Supported ionic liquids for the removal of cyclophosphamide from aqueous solutions

B. Rocha*, M. C. Neves, A.C. Sousa, T. Trindade, M. G. Freire
Department of Chemistry and CICECO-Aveiro Institute of Materials, University of Aveiro, 3810-193 Aveiro, Portugal
* beatriz.rocha@ua.pt

Nowadays, cancer is one of the most relevant causes of death worldwide. It is expected that the incidence of this disease will increase in the following years and, therefore, the use of anticaner drugs (cytostatics) will continue to rise. Oral therapy is being used as an alternative and/or complement to traditional chemotherapy, and therefore most of the cytostatic drugs are consumed by outoubnd patients [1]. Among these, cyclophosphamide (CP) is one of the most used cytostatic drugs to treat cancer – Figure 1.

Figure 1. Molecular structure of cyclophosphamide (CP).

CP as well as other cytostatics are not completely metabolized by humans, being excreted by urine (ca. 25% of the consumed drugs) [2]. These compounds ultimately reach waste water treatment plants (WWTPs) that are unable to efficiently remove or treat them [3]. Thus, the development of materials that could be used as adsorbents of cytostatic drugs from the urine of oncologic patients, i.e. at their entrance point and before they reach WWTPs, is highly relevant to avoid the entrance of such pollutants into the environment.

The main objective of this work is to prepare and identify low-cost materials functionalized with ionic liquids capable of efficiently removing cytostatics from urine samples. Supported ILs (SILs) were already described as efficient materials to remove other pharmaceutical compounds, such as nonsteroidal anti-inflammatory drugs (sodium diclofenac, ibuprofen, naproxen, and ketoprofen) from aqueous samples [4], but were never investigated for the removal of cytostatic drugs. In this work, experiments were carried out with CP, as a main representative of cytostatic drugs. Six SILs (SilPrMImCl, SilPrNMMeBzCl, SilPrNEtCl, SilPrN(C3)Cl, SilPrNMMeBuCl, SilPrNBu2Cl) were synthesized and characterized. A preliminary study was carried out to identify the efficiency of these materials for the removal of CP from aqueous solutions. Kinetic and adsorption isotherms were determined for the best materials, and future studies will be carried out with urine samples.

Acknowledgements
This work was developed within the scope of the project CICECO-Aveiro Institute of Materials, POCI-01-0145-FEDER-007679 (FCT Ref. UID/CTM/50011/2013), financed by national funds through the FCT/MEC and when appropriate co-financed by FEDER under the PT2020 Partnership Agreement. M.C. Neves acknowledges FCT for the post-doctoral grant SFRH/BPD/110423/2015. This work was also financially supported by the project POCI-01-0145-FEDER-031106, funded by FEDER, through COMPETE2020 - Programa Operacional Competitividade e Internacionalização (POCI), and by national funds (OE), through FCT/MCTES.