Elimination of Micropollutants in Wastewater Treatment Plants: Ozonation or Activated Carbon? Conclusions of a One-Year Pilot Project.

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Many organic micropollutants present in wastewater, such as pharmaceuticals and pesticides, are poorly removed in conventional wastewater treatment plants (WWTP). To reduce the release of these substances into the aquatic environment, advanced treatments are necessary and may be soon mandatory in Switzerland. Two advanced treatments were tested in pilot systems over more than one year at the municipal WWTP of Lausanne, Switzerland. The first pilot involves the ozonation of the effluent to oxidize organic substances. It is followed by a sand filtration (SF) to remove the readily biodegradable reaction products. The second pilot consists of a powdered activated carbon (PAC) addition into the effluent to sorb micropollutants. It is followed either by a membrane filtration (ultrafiltration) or a sand filtration to separate the PAC from the treated water. A selection of 58 potentially problematic substances (pharmaceuticals, pesticides, endocrine disruptors) were regularly measured at different stages of treatment by ultra performance liquid chromatography coupled to a tandem mass spectrometer, and a large battery of ecotoxicological tests (16 in vitro and 9 in vivo assays with different organisms) were performed to evaluate the toxicity of the effluents. The results showed that most compounds were removed over 80% with an average ozone dose of about 5.5 mgO3/l or a PAC dose between 10 and 20 mg/l. Only some single compounds, such as X-ray contrast media, were only partially eliminated in both cases. A clear reduction in toxicity was also observed after the two treatments in most of the cases. These two processes (ozonation and PAC addition) are therefore effective to reduce the release of micropollutants into surface waters. Ozonation-SF and PAC-SF proved to be feasible in terms of implementation and operation at large-scale in WWTP, for relatively similar investment and operation costs (about 0.1 to 0.15 € per m3 treated based on local costs). Each technique has its advantages and disadvantages. Therefore the method selection should be made case by case for each WWTP depending on the local constraints (e.g. space, security, energy costs, existing treatment processes, sludge disposal process, need for disinfection, etc.), the quality and the quantity of incoming water and the desired output water quality.