(PO18) Can ionic liquids enhance textile dyeing? Assessing color fixation differences in disperse dyeing when adding ionic liquids in small concentrations

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INTRODUCTION

The textile industry relies on several processes that can be environmentally harsh – not only for the amount of water consumed, but for the chemically contaminated wastewater generated. Ionic liquids (ILs), organic salts with interesting properties such as negligible vapor pressure and high solvatation power and thermostability have been applied to different textile processes[1-3], but their efficiency in dyeing is not yet fully explained. This work means to assess the effect of different types of ILs on disperse dye fixation for natural (wool) and synthetic fibers (nylon and polyester).

RESULTS AND DISCUSSION

One gram fabric samples were dyed at a 1:50 liquor ratio with 0.5 % m/m of the dye C.I. Disperse Red 13 (Sigma-Aldrich) and the following ILs at a concentration of 2.0 $g.L^{-1}$ in the dyebath: choline chloride, 1-ethyl-3-methylimidazolium chloride (EMIM Cl), 1-butyl-3-methylimidazolium chloride (BMIM Cl), 2-hydroxyethylammonium acetate (2HEAA), 1-allyl-2,3-dimethylimidazolium chloride (ADMIM Cl) and 1-hydroxyethyl-3-methylimidazolium chloride (HEMIM Cl). A group of samples was also dyed without ILs to establish comparison to standard procedures. Acetic acid at 4.0 $g.L^{-1}$ was also added to the dyebaths.

For polyester samples, the dyeing processes were carried out at 95 and 130 ºC, both during 60 minutes. Nylon and wool fabrics were dyed at 95 ºC for 60 minutes. All heating steps occurred at a 2.5 $ºC.min^{-1}$ gradient. The samples were then washed using 4 $g.L^{-1}$ standard soap with 1:40 liquor ratio at 60 ºC for 30 min.

The fixation factor (color yield after washing versus color yield before washing ratio) assesses the percentage of dye remaining on the textile substrate after the washing process[5]. The values for wool, nylon and polyester samples are shown in Table 1. On wool and nylon samples, it is safe to assume that the addition of ILs had little to none significant impact on color fixation when compared to the ones without IL. Exceptionally, 2HEAA and HEMIM Cl decreased the dyeing performance for wool by 20.3 and 39.5%, respectively, which might be due to their alkalinizing tendencies[4]. These results contradict those obtained by Bianchini et. al[1]. For the polyester fabric, the best fixation results were found for the dyeing processes at 130 ºC for all ILs tested.

Table 1. Fixation factor (% F) for wool (WO), nylon (PA) and polyester (PES) samples

	Fixation (%)			
Ionic Liquid	**WO**	**PA**	**PES 95 ºC**	**PES 130 ºC**
Choline Cl	> 99.9 *	68.18	88.44	99.37
EMIM Cl	91.82	69.57	86.97	96.28
BMIM Cl	> 99.9 *	70.05	89.71	98.25
2HEAA	70.79	66.12	92.74	96.05
ADMIM Cl	87.93	66.68	88.03	98.28
HEMIM Cl	51.54	69.73	85.31	94.69
Without IL	91.05	70.27	90.46	96.36

*Calculated value was greater than 100%, which indicates irregular color distribution through the sample

However, the difference between those and the control samples at both temperatures was minimal. Since PES dyeing does not rely on chemical interactions between dye and fiber[5], it is not surprising that it was the least affected by the addition of ILs as dyebath auxiliaries.

CONCLUSION

When ILs were used as auxiliaries in the dyeing processes of wool, nylon and polyester, most of the color fixation of the samples was equivalent to those without IL. Further studies are required to determine the nature of interaction between wool keratin and alkalinizing ILs such as 2HEAA and HEMIM Cl.

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