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Editorial: Advanced Processes for Wastewater Treatment and Water Reuse

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Editorial on the Research Topic

Advanced Processes for Wastewater Treatment and Water Reuse

Water scarcity is one of the major challenges faced by mankind (Loeb, 2016). There is a real need to develop ways of using wastewater as a source of reusable water. These streams constitute indirect potable water sources that are often discharged into natural resources (Lee and von Gunten, 2010). The treated effluents must thus be safe for both ecosystems and human health. Even if current wastewater treatment processes can fulfill the required discharge thresholds, trace compounds (both organic and inorganic) in the treated streams present a dangerous potential threat. These compounds show refractory characteristics and are often not fully removed by conventional treatment technologies. Although found in trace levels, their real impact on human health is yet unknown. Moreover, due to their accumulation capacity and biorefractory features, these compounds are starting to be found in drinking water. Bearing these concerns in mind, the European Commission has listed several chemical contaminants whose concentration in natural water resources must be followed by member states.

In wastewater treatment plants (WWTPs), the release of micropollutants is an emerging concern as it is currently not regulated anywhere in the world. Therefore, it is expected that new quality standards for measuring how these harmful contaminants enter the environment, including subsidies such as pharmaceuticals, antibiotic-resistant bacteria, endocrine disrupters, will be included in the revised "Urban Waste Water Treatment Directive." Even though the sustainable use of recycled water to supplement the potable water supply is possible; current wastewater treatment systems are not efficient in removing toxic contaminants and other pollutants may have a strong environmental impact.

McLain and Gachomo evaluated the influence of chemicals that are of emerging concern (pharmaceuticals) due to the fact that they are often not fully removed by traditional wastewater treatment facilities on microbial growth. The authors concluded that even the low concentrations of these compounds found in reclaimed water can lead to a biological response from both microorganisms and plants, which is a serious threat to ecosystems. Although the effect on public health is not fully known, such substances must be efficiently removed from water for human applications since some compounds have already been connected with tumors (Molins-Delgado et al., 2016) and reproductive problems (Esplugas et al., 2007). The shortening of the water supply is pushing us toward strategies of wastewater reclamation and reuse (Gomes et al., 2017). Extracting

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safe reusable water from treated wastewater requires the development of advanced technologies. Among them, oxidation systems such as ozonation, Fenton's process, and persulfate oxidation may be interesting approaches.

Ozone is a powerful oxidant able to react with compounds with high electronic density sites. However, total mineralization is usually not achieved, and the by-products formed may have a higher toxic character than parent compounds. The development of suitable solid catalysts to enhance ozone action over pollutants is an important research area. The use of a catalyst may reduce the costs of this operation and a more efficient ozone usage may be possible. Hu et al. described the production of (Mn)-based Y zeolites in the catalytic ozonation process and showed the potential of such materials for the degradation of refractory contaminants such as nitrobenzene, which is listed as a potential carcinogen.

Fenton's process is another industrially interesting technology as classic Fenton's peroxidation does not require sophisticated equipment and needs only hydrogen peroxide and iron salts. However, one of its main drawbacks is related to the use of a homogeneous catalyst (iron) that must be removed from the treated water after the oxidation process. The development of a suitable solid catalyst can overcome such shortcomings, also allowing the catalyst to recover and be reused. Zhu et al. concluded that CuO/CeO_2 is a suitable solid material to enhance diclofenac removal from water trough Fenton's like reactions. An alternative to Fenton's peroxidation is explored by Xian et al. who tested the persulfate oxidation of organic compounds (acid orange 7 and diclofenac) using Spinel Ferrite MFe_2O_4 as a heterogeneous catalytic material.

Separation technologies are also interesting processes that can be applied as single treatments or integrated with other types of methodologies. Miranda et al. evaluated the efficiency of aluminum coagulants in dissolved air flotation for the treatment of paper mill wastewater. The development of flocculants from natural sources such as wood wastes was successfully applied in the treatment of effluents from the textile industry by Grenda et al.

The removal and recovery of heavy metals from water is also a recurring theme in this Research Topic. The development of adsorbents from green, renewable, and sustainable sources is a step forward toward a circular economy. Zulu et al. functionalized sawdust cellulose with interesting results regarding Vanadium removal from water. Wang, Zhu, Xu et al. used eco-friendly Pickering-MIPEs as an alternative method to produce multi-porous materials in the removal of metals from water. In one paper, Wang, Zhu, Wang et al. were studied, while in a second Wang, Zhu, Xu et al. were addressed. As(III) and As(V) were removed by a hybrid adsorbent that was produced by intercalation of inorganic and organic surfactants onto kaolin clay. Mudzielwana et al. concluded that it is suitable to remove such material from groundwater. Wastewater effluent from E-waste is an emerging concern, as it can contain considerable amounts of valuable metals. Zhang et al. describe how the introduction of a hyperbranched dendrimer-like polymer onto silica gel, leads to a suitable adsorbent that can recover Au.

We hope that this Research Topic can make important contributions, shedding light on the paths that will enable us to reach suitable treatment strategies and obtain safe reusable water from wastewater.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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