Innovative technologies take the ‘waste’ out of wastewater

EU-funded researchers have created a circular wastewater economy with cost-effective and environmentally friendly technologies and processes that turn wastewater into bioenergy and high-value bioproducts.

Water demand is expected to increase significantly over the coming decades. At the same time, almost one fifth of the world’s population already lives with water scarcity and the situation is likely to worsen. The EU-funded INCOVER project identified a win-win situation in moving the mission of wastewater treatment from sanitation to bioproduct recovery and water recycling.

Value from wastewater

As project coordinator Juan Antonio Alvarez Rodriguez explains, “INCOVER transforms wastewater into valuable products in a 'circular economy' approach.” Scientists developed innovative technologies for biomass production, anaerobic digestion, and nutrient and water recovery for effluents from municipal, industrial, and agricultural wastewater.
Bioplastics such as compostable and marine-degradable polyhydroxyalkanoates (PHAs) are still struggling to compete with conventional fossil fuel-based polymers, largely due to costly production mechanisms. INCOVER used wastewater high in organic content to provide carbon as a low-cost substrate for microalgae-bacteria communities without the need for costly sterilisation.

According to Alvarez, “The innovative PHA production process enabled successful recovery of 2.6 kg of PHA per day from phototrophic microalgae-bacteria systems treating domestic wastewater and other wastewater with high organic content. With 85% efficiency of PHA extraction, plants can expect a revenue of EURO 1.06 per cubic metre of wastewater.” Thanks to INCOVER, the plastics industry can cost-effectively source sustainable and environmentally friendly PHA.

INCOVER also delivered cost-effective and environmentally friendly biogas-cleaning technology to help meet increasingly strict regulation worldwide. “The biogas cleaning technology can provide eight cubic metres of high-quality biomethane per day suitable for injection into natural gas grids or use as biofuel in vehicles,” says Alvarez. This biomethane can also be used to power the wastewater plant itself, significantly offsetting operating costs as well as the plant’s carbon footprint.

Agricultural water consumption accounts for 38% of global freshwater withdrawals. INCOVER developed a solar-powered ultra-filtration and anodic oxidation system. As Alvarez explains, “INCOVER’s cost-effective disinfection systems can provide 10 cubic metres per day of pathogen-free wastewater effluent for irrigation and industrial use.”

In addition to technologies for PHA, biomethane, and water purification, INCOVER also developed processes to recover 30 kg per day of organic acids in high industrial demand and 60-70% recovery of phosphorus and nitrogen to be used directly as biofertilisers. These added-value technologies were demonstrated in real scale at three different European sites.

**Supporting implementation**

To assist authorities and facilities managers in choosing technologies and support discussions for market uptake, INCOVER also developed a tailored-to-technology decision support system (DSS) based on a life cycle sustainability assessment (LCSA) framework. INCOVER technologies and products are expected to reduce the overall costs of municipal and industrial wastewater treatment plant operation and maintenance by at least 50%.

INCOVER presented technologies at 101 events and issued 73 press releases. Outcomes garnered international acclaim, including winning the first Sludge & Resource Recovery Initiative of the Year Water
Industry Award 2018 and being one of 10 winners of the POWER Idea Contest for Sustainable Communities 2019. INCOVER's innovative processes and products are poised to close the loop on a circular economy for wastewater, exploiting its hidden treasures.

Keywords
INCOVER, wastewater, water, polyhydroxyalkanoates (PHA), biomethane, microalgae, bacteria, circular economy, agricultural, carbon, irrigation, biofertiliser

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