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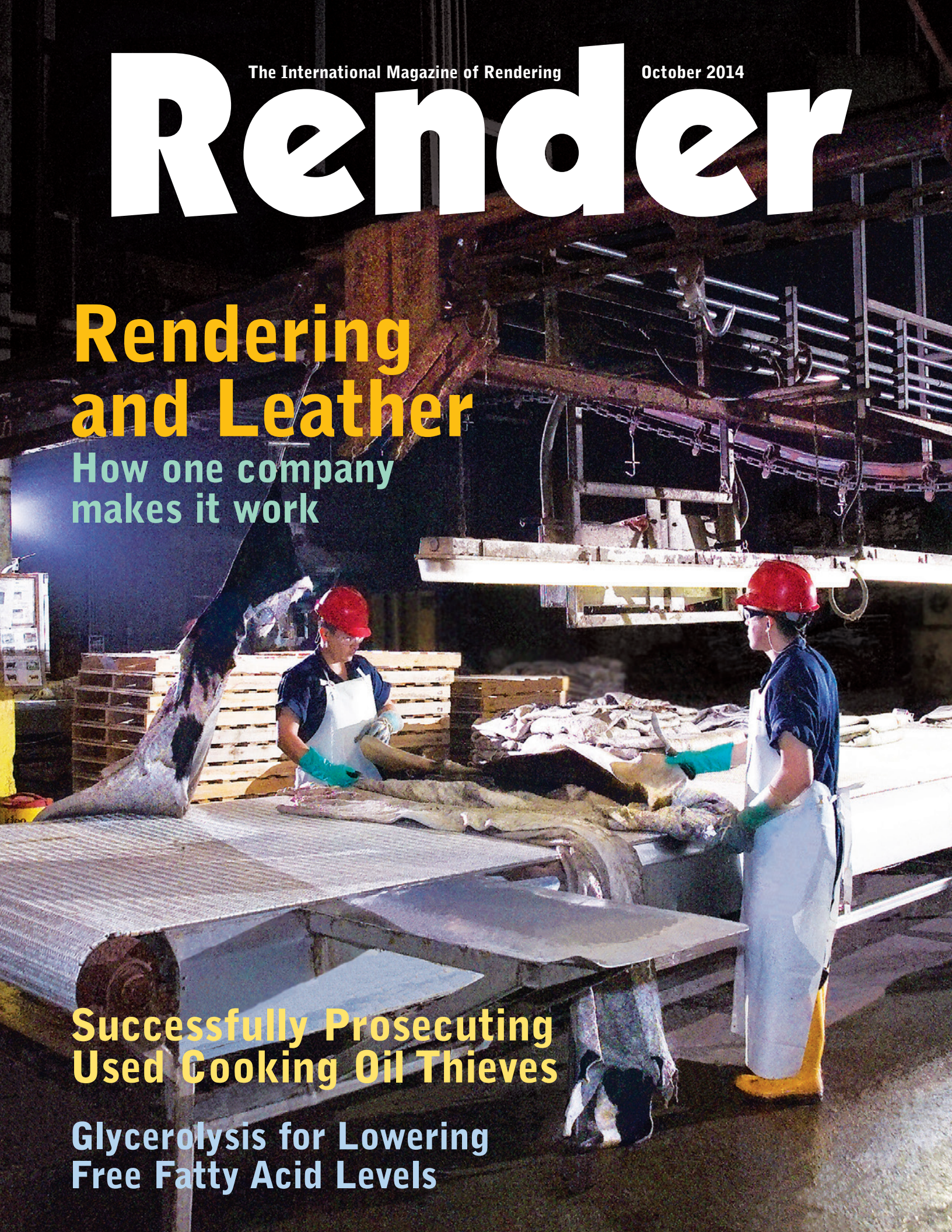

Rendering and Leather

How one company makes it work

Successfully Prosecuting Used Cooking Oil Thieves

Glycerolysis for Lowering Free Fatty Acid Levels

By Annel K. Greene, PhD, Professor and Center Director
Clemson University Animal Co-Products Research and Education Center

Rendered Car Parts?

In 2003, Clemson University embarked on a new research center dedicated to automotive research and education. From that idea, the Clemson University International Center for Automotive Research (CU-ICAR) was born. Now, with over $250 million in investments, CU-ICAR has graduated 183 masters of science and PhD students representing 17 different countries. Of these, 95 percent are now employed in the automotive industry. Supporting industry partners have invested $36 million in four endowed professorships for conducting key research. Just over a decade later, with industry support, CU-ICAR is housed on a 250-acre campus in Greenville, SC, with more than 750 employees. The sixth building in the complex is under construction now as a part of a campus designed to educate students and conduct research for the automotive industry.

