How to face PFAS challenge in drinking water treatment plants: an holistic approach for plant upgrade and management

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Per- and polyfluoroalkyl substances (PFAS) are ubiquitously found in drinking water (DW) sources, increasing concern for their potential human health risk. Worldwide always more stringent limits are posed for PFAS concentration in DW and water utilities need to upgrade or manage their treatments facing this new challenge.

This case study reports several upgrade and management strategies evaluated by the water utility managing the water service in a wide Italian urban area served by 17 drinking water treatment plants (DWTP) fed on groundwater. Each DWTP is fed by multiple extraction wells, abstracting water from 2 different aquifers, and comprises a granular activated carbon (GAC) adsorption process (with multiple filters operating in parallel) followed by disinfection prior to distribution.

Prior to the inclusion of PFAS in the list of legacy parameters in the 2021 European DW Directive, GAC filters were operated preventing the breakthrough of conventional compounds (e.g. volatile organic compounds, chlorinated solvents, pesticides).

Due to PFAS inclusion in the DW Directive, the water utility needed to evaluate different strategies to optimize the process operation to control also PFAS.

A monitoring campaign was used to evaluate PFAS and conventional compounds breakthrough in current GAC filters. PFAS were found to have faster breakthrough compared to conventional compounds in most of the DWTPs, as a function of the inlet water quality. Field big-data analysis was coupled with lab and pilot tests to optimize the adsorption process in terms of GAC type, empty bed contact time (EBCT), filters configuration, GAC regeneration frequency.

Since the adsorption performance was highly dependent on the inlet compounds loads and since each extraction well is characterized by different PFAS-to-conventional compounds concentration ratios, a tool was built to prioritize the wells to be activated in order to provide the best influent water quality (minimizing the concentration of the most hazardous compounds for the specific DWTP), while minimizing the pumping

energy consumption. Such holistic approach, combining wells extraction management strategies to adsorption optimization, was successful to minimize the human health risk due to the mixture of PFAS and conventional contaminants in the treated DW.