Photocatalytical degradation of antibiotics present in water

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Abstract

The presence of antibiotics in water, due to their over- and misuse, has become a matter of considerable concern since they can lead to negative effects on humans and adverse environmental effects. These effects include the development of antibiotic resistance in microorganisms and toxicity to micro flora and -fauna [1-3].

Despite antibiotics entering the sewer network and reaching the wastewater treatment plants, the treatments applied are ineffective for their removal. Therefore, photocatalysis has become an attractive process to promote their degradation since it allows a rapid and efficient removal, transforming the initial compound into harmless substances, as CO_2 and water [4].

Because of their physical and chemical stability, no toxicity, and low cost, TiO_2 and ZnO are promising photocatalysts [5]. However since they have large band-gap energies (higher than 3 eV) they just absorb radiation of wavelengths inferior than 390 nm (5 - 10 % of the incident solar radiation), corresponding to the ultraviolet region.

The use of an artificial light source is the main source of costs which suggests the use of sunlight as an economically and ecologically source. To overcome this limitation, it is necessary to increase the absorbance of the visible light by the photocatalytic nanoparticles. Doping the photocatalysts has been found to be a fruitful way to narrow the band gap or split it into several sub-gaps. Additionally, some dopants may also prevent the fast recombination of the photogenerated electron-hole pair, responsible for decreasing the photocatalytic activity.

Furthermore, the application of photocatalyst dispersed in water shows some disadvantages, as the difficulty of radiation penetration in the aqueous solution and the difficulty to remove the catalyst at the end of the process. Therefore, there have been studied various forms of attachment of photocatalyst particles onto supports that are easily removable from water.

Hence, this project aims to produce and evaluate the photoactivity of Polyvinylidenefluoride-co-trifluoroethylene (PFDV-TrFE) membranes filled with different photocatalysts: TiO_2, doped TiO_2 with three dopant concentrations (Erbium 0.5 %, 1 % and 3 %) and ZnO.

References

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