

Using electricity to break down pollutants left over after wastewater treatment

9 July 2020, by Audrey-Maude Vézina



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Pesticides, pharmaceutical products, and endocrine disruptors are emerging contaminants often found in treated domestic wastewater, even after secondary treatment. Professor Patrick Drogui of the Institut national de la recherche scientifique (INRS) and his team have tested the effectiveness of a tertiary treatment process using electricity in partnership with the European Membrane Institute in Montpellier (IEM) and Université Paris-Est.

The advanced electro-oxidation process (EOA) uses two electrodes to break down non-biodegradable pollutants that remain after biological treatment. Electric current is passed through the electrodes, generating hydroxide radicals ($\cdot\text{OH}$), which attack the refractory molecules. The primary advantage of this method is that it does not require any chemicals to be added to the water.

"EOA processes are revolutionary in the field of [wastewater](#) treatment. It's pioneering technology for treating wastewater contaminated by refractory pollutants such as pharmaceutical wastes," said Professor Patrick Drogui, co-author of the study

published on June 18 in the prestigious journal *Science of the Total Environment*.

The researchers tested new catalytic electrodes. "We have shown that these electrodes are effective and produce large quantities of hydroxide radicals. They are also cheaper than the other electrodes currently on the market, which reduces the cost of the treatment," said Yassine Ouarda, Ph.D. student and first author on the study.



INRS Professor Patrick Drogui, a specialist in electrotechnologies and wastewater treatment. Credit: Jean-Daniel Bourgault (INRS)

Versatile tertiary treatment

Researchers tested the technology on three types of water coming from different treatment processes: conventional, membrane bioreactor, and a treatment process that separates wastewater, including feces, at the source. They focused on paracetamol, otherwise known as acetaminophen. "We tested the process on this particular molecule

because it's one of the world's most widely used drugs. We have already tested it at INRS for some 15 different pollutants, as the process can be used for other pharmaceutical molecules," said Mr. Ouarda.

During partial breakdown of pollutants such as pharmaceuticals, the byproducts can be more toxic than the parent compounds. "We observed that the toxicity of the solution increased and subsequently decreased during treatment. This indicates that the toxic molecules are themselves broken down if the reaction continues," said Mr. Ouarda.

"This work once again confirms that advanced electro-oxidation processes are good candidates for breaking down drug wastes left behind after biological treatment," said Professor Drogui.

More information: Yassine Ouarda et al, Electro-oxidation of secondary effluents from various wastewater plants for the removal of acetaminophen and dissolved organic matter, *Science of The Total Environment* (2020). DOI: [10.1016/j.scitotenv.2020.140352](https://doi.org/10.1016/j.scitotenv.2020.140352)

Provided by Institut national de la recherche scientifique - INRS

APA citation: Using electricity to break down pollutants left over after wastewater treatment (2020, July 9) retrieved 29 September 2020 from <https://phys.org/news/2020-07-electricity-pollutants-left-wastewater-treatment.html>

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