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IPN Students Develop Sargassum-Based Electrodes to Decontaminate Wastewater

- **The effectiveness of the electrodes was tested by removing pollutants from wastewater provided by a textile company containing denim pigments.**
- **To make the technology sustainable, the students incorporated solar panels into the process to supply the energy required for decontamination.**

A group of graduate students from the Instituto Politécnico Nacional (IPN) is developing electrodes made from charcoal obtained from sargassum, which they use in an electrochemical process to degrade contaminants originating from the textile industry.

Geovani Flores Sánchez, Frida López López, Ángel Eduardo Lugo Dorantes, and José Fernando Carmona Neri—students of the master's program in Sustainability and Innovation in Environmental Technology offered by the Escuela Nacional de Ciencias Biológicas (ENCB)—combined their interdisciplinary knowledge to explore new, sustainable uses for this algae, which frequently accumulates along Mexican beaches.

This research aligns with the agenda promoted by IPN Director General Arturo Reyes Sandoval, consistent with the priorities set by the administration of President Claudia Sheinbaum Pardo and supported by the Secretary of Public Education, Mario Delgado Carrillo, regarding the development of new technologies for environmental protection.

The students successfully tested the electrodes at a semi-pilot scale, removing contaminants from wastewater supplied by a textile company. This water contains pigments used in the dyeing of denim.

They noted that indigo dye is particularly difficult to remove from wastewater, often rendering conventional treatment processes incomplete. For this reason, the goal of this IPN technology is to eliminate as much organic and inorganic matter as possible.

Under the guidance of researcher Jorge Alberto Mendoza Pérez, the team applies a technique known as pyrolysis to dehydrated sargassum. Through this high-temperature

thermal process, the algae are chemically transformed into a solid fraction known as biochar.

They then add special catalysts—developed by the students themselves—to the biochar to modify its initial amorphous structures and ensure that the resulting carbon nanotubes and graphene reach uniform nanometric sizes.

In addition, they characterize the nanometric biochar and use various techniques to verify that the particles meet the ideal nanometric dimensions (thickness, diameter, and length) required to manufacture electrodes with superior electrical conductivity compared to commercial devices.

To fabricate the electrodes, the students incorporate certain semiconductors into the biochar and subject the formulation to a thermal process to achieve the specific hardness required for proper electrochemical performance. They also verify that the electrodes meet quality standards based on international norms.

Aiming to create an integral system, Geovani Flores, Frida López, Ángel Lugo, and Fernando Carmona integrated solar panels into the technology to ensure that the process itself reflects sustainable principles. The panels supply the energy needed for the system to carry out wastewater decontamination.

Recently, the student team won first place in the InnoDrop Water Talent Incubator, a program that supports emerging innovation leaders and recognizes entrepreneurial initiatives aimed at addressing Mexico's most pressing water security challenges. With the seed capital awarded, they plan to develop further and scale the project to bring the electrodes to the industrial sector.

For more information, visit www.ipn.mx

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