ENGINEERING TOMORROW'S POULTRY INDUSTRY

PoultryTech

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ATRP in Photos and Podcasts

Researchers in the Georgia Tech Research Institute's (GTRI) Agricultural Technology Research Program (ATRP) ushered in 2025 with a myriad of outreach and engagement activities. Here are highlights of just a few of the events that helped ATRP showcase current R&D projects that are helping to shape the future of poultry, agribusiness, and food manufacturing.

ATRP at the 2025 International Production & Processing Expo (IPPE).

ATRP was once again excited to participate in the International Production & Processing Expo (IPPE) held in January at the Georgia World Congress Center in Atlanta. This year's exhibit highlighted two novel projects: Rehang Shackle Device and Poultry House Robot Assistant. You can learn more about the Rehang Shackle Device in the Research Q&A feature on page 4. IPPE is the world's largest annual poultry and egg, meat, and animal food industry event of its kind. A wide range of domestic and international decision-makers attend this annual event to find solutions for their business, network with industry colleagues, and learn about the latest technological developments and issues facing the industry.

On April 24, ATRP held its annual Advisory Committee Meeting. Project directors provided committee members with an update on program research projects as well as technology transfer and outreach activities. A round-table session was also held where committee members provided feedback and discussed future research opportunities, challenges, and directions with researchers. The annual meeting serves as a key step in ATRP's efforts to identify and conduct research projects that best address priority industry needs. ATRP extends its appreciation to the Georgia Poultry Federation and the individual committee members who give of their time and experience to help review and focus ATRP's research program.

ATRP researchers participate in a roundtable discussion with members of the ATRP Advisory Committee during the 2025 annual meeting.

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IN THIS ISSUE

MANAGER'S CORNER

Welcome to the Spring 2025 issue of *PoultryTech*! The Agricultural Technology Research Program (ATRP) had an active start to the year as seen in the front-page article "ATRP in Photos and Podcasts." I'd like to thank our researchers and staff for their time and dedication to making these outreach activities a success. A special thanks goes to Stephanie Richter for spearheading and hosting the special ATRP series of the Georgia Tech Research Podcast. You can listen to episodes and subscribe to the podcast on Spotify, Google Podcasts, and Apple Podcasts. Episodes can also be accessed from GTRI's website at gtri.gatech.edu/podcast.

This issue also highlights two research projects that are seeking to bring better understanding of and potential solutions to industry production and processing challenges. Daniel Sabo, Ph.D., overviews his ongoing work on understanding the dynamics of PAA (peracetic acid) decay and its effects on product safety in "What Killed the PAA?" on page 3. An innovative alternative to manual carcass rehanging after the chiller is discussed in the Research Q&A column with Konrad Ahlin, Ph.D., on page 4. He provides an in-depth look at a semi-automated concept known as the Rehang Shackle Device.

I hope you enjoy the issue and as always feel free to reach out with any questions or comments at doug.britton@gtri.gatech.edu. We value you, our indispensable partners, in our pursuit of Transforming Poultry, Agribusiness, and Food Manufacturing through Advanced Technologies. We could not adequately fulfill this vision without your continued support. Thank you!

