# DEHYDROCHLORINATION OF POLYVINYL CHLORIDE IN GREEN SOLVENT

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## Abstract

*Highly efficient dechlorination contributes to successful chemical recycling of PVC-containing waste plastics. We utilize green solvents such as poly (ethylene glycol) (PEG) and ionic liquids for highly efficient dehydrochlorination of PVC at atmospheric pressure. The significant advantages of this method are: operational simplicity, high dechlorination efficiency, greenness of procedure by avoiding hazardous organic solvent, additional catalysts, and toxic waste byproducts, and satisfactory recyclable properties. It holds great promise for application in other dehalogenation processes.*

***Keywords:*** *Dehydrochlorination; Polyvinyl chloride; PEG; Ionic liquids; Recycling*

## 1. Introduction

Recycling of waste plastics is of great interest due to the serious environmental problems caused by waste plastics. Highly efficient dechlorination contributes to successful chemical recycling of PVC-containing waste plastics [1]. Dehydrochlorination in an alkaline solution is efficient for the dechlorination [2]. However, volatile and often toxic solvents were adopted using this method, moreover, by-product such as KCl could be produced that caused the problem of secondary pollution. Although the methods of hydrothermal and supercritical dechlorination have been developed to increase the dechlorination efficiency, they have high requirements for the equipments [3]. Therefore, the development of environment-friendly methods for highly efficient dehydrochlorination of PVC is an area of considerable importance.

In this paper, we utilize green solvents such as poly (ethylene glycol) (PEG) and ionic liquids for highly efficient dechlorination of PVC at atmospheric pressure. These green solvents possess environmentally benign characteristics. In addition, they showed satisfactory recyclable properties in this reaction system.

## 2. Materials and Methods

PVC (SG-1) was obtained from Xian Chemical Co., China. Its chlorine content of the PVC is 51.5 %.1-butyl-3-methylimidazoliumchloride ([Bmim]Cl), 1-Allyl-3-methylimidazolium Chloride ([Amim]Cl), 1-butyl-3-methylimidazolium hydroxide ([Bmim]OH), 1-butyl-3-methylimidazolium tetrafluoroborate ([Bmim]$BF_4$) and 1-butyl-3-methyl-imidazolium hexafluorophosphate ([Bmim]$PF_6$), 1-(2-hydroxylethyl)-3-methylimidazoliumchloride ([$C_2$OHmim]Cl ) and PEGs were of analytical grade and dried under vacuum at 60 ºC for 24 h.

PVC and solvent were added into a 100 mL three-neck flask equipped with a thermometer and a nitrogen gas bubbler to react under set temperatures. After reaction, the dechlorinated PVC (DPVC) was filtered and dried under vacuum at 60 °C for 24 h, then characterized using oxygen–combustion–chlorine selective electrode method.

## 3. Results and Discussion

Effects of solvents on dehydrochlorination of PVC are shown in Fig.1. The dechlorination degree of PVC is as follows: BmimOH ＞ BmimCl ＞ PEG600>AmimCl ＞ $BmimBF_4$＞$C_2$OHmimCl＞$BmimPF_6$,suggesting that the structure of the solvents influence the dehydrochlorination of PVC.

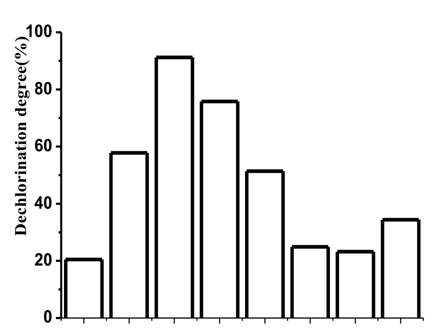


Fig. 1. Effects of solvents on the dechlorination degree of PVC

Moreover, it can be seen from Fig.2 that the dehydrochlorination is almost constant for 6 cycles for both PEG600 and [Bmim]Cl, proving that the reuse of theses green solvents is feasible for the dehydrochlorination of PVC.

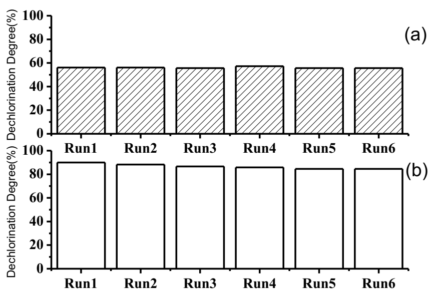


Fig.2 Recyclability of (a) PEG (180 $^0$C, 1 h) (b) BmimCl (200 $^0$C, 1 h) in dechlorination of PVC

## 4. Conclusions

Highly efficient dehydrochlorination of PVC has been realized using green solvents such as PEG and ionic liquids at atmospheric pressure. The process does not require any organic solvent or additional catalysts, and the solvents can be recycled (6 cycles) without any appreciable loss of its catalytic efficiency. It is found the structure of the solvents influence upon the dehydrochlorination process.

## References

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## Acknowledgments

The authors thank the financial support of the 863 program (Contract No: 2007AA06Z325) and the Program for New Century Excellent Talents in University (NCET-08-0366).