Absorption of Ethyl Acetate from Contaminated Air Flow in Ionic Liquids

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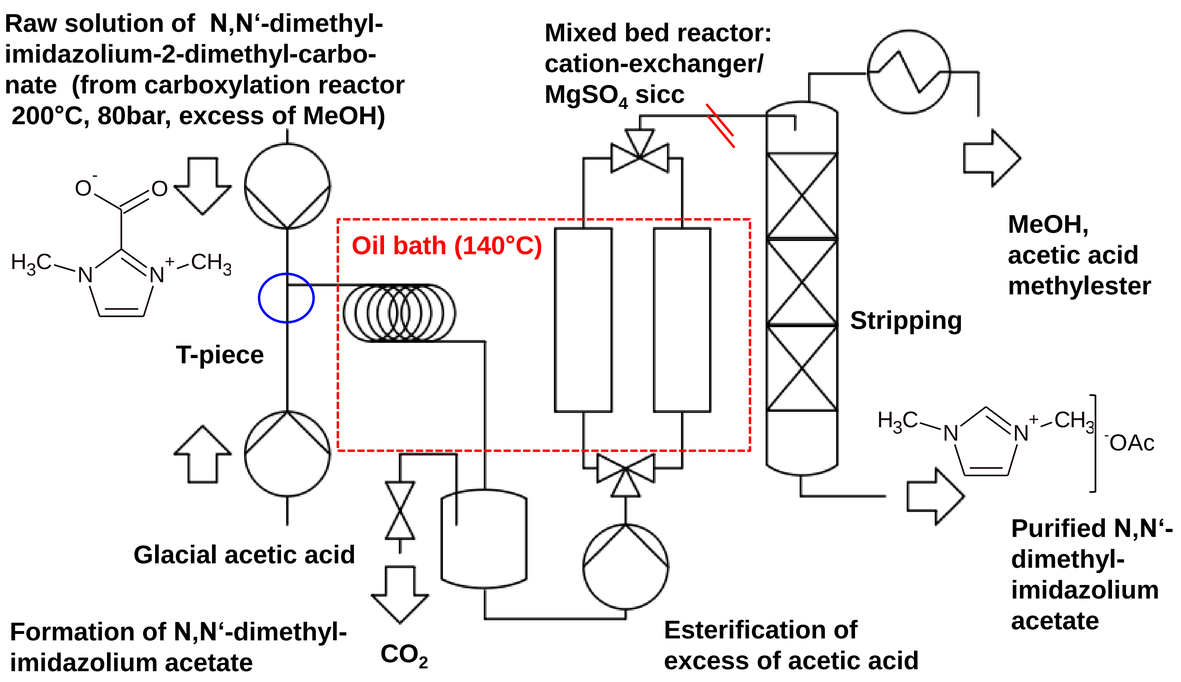
Introduction

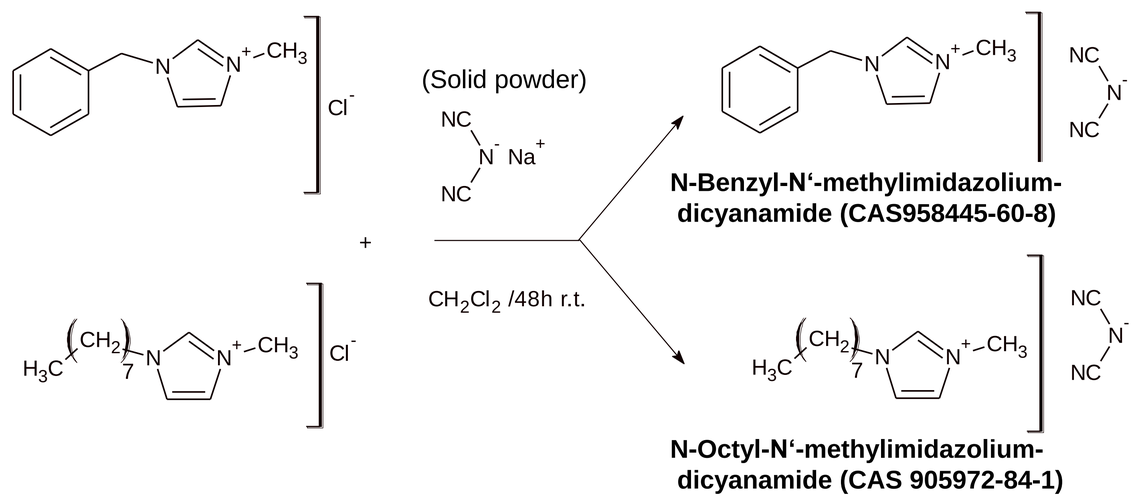
The avoidance of environmental contamination with solvents (VOCs) becomes more and more important. Packing e.g. of beverages and meals into recyclable plastic bottles and boxes becomes common. To attract customers, packages are directly printed customarily with colorful advertisement and necessary product information, or wrapped with printed banderoles. Up to now, printing on plastic materials requires toxic or otherwise harmful organic solvents, e.g. chlorinated hydrocarbons, toluene or ethyl acetate [1]. Ethyl acetate is less toxic in low air concentrations (1,500 mg ethyl acetate in 1 m^3 air) compared to other solvents. Nevertheless, a high throughput printing plant has to recover approximately 100 kg ethyl acetate per hour from the exhaust-air stream.
The absorption properties of ionic liquids (ILs), based on the imidazolium core, were examined to evaluate their possible use in the purification of ethyl acetate contaminated exhaust-air from a printing plant. To simulate equivalent production conditions, an air stream of 200 mL min^{-1} was contaminated with 0.128 g (8.6 mL h^{-1}) ethyl acetate at 30°C. Octyl-methylimidazolium dicyanamid ([OMIM][DCA]) shows the highest capability (472 mg mL^{-1} IL) to accumulate the solvent, followed by dimethyl-imidazolium acetate ([MMIM][OAc]) with 462 mg ml^{-1} IL. The absorbed ethyl acetate could be recovered by distillation from the IL. Both, the ethyl acetate and the IL, can be reused without any restrictions.