Doug Britton, Ph.D.
ATRP Program Manager

ATRP in Photos and Podcasts

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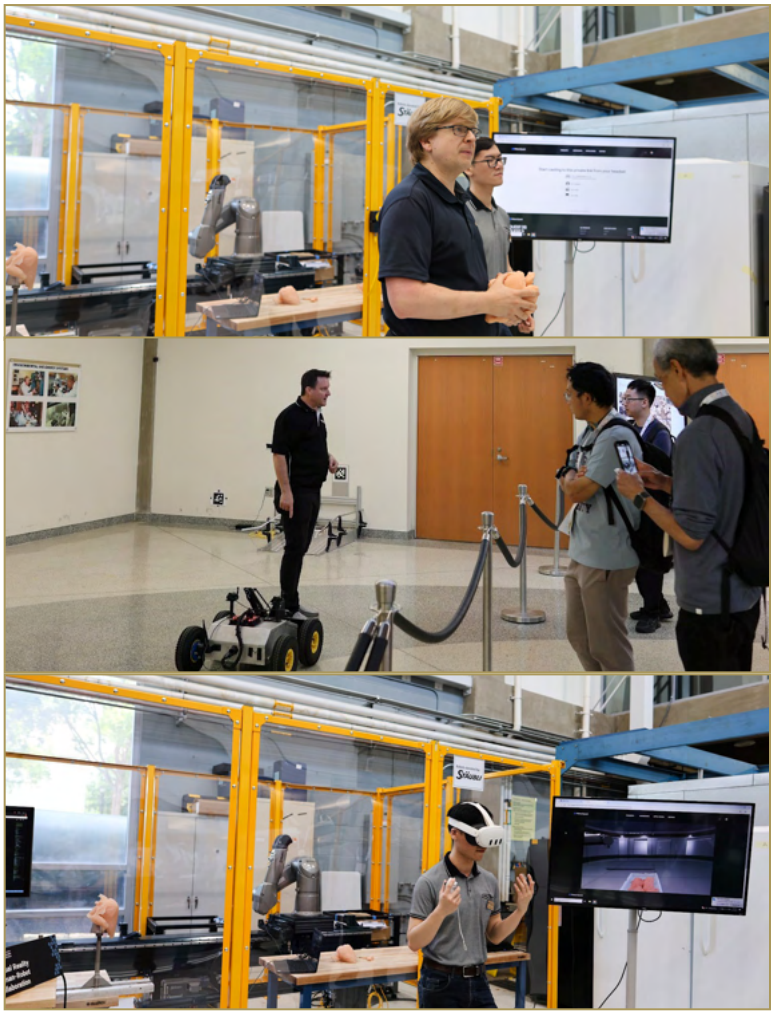
ATRP hosted attendees in town during the 2025 International Conference on Robotics & Automation (ICRA 2025) held May 19-23 at the Georgia World Congress Center in Atlanta. Demos were held at GTRI's Food Processing Technology Building and showcased innovations in flexible robot assembly, autonomous ground robotics, and human-robot collaboration with immersive virtual reality technologies. The flagship conference of the IEEE Robotics and Automation Society (RAS), ICRA brings together the world's top researchers and industry leaders to share ideas, exchange knowledge, and advance the field of robotics for the benefit of humanity.



ATRP researchers demonstrate projects to ICRA 2025 attendees at the Food Processing Technology Building at GTRI.

The Georgia Tech Research Podcast highlights unique research projects and looks closely at research that benefits the state of Georgia. Recent episodes featuring ATRP projects include:

ATRP Episode 20: GTRI and ATRP at the 2025 International Production & Processing Expo (IPPE)

ATRP Episode 21: Comas Haynes and Saikamal Srinivas on Enhanced Poultry Chilling Automation

ATRP Episode 22: Daniel Sabo on PAA and Food Safety

ATRP Episode 23: Jie Xu and team on Advances in Real-Time Monitoring of PAA with Optical Sensor

To listen to these episodes, scan the QR code above or visit gtri.gatech.edu/podcast.

What Killed the PAA?

BY DANIEL SABO, PH.D.

Research Overview

The poultry industry relies on peracetic acid (PAA) as an antimicrobial agent to ensure food safety and control microbial contamination in carcass chilling operations. PAA stock comes chemically stabilized, but once it is diluted with water or dosed into chillers, the chemical begins to decompose into acetic acid and water. The importance of PAA for product quality and safety highlights the need to clearly understand its decay rates within immersion chillers and the factors attributing to that decay.

PAA decomposition rates are reported as chemical half-life and measured in minutes. The chemical half-life is the time required for a quantity of PAA to reduce to half of its starting value. Evidence shows PAA decays rapidly with high organic carbon loading. Organics are common in the chiller and appear in the form of total suspended solids (TSS); total dissolved solids (TDS); and fats, oils, and greases (FOGs). The exact contributors of PAA decay have not been documented, and poultry processors have expressed an interest in understanding decay kinetics.

