Benefits abound with recently patented system that reduces phosphorus in wastewater

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A team of bioprocessing engineers with Kansas State University's Advanced Manufacturing Institute has been issued a patent for a system that removes phosphorus from wastewater and addresses environmental regulations.

Excess phosphate from both animal and human wastewater is an important environmental problem. It can pollute water resources and cause algae blooms, a problem that was present in many Kansas lakes and reservoirs this summer.

The phosphorus reduction system, called Phred for short, is an easy-to-use fully automated system that removes up to 60 percent of phosphorus in wastewater from cattle feedlots. The system was issued as a patent titled "Fluidized bed precipitator with optimized solids settling and solids handling features for use in recovering phosphorus from wastewater" to the Kansas State University Research Foundation, a nonprofit corporation responsible for managing the technology transfer activities of the university.

"In essence, the system changes the chemistry of wastewater from the feedlot. It runs the water through the reactor and the phosphorus is retained in pellet form. A chemical reaction occurs, so the water comes out with lower phosphate levels," said Sigifredo Castro Diaz, a bioprocessing engineer with the Advanced Manufacturing Institute, or

AMI, who helped create the patented system.

"Through this system, we can recycle the excess phosphate, while before it could be wasted and end up feeding algae water in lakes," Diaz said.

The project started as a partnership with Kansas Environmental Management Associates, or KEMA. The researchers created a pilot system in the laboratory then used a scale version on the university's lagoon or the feeding operation pond. Finally, the team developed a large-scale system to use at Supreme Cattle Feeders near Liberal, Kan.

The final patented system works by removing phosphorus from lagoons and trapping it in pellet form, making it easier to distribute and package. By doing so, it addresses two important farming concerns involving irrigation.

"Without the system, if farmers reuse the wastewater and there is too much phosphorus in it, they can face fines by the EPA," Diaz said. "But during a drought, it is not helpful to have all this water that they cannot use because of the phosphorus content. So with this phosphorus reduction system, farmers can remove the phosphorus and safely use the water."

As a result, the system helps farmers cut costs while following Environmental Protection Agency regulations. Farmers can purchase the system with assistance from the Environmental Quality Incentive Program, a federal program that provides assistance to farmers. While competitive systems exist, they are often more expensive, less efficient and less applicable to agricultural wastewater, the researchers said.

"The development of the Phred system provides livestock farms and others with a valuable tool to protect our nation's lakes, streams and estuaries, and KEMA is proud to be the driving force behind its

development," said Kylo Heller, director of development for KEMA.

Diaz is now leading related research projects through partnerships with Kansas State University and other organizations. The team is improving the efficiency of the current bioprocessing system by partnering with additional AMI and university researchers, such as Larry Glasgow, professor of chemical engineering.

The researchers are discovering uses for the phosphorus pellets that come from the system. Kimberly Williams, professor of horticulture, worked on a nutrient release study and found several important advantages of phosphorus pellets as fertilizer for lawns and plants. For instance, the pellets are a natural slow-release fertilizer, meaning they slowly release nutrients to plants.

Similarly, the team is looking at ways to decrease phosphorus in cattle feed. Doing so will prevent excess phosphorus from entering the ecosystem.

While the current system is optimally designed for wastewater from cattle feedlots, Diaz has been leading efforts to apply the same method at dairy and hog farms. The wastewater from these farms is different because it often comes from indoor barns that produce more phosphate-concentrated wastewater. The researchers have proved that the same system can work with both types of farms and are now working to fine-tune it.

Provided by Kansas State University