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Short communication

Comparison of UV/H_2O_2 based AOP as an end treatment or integrated with biological degradation for treating landfill leachates

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HIGHLIGHTS

- UV/H_2O_2-based AOP as an end treatment of landfill leachate was tested.
- UV/H_2O_2-based AOP integrated with biological degradation was tested.
- Biological degradation integrated with UV/H_2O_2-based AOP offers better performances.
- H_2O_2 alone is quite ineffective both at mineralizing and as a biodegradability enhancing agent.

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ABSTRACT

The application of a biological treatment together with a chemical oxidation process was investigated. In particular, the effectiveness of the biological treatment followed by a UV/H_2O_2-based advanced oxidation process (AOP) used as an end treatment was compared with that in which the same AOP was integrated with biological degradation for treating a medium age sanitary landfill leachate.

The results show that better performance with removal efficiencies higher than 80% for all investigating parameters was obtained when AOP was integrated with the biological treatment, thus allowing the discharge limits to be met. This was due to the biological removal of the biodegradable compounds produced by UV/H_2O_2 treatment. Instead, UV/H_2O_2-based AOP biodegradability enhancement gave no advantage when it was used as an end treatment. Finally, the results show that H_2O_2 alone (i.e., without UV power) was quite ineffective either as a mineralizing or as a biodegradability enhancing agent and that the only reactive species was essentially the hydroxyl free radical $OH^{\cdot}$.

1. Introduction

Landfilling is still one of the main practices for disposing of municipal solid waste in many countries [1]. Unfortunately, the leachate resulting from rainwater percolation through the landfill waste is a highly polluting liquid. Indeed, the treatment of such leachates is one of the most important issues in landfill management [2]. Based on landfill age, leachates can be classified as young, medium or old. As a landfill site increases in age, the biodegradable fraction of the organic pollutants in its leachate decreases due to anaerobic decomposition [3]. Consequently, the traditional biological systems are not adequate as the sole treatment of leachates, especially for medium–old ones, since the recalcitrant compounds which pass unaltered through the plant make it difficult to meet the current discharge limits. Therefore, a combination of biological and physico-chemical methods is usually required for an effective treatment [4,5]. Among the latter, the advanced oxidation processes (AOPs) are of particular interest and are widely recognized as highly efficient for recalcitrant wastewater treatment [6,7]. These processes involve the generation of the hydroxyl free radical ($HO^{\cdot}$) which has a very high oxidation potential and is able to oxidize non selectively almost all pollutant organic compounds. Unfortunately, if applied as the only treatment, AOPs would render the treatment process economically expensive, as they are both capital and energy intensive. Therefore, AOPs should be applied after a first biological stage (in order to make sure that the costly chemical oxidant is only used on recalcitrant compounds) and prior to a second biological treatment with the aim of rendering recalcitrant compounds biodegradable minimizing their mineralization (integrated approach).

In order to evaluate the benefits of such an approach, the effectiveness of UV/H_2O_2 based AOP as an end treatment or integrated with biological degradation for treating a medium-age sanitary landfill leachate is compared in this study.

The biological degradation was carried out in an advanced system (SBBGR – Sequencing Batch Biofilter Granular Reactor)

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