In response, researchers with the Georgia Tech Research Institute's (GTRI) Agricultural Technology Research Program (ATRP) have been conducting studies to quantify factors that primarily lead to the accelerated decay of PAA in chiller water under a variety of conditions. The team recently released results of studies that explored the effects of chemical formulations and incoming water quality on PAA decomposition.

Key Takeaways

During our testing, we found three parameters common to immersion chillers to have the largest effect on PAA decay: TDS components, water temperature, and pH of immersion chillers.

TDS Components

Individual TDS components (proteins, cations, blood) by themselves did not have a substantial impact on PAA stability. Once individual TDS components are combined, a noticeable negative effect on PAA stability was observed. For example, when cations and proteins were combined, there was a decrease of 70% in PAA's half-life, while when cations and blood were combined, the impact was a 75% drop in PAA stability.

Water Temperature

It was found that there is a combined effect of water temperature and organic load on PAA decay. At room temperature, the half-life of PAA was 170 minutes in potable water, and decreased by 57% in chiller water at room temperature. Decreasing water temperature to near freezing will extend PAA's half-life by 150% in potable water to 254 minutes. When measured for simulated chiller water, the stability of PAA dropped by 42% to 148 minutes. Increasing water temperature to 95°F will decrease PAA's half-life by 18% in potable water to 139 minutes. When measured for warmed chiller water, the stability of PAA dropped by 66% to only 47 minutes.

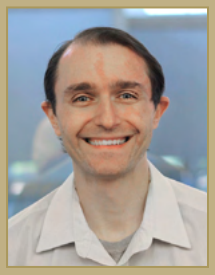
pH of Immersion Chillers

pH adjustment was found to have a noticeable effect on PAA stability, and PAA was most stable at a pH around 4.0. As pH increases, the stability of PAA decreases. The lowest observed half-life of PAA was at pH 10.0.

Benefits to Industry

Lower than expected PAA levels in the chiller could mean less pathogen elimination, resulting in higher pathogen loads on carcasses. Additionally, increases in organic loads in the chiller, typical during a processing shift, result in PAA drop-off and fluctuations that can cause variability in pathogen loads throughout the day. This could result in a negative impact on food safety.

Daniel Sabo, Ph.D., is a senior research scientist in GTRI's Agricultural Technology Research Program.



Cost implications come into play as processors use more PAA than necessary due to rapid fluctuations in PAA levels throughout a processing day. By understanding the factors that have the largest effect on PAA stability, strategies and technologies can be implemented to counteract these fluctuations, ensuring food safety while reducing operating costs.

More information on the results can be found in a number of Research Briefs, which are available at atrp.gatech.edu/research-briefs.

Next Steps

Our next steps will focus on how PAA interacts with other technology used for bacterial reductions including ultrasonication. It has been demonstrated that the application of ultrasonic waves can aid in the reduction of bacterial contamination. We are currently investigating if there is any impact (positive or negative) of ultrasonication on the breakdown of PAA. We are also exploring the synergetic impact of ultrasonication on PAA's antimicrobial activity.

Rehang Shackle Device

Konrad Ahlin, Ph.D., senior research engineer, discusses his research project "Rehang Shackle Device." The project's focus is on designing a mechanical system to help lift/rehang chicken carcasses onto moving shackles after chilling in a way that reduces the exertion required by workers.

Q: What industrial challenge is the project addressing?
A: This project is developing an alternative method for the rehang operation in poultry processing. Rehang occurs after the bird exits the chiller bath and is placed onto a moving shackle line. This process is performed manually with workers lifting and hanging each individual bird.

The Rehang Shackle Device attempts to simplify the rehang process by removing the need to lift the product. Rather than hanging the bird by the legs, an operator simply slides the bird onto a specially designed ***rehang mat*** positioned on a moving conveyor line. The conveyor moves in sync with the shackle line, and the mat has grooves that are designed to separate and singulate the legs of the bird. Due to the design of the rehang mat, the legs are passively aligned with the moving shackles. At the end of the conveyor, the line raises and carries the product with it; increasing the safety and efficiency of the operator by removing the need for strenuous lifting.

