Ibuprofen adsorption and heterogeneous photodegradation from water

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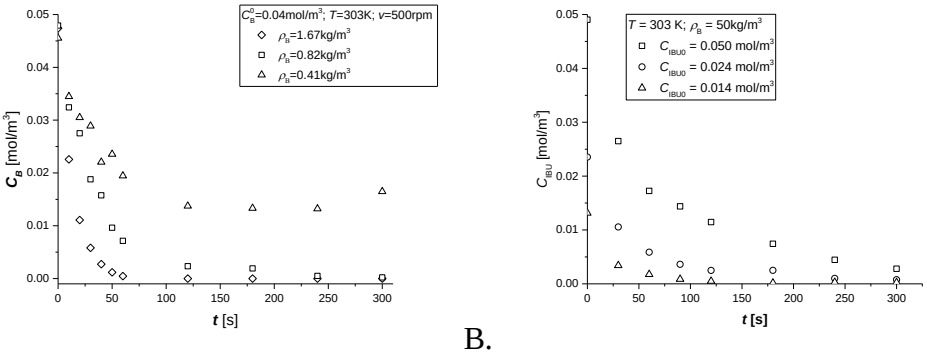
Ibuprofen [2-(4-Isobutylphenyl) propionic acid] is a nonsteroidal anti-inflammatory drug (NSAID) that is primarily used as a painkiller and antipyretic. Due to its widespread use, it is one of the most prevalent ECs (Emerging Contaminants) found in the environment, with detected levels in wastewater treatment plants influents which go from the tens to the hundreds µg/L [1]. Adsorption and photodegradation were proved to be efficient methods for wastewater treatment due to their high efficiency and low costs, also thanks to the employment of solid materials which can be easily separated and reused [2]: for this reason, these technologies are promising for the removal of ECs from waters. The aim of this work is to conduct an in-depth study of the ibuprofen abatement processes through adsorption, using activated carbon, and heterogeneous photodegradation, catalysed by inorganic nanocrystalline semiconductors (commercial TiO_2 and synthetic CeO_2), to maximize the efficiency of these methods and to provide the kinetics for both processes.

A series of adsorption tests were conducted in stirred glass-jacketed reactor, to investigate the effect of various parameters on the ibuprofen adsorption rate over activated carbon. For simplicity, only the data collected to investigate the catalyst bulk density dependency are reported in Figure 1A. As revealed, by increasing the sorbent load, a corresponding increase of both the adsorption rate and the ibuprofen uptake is observed.



A. B.

Figure 1 – A. Effect of the sorbent load on ibuprofen adsorption over activated carbon. B. Ibuprofen photodecomposition using Aeroxide P-25 TiO_2.

Photodegradation experiments took place in a magnetically stirred 1.5 L glass jacketed reactor, in which air was bubbled through a mesh filter. Irradiation was provided through a UV lamp (365nm) inserted coaxially in the reactor. The experimental results showed that CeO_2 has an activity comparable with the commercial TiO_2 (Aeroxide P-25) in the photodegradation of ibuprofen. A higher conversion was obtained with higher catalyst concentration and temperature and lower initial concentration of ibuprofen (Figure 1B). As revealed, an increase of the decomposition rate is observed when increasing the initial concentration of ibuprofen, suggesting a first-order reaction rate. Further elaboration will lead us to the determination of kinetic parameters for both processes.

References

[1] Březinova et al. (2018) *Ecological Engineering* **120**: 1–5.
[2] Mukwevho et al. (2019) *Journal of Industrial and Engineering Chemistry* **81**: 393–404.