Story by Katie Heinrich

Making wastewater environmentally sustainable

Innovative technology offers new possibilities for wastewater treatment

Municipal wastewater treatment plants may soon become more sustainable in their treatment of wastewater by pursuing new electron beam (e-beam) technology being researched at a Texas A&M AgriLife Research center in College Station.

To help these plants in their move to increased sustainability in wastewater treatment, the National Center for Electron Beam Research (NCEBR) is focused on bringing e-beam technology to the wastewater industry, said Dr. Suresh Pillai, director of the center, professor of microbiology at Texas A&M University and a Texas A&M AgriLife Research Faculty Fellow.

E-beam technology can remove pathogens and chemical contaminants normally found in wastewater in one step. The technology also retains valuable plant nutrients and other compounds in wastewater. Using this technology, municipalities would be able to generate biosolids, which can be applied to agricultural lands and landscaping without any concerns of potential pathogens, Pillai said.

Biosolids are the nutrient-rich organic materials resulting from the treatment of sewage sludge, which is the name for the solid, semisolid or liquid untreated residue generated during the wastewater treatment.

By partnering with wastewater industry groups such as the Water Environment Research Foundation (WERF) and industry leaders such as Headworks BIO Inc., a wastewater screening equipment engineering company in Houston, the NCEBR is attempting to accelerate the move of e-beam technology commercialization from the research laboratory to the marketplace, Pillai said.

E-beam processing or electronic irradiation is a process that uses electrons, usually of high energy, for various purposes. E-beam technology and processing are currently used commercially in the medical industry to sterilize medical products, in the food industry to pasteurize food against pathogens and protect it from contamination, and in the agricultural industry to prevent the introduction of invasive pests into unprocessed bulk crops that may be sent across national borders.

"The NCEBR has been at the core of research and commercialization of this technology for over a decade," Pillai said. "Now we are actively working with our research partners to develop commercially relevant information to help promote adoption of this technology into the wastewater industry. It is imperative that we collect realistic metrics and economics of the technology.

"When tested on wastewater, this technology has worked beautifully," he said.

Pillai said the technology can be used for both the liquid and solid wastes present in municipal waste streams. Besides killing all viruses, parasites and bacteria, e-beam can degrade certain pharmaceutical and personal care products.

Proximity to adoption

No wastewater treatment plant currently uses the e-beam technology; only pilot-scale field tests have been done. In the 1980s a study was done in an e-beam pilot plant in Florida. The study showed promising, positive data; however, the linear accelerator energy needed for high volume applications was not available at the time, Pillai said.

Pillai hopes that within the next one to four years, there will be at least one pilot scale installation of the e-beam technology in a wastewater treatment plant and that this installation will show that this technology is robust and sustainable, leading to wider adoption of e-beams in wastewater treatment.

Theoretically speaking, this technology could find immediate application in many cities if it were to become commercially feasible, Pillai said.

Funding from WERF has allowed the center to pursue advancements in the e-beam technology that would make the technology highly suitable for the wastewater industry. Based on these findings, the center has filed a U.S. patent for the application of e-beam technology in wastewater treatment.

Pillai hopes the commercialization of the patented technology will bring in additional research funding, allowing the center to further improve and develop the technology for wastewater treatment.

E-beam and cities

By working with e-beam technology companies, Pillai said they are taking steps to customize the technology into operational units for cities and water municipalities. The United States has many sizes of wastewater treatment plants, so the installation of the e-beam technology needs to be suitable for the size of the plant, Pillai said.

"We are configuring the technology to meet different-sized cities and preparing design specifications for cities of different sizes," Pillai said. "The wastewater industry could lose faith in the technology if we erroneously put an e-beam into a small city that does not have the capacity to use it or have the means for the capital investment in the technology."

Pillai said it is increasingly common to see public-private partnerships in which a consulting or engineering firm builds and operates a treatment facility and then receives revenue from the city for the volume of wastewater treated. This helps cities that may not have the funding capacity to incorporate new industry technology into their treatment plants.

Multiple advantages

The e-beam technology will improve the quality of the sewage sludge from the wastewater. E-beam technology, when used at appropriate doses, disinfects the sludge and transforms it into a pathogen-free biosolids fertilizer, making it a valuable product of this technology. The product is environmentally stable and meets federal standards for fertilizer, allowing it to be applied to agricultural lands, he said.

"By adopting this technology, a municipality does not have to pay for [sludge] to be taken to a landfill," Pillai said. "Rather, the sludge is marketable and the city utility can actually sell the sludge."

Pillai partnered with Dr. Bob Reimers, a wastewater treatment process chemist at Tulane University, to conduct a cost benefit analysis, learning what the cost would be to use this technology in sludge processing.

"There are a lot of ways this technology can be used," Pillai said. "You have to be careful that you are recommending this technology to the appropriate municipality. That's why we are working with wastewater engineering companies who do know the industry well."

Pillai and his team at the NCEBR have also worked with environmental consulting companies such as BCR Environmental in Florida and the International Atomic Energy Agency in Vienna, Austria, a global agency that promotes e-beam technology for wastewater treatment.

"Harnessing e-beam technologies to clean, heal and feed the world is part of the NCEBR's mission," Pillai said. "We are hopeful our efforts to commercialize e-beam treatment of wastewater will help us deliver on that mission."

(left photo) Wastewater treatment plants may soon become more efficient and more sustainable, thanks to electron-beam technology. Photo courtesy of Texas A&M AgriLife Extension Service.

(right photo) Mickey Speakmon, electron beam facility manager, works in the e-beam center. Photo by Leslie Lee.