Demonstration of rehang mat aligning and singulating legs for shackling. Rather than hanging the bird by the legs, an operator simply slides the bird onto the specially designed mat positioned on a moving conveyor line. The line then raises and carries the product with it, greatly reducing the need for strenuous lifting.

Q: What is the project's approach and how is it different from current practice?
A: The primary difference between this approach and previous attempts at automating the rehang processes is that the Rehang Shackle Device is not trying to replace the operator; rather, this project is attempting to simplify the actions required by the operator. The addition of the rehang mat to separate and singulate the legs allows a person to perform the rehang operation with one hand in a casual pushing motion. This action requires much less physical effort than lifting the bird, which will allow for workers to be more efficient with their motions and reduce the risk of accident and injury.

Q: What are the results to date?
A: The primary success so far is the rehang mat. This is a passive device designed to separate and singulate the legs of the bird to align them with the shackle. However, since the design is passive, consideration is necessary to ensure that the design is able to operate as intended. We have tested about a dozen different prototypes with different materials to find a suitable design. The compliance of the bird is heavily dependent on its age and temperature, which change how it behaves when manipulated. We performed numerous trials with various types of birds in different states to ensure that our design will meet the needs of processors.

In addition to the rehang mat, we have developed a stand for testing the rehang operation on a single bird. Ideally, the Rehang Shackle Device will involve a conveyor belt tied to the moving shackle line. However, to test the various components of the device, including the rehang mat, we developed a stationary version that allows us to rapidly iterate design elements.

Q: What has been the most challenging and/or rewarding aspect of working on the project thus far?
A: The most challenging aspect of working on this project so far has been thinking through the unintended consequences of developing a new process. If this device were to be implemented, it would change how a person's day-to-day

job is performed. Our hope is to make this process easier and less strenuous for operators, so we have to ensure that everything we design is with the person in mind.

The most rewarding aspect of this project so far has been the feedback that we've received from industry. We demonstrated this technology at the International Production & Processing Expo (IPPE) at the Georgia World Congress Center this past January. As part of the Agricultural Technology Research Program (ATRP), we had the opportunity to show our device to subject matter experts and industry personnel and hear their feedback, which has vindicated the work to date. This is not the first time that rehang has been addressed, but we believe that our approach offers something unique. The process has proven so simple that we have been able to "bowl" the product into position with a gentle push; demonstrating the effectiveness and efficiency of the rehang mat.

Q: What are the project's next steps and long-term goals?
A: The next step for the project is to develop the continuous version of the Rehang Shackle Device. To date, all of the testing and research has occurred with singulated birds and a stationary shackle. A continuous device will allow us to simulate the industrial process more closely and demonstrate the effectiveness of this technology. With a continuous Rehang Shackle Device, we will then benchmark its performance to definitively show the improvements that this system offers compared to traditional rehang.

Q: What are the potential benefits for poultry processors?
A: The primary benefit of this system for poultry processors is the reduction in strenuous activity required by its operators. The Rehang Shackle Device is intended to simplify the rehang process and mitigate the risk of potential accidents and injuries, which should help operators to be more efficient and safer. Furthermore, by improving the rehang process, the Rehang Shackle Device acts as a gateway to more advanced automation for future developments.

Q: Is there anything else you would like to add?
A: I would like to thank the R. Harold and Patsy Harrison Foundation and the Agricultural Technology Research Program for their support. The genesis for this idea came during my time as the R. Harold and Patsy Harrison Research Faculty Fellow in Poultry Technologies. These organizations are critical for our continuing development in poultry processing, and I am personally very thankful for their support and guidance. Poultry is a critical part in global markets and in people's daily lives. It is our hope that we can use our expertise and inventiveness to help improve poultry processing.

RESEARCHER PROFILE

Nathan Damen

Job title: Research Engineer I

Education: M.S., Computer Science, Georgia Institute of Technology (pursuing)
B.S., Mechanical Engineering, Georgia Institute of Technology

Areas of research expertise: Human-Robotic Interaction, Mixed Reality, Wearable Technologies

List of any poultry industry projects you're working on and your role: I have been working on the Rehang Shackle Device project and some outreach efforts. The Rehang Shackle Device is an effort focused around reducing strain on individuals during rehang, post chiller. Instead of picking up and hanging birds, the operator would be able to orient and slide birds into shackles, given our custom alignment mat. I designed and fabricated our mobile test cell, which we had on the floor of this year's IPPE. This cell, allows us to test a variety of alignment mat designs, table angles, table heights, shackle designs, and even custom electronic feedback interfaces that could aid the operator.

