Ozone bubbles to eliminate wastewater micropollution

July 31 2015

Ozone treatment efficiently removes many micropollutants contained in wastewater, but in some cases, it can lead to the formation of toxic byproducts. A new test informs on whether ozonation is a suitable technology for enhanced wastewater treatment.

The widespread use of pharmaceuticals, pesticides, and other chemically complex consumer goods has led to the release of persistent and often harmful micropollutants into the aquatic environment via municipal wastewater. In response, the Swiss Federal Agency for the Environment called for about 100 wastewater treatment plants across Switzerland to be upgraded, adding treatment steps specifically designed to eliminate micropollutants. Ozone treatment is one viable candidate technology that is both easy to implement and highly efficient. There are, however, certain compounds that can become more toxic when treated with ozone. In a study published in the journal *Water Research*, a team of researchers from EPFL, ETH Zurich, and Eawag present a test to evaluate the suitability of ozone treatment for urban wastewater taking into account potential contributions from industrial sources.

When ozone, or O3, is added to water it can react directly with micropollutants or it decomposes to form highly reactive hydroxyl radicals that can rapidly interact with and break apart a broad range of chemical compounds. Because ozone efficiently kills bacteria and viruses, ozone treatment has found widespread application in drinking water disinfection in Switzerland and other countries. And in 2014, a first Swiss wastewater treatment plant in Dübendorf was upgraded to

include an ozonation step to eliminate micropollutants from already treated wastewater, demonstrating the maturity of the technology.

Over the next 20 years, about one in seven Swiss wastewater treatment plants will be upgraded with the goal of reducing the micropollutants load into the environment by a half. Plant operators in agreement with cantonal and federal authorities have to decide whether to use powdered activated carbon to adsorb micropollutants, or ozone to destroy them. According to Urs von Gunten who led the study, both approaches have similar efficiencies, but differ in other important ways. Once used, powdered activated carbon is incinerated with the sewage sludge, effectively destroying any adsorbed micropollutants. However, it requires significant maintenance operations. Ozone treatment, by contrast, is easy to automate and clean to handle. Micropollutants are broken apart chemically, and the fragments are then released into the environment.

Despite its advantages, ozone treatment of wastewater has one important caveat. "Whether wastewater treatment plants should implement ozone treatment depends on the water they treat," says Urs von Gunten, joint professor at EPFL and Eawag. "When, for example, ozone treatment is used to treat wastewater containing bromide, bromate can be formed, a potentially carcinogenic compound."

von Gunten and his team developed a four-step test procedure to assess whether the wastewater from a specific plant can be safely treated with ozone. Not only does it involve assessing the efficiency of micropollutant abatement and the formation of oxidation byproducts, the test also includes a series of biological assays to test the toxicity of the treated wastewater before and after treatment. "The idea is that the test, which will be carried out by a private laboratory, will assist cantonal agencies and federal authorities in deciding how best to upgrade wastewater treatment plants," he says.

Upgrading wastewater treatment plants to eliminate micropollutants is one way to curb their release into the environment. But, says von Gunten, legislating the use of particularly persistent, harmful compounds and replacing them with less harmful alternatives could contribute to solving the problem at the source.

Provided by Ecole Polytechnique Federale de Lausanne