INNOVATIONS

Food researchers use plasma jets to target biofilms on food processing equipment

By BRAD CARLSON
Capital Press

Brad Carlson/Capital Press

Boise State University's Jim Browning and Ken Cornell at their plasma array test setup.

BOISE — New ways to remove biofilms could help food processors save water, reduce system downtime, and increase food and worker safety.

Boise State University researchers Jim Browning and Ken Cornell are making progress with plasma.

"If we can deploy plasma treatment systems to kill or remove contaminants, we can reduce the need for water and chemical usage, and potentially reduce cost while improving food safety," said Browning, associate professor of electrical and computer engineering.

Food manufacturing, a major industry in Idaho, uses substantial water and will face more competition for it as the population and industrial base grow, said Cornell, a professor of biochemistry.

Familiar biofilms include pond scum, slick material on stream-bed rocks, and tooth plaque.

But biofilms "exist on almost every surface around you," Cornell said. More than three-quarters of microbes colonize in biofilms as opposed to living on their own.

"All of the food-processing surfaces that can come into contact with food are going to develop biofilms," he said. They show up on tabletop surfaces, machines and conveyor belts, and in pipelines.

Browning said bio fouling in pipelines that deliver food products like milk, juice and yogurt poses a major challenge. Steam and water flushes, and alkali and acid solutions are used.

"In the liquid setting, there are more challenges," Cornell said. Shutdown is required.

The scientists use cold atmospheric pressure plasma and a low-temperature, co-fired ceramic.

Browning said the approach can clear the vast majority of biofilm bacteria from surfaces including stainless steel, glass and plastic. Variables include biofilm thickness and total amount, though processors work hard to avoid buildups.

Cold atmospheric pressure plasma is a partly ionized gas, with charged particles, that can be generated at atmospheric pressure and low or room temperature.

Co-fired ceramic, which students fabricate, can be made into geometries that range from planar arrays suited to flat surfaces to radial arrays that can go through a pipe.

Cornell said getting the plasma to the target, such as biofilms on a surface, usually involves a carrier gas that delivers the reactive species created by the plasma device's electric discharge.

He said the devices can be designed as "plasma jets" that discharge an ionized gas plume or cone beyond the device — like an acetylene torch, but not hot.

Another design keeps the discharge within the device. Ionized plasma species are ejected from the device using a current of carrier gas, similar to a compressed-air canister for keyboard cleaning. The glow of plasma discharge is not seen since it is contained.

Cornell said a prototype radial plasma device projects plasma outward from within a pipe and functions somewhat like a "plasma bottle brush."

"And we have shown we can do this with compressed air as a feed gas rather than argon or helium," he said. Compressed air is easier and cheaper to use, and more sustainable.

Cornell said food processing is better than ever but will come under more resource pressure. Food-borne illness, worker safety and economical, sustainable food production will remain priorities.

"You can't stand still," Browning said.

The multi-year project has grant funding from USDA, the National Institutes of Health and the National Aeronautics and Space Administration.

It is lab-based and currently not part of a pilot project at a food processor.

Robotic hives use artificial intelligence to help honey bees — and beekeepers

By SIERRA DAWN McCLAIN
Capital Press

Courtesy of Saar Safra/Beewise

Saar Safra said it takes about three hours for a beekeeper to populate a BeeHome with hives.

An Israeli startup called Beewise has invented robotic hives that use artificial intelligence intended to help beekeepers manage pollinators and save honey bee colonies from collapse.

Colony collapse is a major problem. According to USDA, U.S. beekeepers on average lose 30% of their managed honey bee colonies annually. Threats to honey bee survival include the deformed wing virus, varroa mites, drought, pesticides and other pressures.

Beewise claims its new, solar-powered technology, called the "BeeHome," can help reduce colony losses by detecting threats with AI. Beewise claims its hives experience 8% colony loss compared to the 30% average.

The BeeHome was the brainchild of Eliyah Radzyner, an Israeli beekeeper, who in 2017 was "amazed" beekeepers were still carrying around wooden boxes for hives, which had been the industry standard since the 1800s.

He wondered: Wasn't there a better way?

Alongside business experts, researchers and engineers, Radzyner started Beewise.

A BeeHome is precisely what it sounds like: a home for bees. It's a 12-square-meter white box resembling a shipping container with colorful slots through which bees can enter and exit. Step through the door designed for a beekeeper and inside, is a system of robots and AI working to monitor and host 24 colonies — potentially more than 1 million honey bees.

Courtesy of Saar Safra/Beewise

A BeeHome in transit.

Within the BeeHome, video feeds continually monitor bees, and AI analyzes the footage, detecting pests, pathogens, honey and brood with about 99% accuracy. The system can monitor 4.3 million cells: 6,000 cells in a frame, 30 frames in a hive, 24 hives in a BeeHome.

"We know everything that is going on in every single cell in every single frame," said Saar Safra, Beewise's CEO and co-founder.

A beekeeper can watch live hive footage remotely or view AI-generated graphs on hive health.

Safra said the BeeHome has many advantages.

First, it can "raise red flags" when something undesirable, like a pest, is detected.

Although the beekeeper remains the strategist and decision-maker, the BeeHome contains robotics that Safra said can act as the "hands and legs" of a beekeeper who's not on site.

For example, the BeeHome's robots can harvest honey, heat-treat frames to kill off varroa mites and give bees food, water and medication.

When pesticides are sprayed, the BeeHome temporarily closes its hatches to protect the bees inside.

Beewise's services are designed for commercial operations with 1,000 or more hives.

Andony Melathopoulos, Oregon State University Extension Service's pollinator health specialist and assistant professor, said because Beewise is a young company, he's not yet familiar with its technology, but he said AI could potentially be useful in the pollination industry.

"New tools that use machine learning have a lot of potential to help increase the health of honey bees and lower production costs, particularly as labor costs continue to rise," he said.

Melathopoulos said he believes the strongest technologies will be those "where companies include commercial beekeepers at the development phase."

Safra said Beewise is doing just that. Since the company launched in 2018, Beewise has been doing trials and commercial work with beekeepers worldwide, including in Israel, California and Oregon.

The company started small and is revving up. Beewise is deploying about 1,000 BeeHomes in 2022 and plans to deploy 5,000 devices in 2023.

Beewise is backed by private funding and has raised $120 million to date from investors.

BeeHomes are available commercially. The beekeeper pays a one-time $2,000 delivery fee. From that point on, the beekeeper pays a subscription service at $400 per month.