For the outreach effort, I have been co-leading a group of undergraduate students in designing a pick-and-place robotic cell with crane-game style controls. This outreach cell has been previously taken to the Georgia National Fair and Atlanta Science Festival in an effort of showing how human-robot collaboration can contribute back to Georgia's agricultural and poultry industries, while still being a fun, approachable demo for anyone.

What I find most rewarding about working on poultry industry projects: I find the positive impact on individuals throughout the state of Georgia and beyond the most rewarding aspect of poultry industry projects.

A talent I wish I had: Whistling songs by ear

Another occupation I'd like to try: I'd like to run a tea shop … with Rube Goldberg machines to brew the tea.

My first job: Sewing robotics and automation systems engineer

If I could meet someone famous, who would it be and why: J.R.R. Tolkien, to share conversation over second breakfast

One thing people may not know about me: I invented/named a skateboard trick during my brief time competition skating

My day would not be complete without: Espresso

The last book I read: *Lonesome Dove* by Larry McMurtry

The last movie I saw: Hukkle by György Pálfi

My favorite song: Currently, most played is "Cicadas" by Machine Girl, but there is too much music out there to have a favorite.

My motto: Adventure never happens on a calm day

My hobbies: Performance art along the Atlanta Beltline and skating of all kinds

Biosensing Technologies: A Look at the CRISPR-Cas System

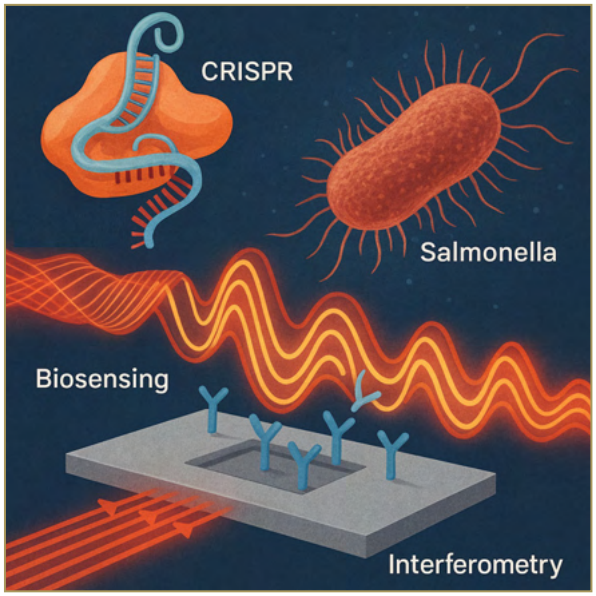
BY STEPHANIE RICHTER

Stephanie Richter is a research scientist II in GTRI's Agricultural Technology Research Program.

Biosensing technologies, a convergence of physics, biology, and chemistry, are designed to detect specific biological molecules. Essential to a biosensor's function are three components: a target-specific recognition element, a transducer, and a reader. The transducer converts the biological interaction into a measurable signal, which the reader then interprets, providing user-friendly results.

A powerful tool in biosensing is the CRISPR-Cas system. Originating as a natural defense mechanism in bacteria and archaea, CRISPR-Cas systems provide adaptive immunity by recognizing and deactivating foreign genetic material. These systems utilize repeating DNA sequences and associated Cas proteins. Cas proteins function as programmable molecular scissors, capable of precisely cleaving specific nucleic acid sequences. Guide RNAs (gRNAs) direct the Cas protein to the target sequence, designed to be complementary to pathogen genomes.