Dr. Srikanth Pilla, an assistant professor of automotive engineering at CU-ICAR, has been selected by the Animal Co-Products Research and Education Center (ACREC) Research Committee to conduct an exploratory study to develop thermoset-based biocomposites from rendered proteinaceous materials for use in automotive applications. Thermoset materials are usually liquid or malleable prior to curing and are designed to be molded into their final form. Once hardened, a thermoset resin cannot be reheated and melted to be shaped differently.

In his work, Pilla will study ways to overcome the poor mechanical, high moisture absorbing, and inherent odor properties of rendered protein plastics. He will explore ways to develop structural products by laminating layers of products for use in high performance applications such as automotive parts. Pilla's current work involves developing high-strength, toughened laminated biocomposite structures using biobased products. He uses biobased resins and natural fibers that have been treated with heat and ultraviolet light to cure them for high performance applications.

In the first phase of his ACREC project, Pilla will measure the span of cross-linking possibilities for increasing strength in the protein plastics. He will use a chemical transformation process known as an epoxy mechanism in combination with a biorenewable epoxidized soybean oil. Epoxidized means the chemicals have been formed into a ring structure that makes it more able to chemically react to form plastics. The cross-linking should increase the strength of the plastic, but most likely will not improve its rigidity, thermal stability, and toughness. Toward this end, Pilla will then study different reaction mechanisms to change the molecular structure on a nanoscale level, which is extremely small, with one nanometer equivalent to 0.00000003937 inches. Pilla's goal is to induce branching on the nanoscale level to improve impact resistance of the protein-based plastics. This should enhance the toughness without compromising the strength of the resulting polymer. Additionally, he will investigate the effects of different curing mechanisms on polymer qualities.

Dr. Srikanth Pilla

Pilla's objective for modifying the protein polymers is to develop materials that can be used in creating composites. He intends to develop a multi-layer plastic that combines both synthetic and natural materials to create a superior-performance product. One of the major concerns with using rendered animal proteins in composites is the inherent odor of the proteins. To resolve that problem, Pilla will sandwich the materials with other thermoset resins.

Once the composites have been created, Pilla will test their mechanical

properties using industry-standard testing protocols. Testing will determine the strength, how far the product can be stretched before failure, brittleness, characteristics at different temperatures, and so on, and compare these qualities to currently existing polymers used in the automotive industry.

Previous studies on plastics from rendered animal products revealed inferior mechanical properties and pungent odors. This project will potentially overcome those difficulties by enhancing the cross-linking of the polymers as well as laminating them with other plastics.

If successful, this project has potential to open new markets for rendered animal products. Worldwide, it is estimated that 150 million cars will be built and sold in 2015. New standards in the United States for automotive fuel efficiency will require 49 to 61 miles per gallon by 2020 to 2025, respectively. Therefore, to achieve this, automotive parts will need to be lighter weight and use of composite materials is one way to reduce weight. To advocate sustainability in this realm, the current practice is to create composites from biorenewable materials that are primarily derived from sugars and vegetable oils. However, the tremendous volume of these products needed for the automotive industry cannot be met with current production rates. Moreover, these biobased products are quite expensive, averaging in the range of $6 to $8 per pound.

Animal proteins from rendered products have great potential as a resource to make composites since the available volume is large and typically these proteins sell for $0.20 to $1 per pound. Even with the additional cost and effort to cross-link the protein polymers, the cost should still be considerably lower than using sugars and vegetable oils for making these composites.

Pilla obtained his PhD in mechanical engineering from the University of Wisconsin-Milwaukee and conducted a post-doctoral study at Stanford University in civil and environmental engineering. He worked as a research scientist for three years at the Wisconsin Institute for Discovery, University of Wisconsin-Madison, prior to joining Clemson University in August 2013. PhD student Xiaoyan Yu will work on this project with Pilla starting this fall. **R**

International *Continued from page 30*

Examples of practical use will be shown, including economic benefits for a variety of species.

Finally, it will be reiterated that rendering is a mature and developed manufacturing industry, and comparisons will be drawn to some of the more developing industries sharing the platform with WRO. Nonetheless, if the global aquafeed industry continues to grow at the expected rate, there is room for all suppliers of quality proteins in this sector. The WRO involvement at GOAL will be reported, hopefully in the next edition of *Render*.

Meanwhile, follow WRO's tweets (@WorldRenderers) to stay connected and keep abreast of global rendering issues. Also, join and participate in WRO to help build a strong and proactive global rendering network. The next WRO meeting will be held October 22, 2014, at the National Renderers Association convention in Rancho Mirage, CA. **R**