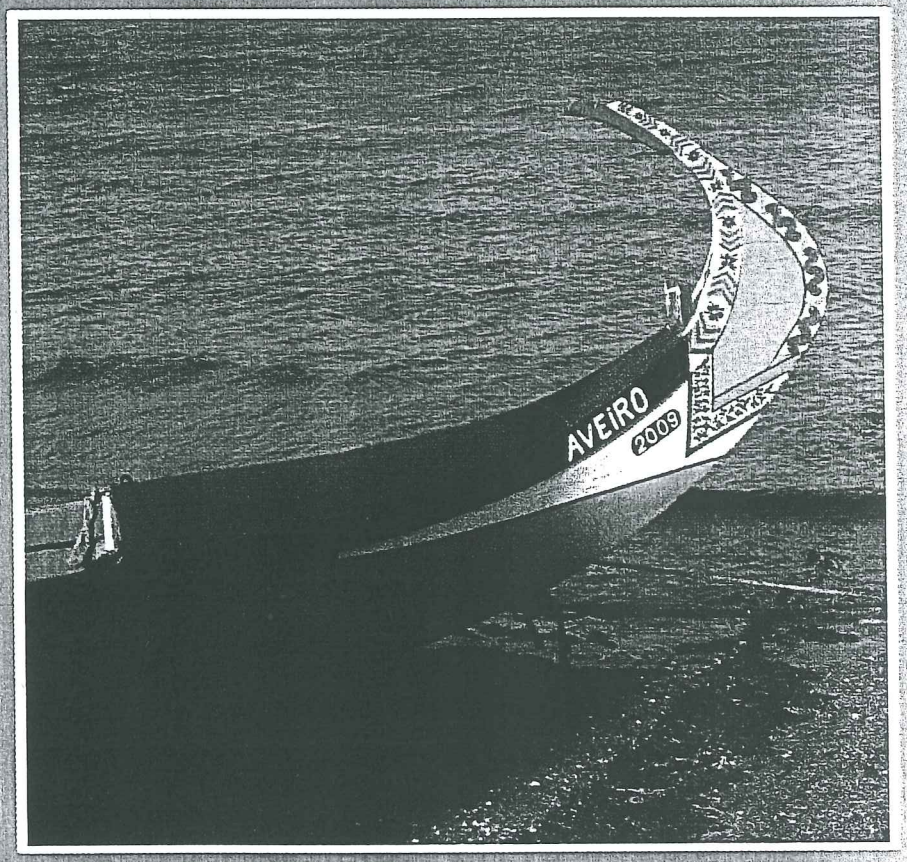
SOCIEDADE PORTUGUESA DE QUÍMICA

Book of abstracts

9º Encontro Nacional de Química Física
1st Iberian Meeting on Ionic Liquids

June 15-16th, 2009
University of Aveiro



1st IMIL.O7

Effect of the Ionic Liquid [BMIM]Cl on Hydrolysis of Carboxymethyl Cellulose by Cellulase

Ângelo M. C. Salvador, Mickael C. Santos and Jorge A. Saraiva

Departamento de Química, Universidade de Aveiro, 3810-193, Aveiro, Portugal,

Cellulose is the most abundant renewable bioresource produced in the biosphere (about 100 billion dry tons a year). Based on this fact, bioethanol produced by the fermentation of glucose from cellulose is a very promising biomass-derived fuel, mainly because it could replace depleting fossil fuels and solve the problem of production of bioethanol from agricultural feedstocks, since this biopolymer is almost endless[1]. However, it is necessary to solve the problem of the difficulty of hydrolysis of this biopolymer into glucose. Enzymatic hydrolysis of cellulose is hindered by its low solubility in aqueous solutions. In the last years ionic liquids have emerged as a new kind of solvents for biocatalysis, with possible advantages compared to biocatalysis in aqueous solutions or in organic solvents. Recently, it was shown that ionic liquids can solubilise cellulose[2,3] and also that cellulase can hydrolyze cellulose in ionic liquids[4,5]. This opens a good potential for a substantial improvement, on yield and rate of enzymatic cellulose hydrolysis using ionic liquids. The ionic liquid [BMIM]Cl (1-butyl-3-methylimidazolium chloride) has been shown to be one the ionic liquids more suitable to solubilise cellulose[2,3].

In this work it was studied the effect of the ionic liquid [BMIM]Cl on the enzymatic hydrolysis of carboximethyl cellulose (CMC) by cellulase. In the presence of 10% [BMIM]Cl it was found that cellulase activity decreases with time of hydrolysis, reaching 45% of the activity in aqueous buffer after 50 min. This loss of activity occurs faster at initial hydrolysis times, an effect that was modelled considering a biphasic profile for activity decrease and using a bi-exponential model. When activity is measured in aqueous buffer, after the enzyme have been in contact with 10% [BMIM]Cl, the activity decreases a maximum of 15% for 40 min contact, indicating that loss of activity caused by the ionic liquid presence is mostly reversible. Cellulase activity decreased with increasing amounts of [BMIM]Cl, reaching ca. 50% of the activity in aqueous buffer for 30% [BMIM]Cl. The decrease of cellulose activity showed a linear relationship with the reduction of water activity (aw) caused by increasing concentrations of [BMIM]Cl (R^2=0.96).

References:

[1] Turner, M. B.; Spear, S. K.; Huddleston, J. G.; Holbrey, J. D.; Rogers, R. D., Green Chem. 2003, 5, (4), 443-447.
[2] Swatloski, R. P.; Spear, S. K.; Holbrey, J. D.; Rogers, R. D., J. Am. Chem. Soc. 2002, 124, (18), 4974-4975.
[3] Zhu, S. D.; Wu, Y. X.; Chen, Q. M.; Yu, Z. N.; Wang, C. W.; Jin, S. W.; Ding, Y. G.; Wu, G., Green Chem. 2006, 8, (4), 325-327.
[4] Kamiya, N.; Matsushita, Y.; Hanaki, M.; Nakashima, K.; Narita, M.; Goto, M.; Takahashi, H., Biotech. Lett. 2008, 30, (6), 1037-1040.
[5] Turner, M. B.; Spear, S. K.; Huddleston, J. G.; Holbrey, J. D.; Rogers, R. D., Green Chem. 2003, 5, (4), 443-447.

Acknowledgments: This work was supported by Fundação para a Ciência e a Tecnologia through the project PTDC/CTM/73850/2006.