A foundation of ongoing work in the Georgia Tech Research Institute's (GTRI) Agricultural Technology Research Program (ATRP) is the application of the CRISPR/Cas12 system for rapid and accurate pathogen detection including *Salmonella*. Beyond its targeted DNA binding, the Cas12-gRNA system exhibits an interesting phenomenon known as collateral cleavage. This refers to the enzyme's ability, once it has successfully recognized and bound its specific double-stranded DNA target, to also non-specifically degrade nearby single-stranded DNA (ssDNA). We are utilizing gRNAs complementary to unique *Salmonella* genomic regions, aiming to achieve high specificity for cleaving the ssDNA-coated waveguide chip, integrated within our developed interferometer. This approach is elegant because ssDNA-coated chips can serve as a universal sensing platform for CRISPR/Cas12-based detection of any pathogen of interest.



The CRISPR-based biosensing development combines CRISPR technology with interferometry to design a biosensor capable of detecting Salmonella enterica *in poultry samples.*

Our current research is focused on optimizing the collateral cleavage efficiency to enhance the detection sensitivity. We are using fluorescence tagging to characterize and capture fluorescence intensity profiles over time to confirm Cas protein cleavage.

For signal transduction, ATRP has developed a highly sensitive interferometric detection system. This system leverages custom-designed optical components and algorithms to measure minute changes in the refractive index at the sensor surface, induced by the CRISPR-Cas interaction on the waveguide surface. Our interferometric setup is optimized for high signal-to-noise ratio and rapid readout, allowing for real-time monitoring of the CRISPR-Cas reaction. We are continuing to optimize both the chip surface chemistry and the interferometric readout, with the goal of achieving high sensitivity, enabling the detection of very low concentrations of *Salmonella*.

— SAVE THE DATE —

NATIONAL SAFETY CONFERENCE FOR THE POULTRY INDUSTRY

August 18-20, 2025
Hilton Sandestin Beach Golf Resort & Spa
Destin, Florida

The 2025 National Safety Conference for the Poultry Industry is designed specifically for poultry facility and corporate safety personnel. The three-day event features key presentations on important industry topics and updates on government policy. Other highlights include breakout sessions for discussing best practices and current challenges, as well as networking and knowledge exchange opportunities with other safety and health professionals.

To register, visit **uspoultry.org/programs/education/seminar**

The Rendering Industry's Commitment to Sustainability

BY PAUL BREDWELL, EXECUTIVE VICE PRESIDENT OF REGULATORY PROGRAMS, U.S. POULTRY & EGG ASSOCIATION (USPOULTRY) — REPRINTED WITH PERMISSION FROM *POULTRY TIMES*

A critical yet often overlooked aspect of the poultry industry's commitment to sustainability is the rendering of by-products not consumed by humans.

While the majority of the 9 billion chickens processed annually in the United States are consumed by people, approximately 37 percent of the liveweight of broiler chickens goes unused for human consumption. This statistic, highlighted in the 2006 book, *Essential Rendering*, published in 2006 by the North American Renderers Association, the Fats and Protein Research Foundation, and the Animal Protein Producers Industry, underscores the importance of sustainable by-product management in the poultry sector.

Rendering, a process which involves the application of heat, the extraction of moisture, and separation of fat, has been around for centuries. By-products bound for rendering are made up of feathers, blood, water, and bones discarded after edible meat is removed from the carcass, and much of the bird's internal organs and digestive system.

Perhaps the most important and valuable use of these by-products is the production of feed ingredients for poultry, livestock, aquaculture, and pets. *Render Magazine* reported in 2021 that approximately 10,425 metric tons of rendered poultry products were produced in the United States.

Poultry rendering companies produce feather meal, poultry by-product meal, and poultry fat. Feather meal is a good protein source and can replace other proteins in livestock and aquaculture diets. Poultry by-product meal is an excellent source for poultry and swine rations and can also replace fish meal in many diets. Poultry fat provides significant energy when added to the feed of livestock, poultry, aquaculture, and companion animals.

In addition to feed products, the rendering industry is responsible for the production of fertilizer and many household products. Referred to as oleochemical products, these items include gel caps used to contain vitamins, drugs, and supplements; soap; lotions; cosmetics; and tires. Additionally, rendered poultry and animal fat is used to produce nonfood items like candles, deodorant, lubricant, paint, chalk, and cement.

