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# Effectiveness of conventional drinking water treatment in the removal of polycyclic aromatic hydrocarbons

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## Extended Abstract

The presence of recalcitrant organic pollutants, such as polycyclic aromatic hydrocarbons (PAHs) in aquatic environments poses a threat to the human health [1]. According to recent studies, PAHs, such as benz[*a*]anthracene and phenanthrene, has been found in untreated drinking water [2]. Hence, the removal of these contaminants through conventional treatment processes should be carefully evaluated. In this work, levels of selected PAHs in drinking water have been monitored during conventional treatment processes. The simulation of a full-scale Potable Water Treatment Plant (PWTP) located in the south of Spain was carried out using jar tests, a widely accepted tool in water treatment. The PAHs evaluated included benzo[*ghi*]perylene (BghiP), chrysene (CHY), benz[*a*]anthracene (B*a*A), benzo[*b*]fluoranthene (BbF), anthracene (ANT), benzo[*k*]fluoranthene (BkF), benzo[*a*]pyrene (BaP), fluoranthene (FLU), Indeno[1,2,3-cd]pyrene (IcdP), phenanthrene (PHE), dibenz[*a*,*h*]anthracene (DahA), fluorene (FL), and pyrene (PYR); organic contaminants categorized by USEPA as priority contaminants. The quantification of PAH concentration in drinking water was carried out using gas chromatography coupled with mass spectrometry.

The PWTP under study is designed to treat an influent of 2500 $L\ s^{-1}$ collected from natural supply sources. The conventional treatment proposed is based on the sequential chemical addition of: $KMnO_4$, NaClO and $FeCl_3$ into the raw water. After reagent addition, the removal of solid particles from water is obtained through sedimentation. The clarified water is submitted to filtration to separate suspended and colloidal particles.

With the aim of evaluating the role of reagent addition in PAHs behaviour, the aforementioned contaminants were added to raw water samples to obtain a total concentration of 0.1 $\mu g\ L^{-1}$ for each compound. After that, the addition of $KMnO_4$, NaClO and $FeCl_3$ was carried out at the same experimental conditions implemented in the PWPT.

Experimental results showed that the reduction of organic contaminant concentration is directly dependent on the PAH compound. The higher reduction of PAH obtained after permanganate treatment was 80% for B*a*P [3]. On the other hand, the most recalcitrant contaminants to degradation were FL, PHE, FLU, B*ghi*P and I*cd*P. According to previous studies, the main mechanism reaction for these organic compounds, the electrophilic aromatic substitution [4], depends on PAH chemical structure. For electrophilic aromatic substitution, the ability to donate electrons of each component, that is, the ionization potential (IP), could be used to approach the energy involved in the PAH oxidation. According to experimental results, the higher the values of IP, the lower removal was obtained. The effectiveness of NaClO and $FeCl_3$ addition and sedimentation was also studied concluding that the most effective removal was obtained for PYR, D*ah*A, B*ghi*P, I*cd*P which increased by more than 30% compared with samples treated only with $KMnO_4$.

With the aim of evaluating the behaviour of PAHs, a parameter based on its chemical properties, such as sorption capacity and the energy required to remove an electron, was proposed. Experimental results indicated that this approach allows good predictions of the removal percentage of these recalcitrant organic contaminants.

## References

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