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Advanced treatment of industrial wastewater: Combining biological treatment and advanced oxidation processes towards a cleaner production and greener environment

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The decreasing availability of freshwater resources has redirected the objectives in the area of water and wastewater treatment from disposal to minimization, reuse and recovery. On the other hand, the increasing trend of toxic, biorecalcitrant and inhibitory compounds in industrial wastewaters has had adverse effects on the quality of the environment. Moreover, the progressively stricter standards for effluent discharge worldwide have made the developing of advanced water treatment technologies necessary. As a result, a high level of treatment must be achieved while researchers are required to develop novel technologies to accomplish higher mineralization rates with cost-effective performance. Therefore, advanced wastewater treatment has become crucial for the continuing development of the society. Although biological wastewater treatment is known as the most cost-effective treatment method, several industrial effluents, such as those from petrochemical, pharmaceutical, slaughterhouse, textile and pesticide manufacturing plants, contain considerable non-biodegradable and refractory compounds. Conventional treatment cannot remove these pollutants; therefore, standard regulations cannot be reached. Hence, advanced oxidation processes (AOPs) have been proven to be efficient for degrading resistant materials or mineralizing stable, inhibitory or toxic contaminants. Even though AOPs are highly effective in treating organic compounds, some drawbacks prevent their commercial applications. A high requirement of oxidant/catalyst dosage, high electrical power consumption and nutrients removal are common disadvantages. Thus, these processes are recommended as complementary treatment options, either pre-treatment or post-treatment, to biological processes. Advanced wastewater treatment is focused on the reduction in operation and maintenance costs, making the combined processes more attractive than conventional methods. The optimized integration of AOPs and biological processes contributes to a cleaner production and greener environment, providing high-quality treated effluents and allowing water recycle in industrial applications with overall pollutant removal efficiencies over 90%. Figure-1 illustrates the layout of the pre-treatment, treatment and disinfection of a typical industrial wastewater.

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