Food safety is another critical component of sustainability. Cooking time and temperature is critical in inactivating bacterial and other microorganisms in the raw products. Although these products are not consumed by humans, the feed ingredients produced through the rendering process must still pass strict safety guidelines established in the U.S. Food and Drug Administration's Food Modernization and Safety Act.

Upcycling by-products from poultry and livestock harvesting and processing significantly enhances sustainability efforts. By feeding rendered products to animals, the demand for plant-based feed is reduced, leading to less cropland needed for growing crops and forage for livestock raised for human consumption. Not only does this conserve valuable agricultural land, it also decreases water usage for crop production and lowers fuel and energy consumption required for cultivating, planting, and harvesting those crops and forage.

Water scarcity and quality are key components of any sustainability initiative, especially for the agricultural industry. While the poultry industry uses water as a mechanism to produce a safe supply of animal protein, the majority of the water used during the harvesting process is returned to the environment.

Due to the high moisture content of the by-products collected from poultry and livestock harvesting facilities, rendering plants can reclaim a substantial amount of water. According to the North American Renderers Association, 3.7 billion gallons of water per year are reclaimed from products that undergo rendering.

Before recycling into the environment, the reclaimed water is treated to an elevated level of quality in accordance with a permit issued though the U.S. Clean Water Act National Pollutant Discharge Elimination System. This permit sets limits on various pollutants that could harm the environment, people, or wildlife. Reclaimed water that is not discharged to the environment undergoes varying levels of wastewater treatment established by state or local requirements prior to being discharged to a municipal wastewater treatment facility for further handling.

Not known widely, the rendering industry is responsible for the production of a substantial volume of biodiesel fuel. A report issued by the

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The Rendering Industry's Commitment to Sustainability

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U.S. Energy Information Administration indicated that of the total 1.86 billion gallons of biodiesel produced in 2018, 9.2 percent of the feedstock were classified as animal fats. Furthermore, rendering sequesters five times more greenhouse gases than it produces.

If every sustainability effort listed above was lost and all products that could be rendered were diverted to a landfill, all available landfill space would be gone in four years.

The rendering industry's contribution to sustainability is unmistakable. But like any initiative to be sustainable, there is no destination … only a journey. To develop a roadmap for that journey, the Poultry Protein & Fat Council (PPFC) was founded in 1988. Growing out of leadership established by key individuals working in the poultry rendering industry, the PPFC helps to guide the U.S. Poultry & Egg Association in providing needed assistance.

PPFC members agree that research is an urgent and vital need to support the poultry rendering industry. From its inception, the PPFC has funded more than $2.5 million in research associated with the rendering industry. PPFC continues to solicit research proposals that are aimed at providing information that has the potential to solve real industry problems – especially those that are associated with making the industry more sustainable.

For information regarding PPFC's research funding program, please visit poultryrenderers.org/research.cfm.

Technical Assistance Is Just a Phone Call Away

The Agricultural Technology Research Program (ATRP) provides no-cost technical assistance to Georgia-based firms and individuals in the poultry industry. These assists range from simple inquiries regarding information or help needed to address a problem to extensive on-site consultations in which researchers collect data and provide a report on their findings and recommendations. The program also offers in-plant energy usage/cost assessments and workplace safety evaluations.

ATRP uses input from all assists to gauge situations calling for new research initiatives in energy, environmental, safety, and other areas.

To inquire about the program or to schedule an assist, contact ATRP Program Manager Doug Britton at 404-407-8829 or doug.britton@gtri.gatech.edu.

Like Us on Facebook

ATRP's Facebook page features information about exciting research initiatives underway, interesting poultry and food industry news, industry events, photos, videos, and more!

facebook.com/ATRP.GTRI

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Agricultural Technology Research Program
GTRI/ATAS/ISTD
Atlanta, GA 30332-0823

Phone: 404-407-8812
FAX: 404-407-8569

Angela Colar
Editor
angela.colar@gtri.gatech.edu

Doug Britton, Ph.D.
ATRP Manager/Editorial Adviser
doug.britton@gtri.gatech.edu

Online:
atrp.gatech.edu

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