” said Webster.

Funding for the biobased coatings research was provided by the United States Department of Agriculture (USDA) Cooperative State Research, Education, and Extension Service under grant number 2007-38202-18597. The United Soybean Board is sponsoring current biobased coatings

research at NDSU. The base sucrose ester resins used in this research were provided by P&G Chemicals.

Webster's research is among a broad-based research portfolio in renewable technologies at NDSU, with research funded by USDA, the National Science Foundation, U.S. Department of Energy and entities in North Dakota, including the North Dakota Renewable Energy Council and North Dakota Soybean Council.

Webster has been involved in polymer synthesis and structure-property relationships of coating binder systems for more than 20 years. He is receiving the prestigious Roy W. Tess Award in Coatings from the American Chemical Society on August 29, 2011, during the group's annual meeting in Denver, Colo.

Dr. Webster has authored more than 75 peer-reviewed papers and publications and is credited with 11 patents (an additional 18 pending) on coatings related topics. He has won Roon Foundation Awards for the best paper in the 2003, 2004 and 2006 International Coatings Exposition (ICE) of the American Coatings Association. Dr. Webster's career in the coatings industry includes research and development in the Consumer Division of Sherwin-Williams in Chicago, Ill., and at Eastman Chemical Company. He received his Ph.D. in materials engineering science and his B.S. degree in chemistry at Virginia Polytechnic Institute and State University.

NOTE APPENDED BY NDSU RESEARCH FOUNDATION:
These patent-pending biobased coatings technologies are immediately available for licensing from the NDSU Research Foundation. Please contact Jonathan Tolstedt at 701.231.8173 or jtolstedt@ndsurf.org for additional information.

More information:
"High Biobased Content Epoxy Anhydride Thermosets from Epoxidized Sucrose Esters of Fatty Acids"
Biomacromolecules, 2011, 12 (6), pp 2416–2428 May 12, 2011
DOI: 10.1021/bm200549c http://pubs.acs.org/doi/abs/10.1021/bm200549c

"Novel biobased epoxy compounds: epoxidized sucrose esters of fatty acids"
Green Chemistry, 2011, 13, 965-975, February 2011
DOI: 10.1039/C0GC00882F
http://pubs.rsc.org/en/content/articlelanding/2011/gc/c0gc00882f/unauth

"Impact of Structure and Functionality of Core Polyol in Highly Functional Biobased Epoxy Resins"
Macromolecular Rapid Communications 20 JUN 2011
DOI: 10.1002/marc.201100215
http://onlinelibrary.wiley.com/doi/10.1002/marc.201100215/abstract