Micro-flow synthesis and purification of DMIM]OAc

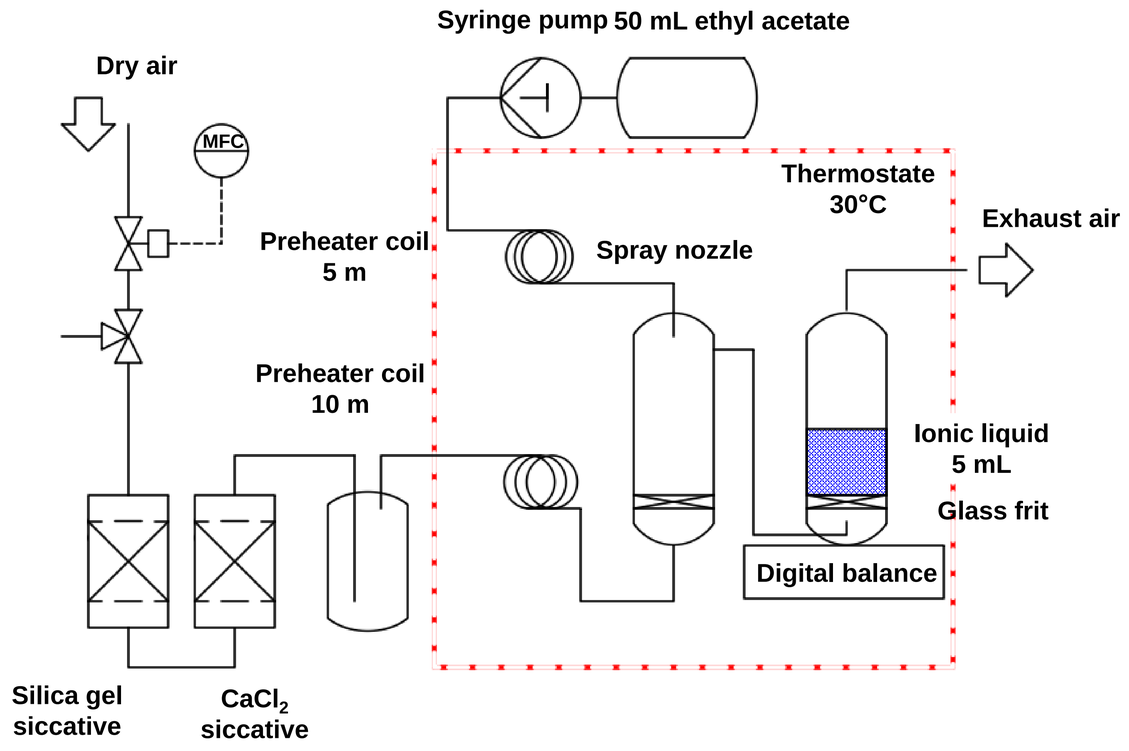


Synthesis of dicyanamide containing Ionic Liquids

Common batch syntheses:
BzMIM]Cl from N-methylimidazole with benzylchloride in acetonitrile under reflux for 48 h.
OMIM]Cl from N-methylimidazole with octylchloride in ethyl acetate under reflux for 46 h.

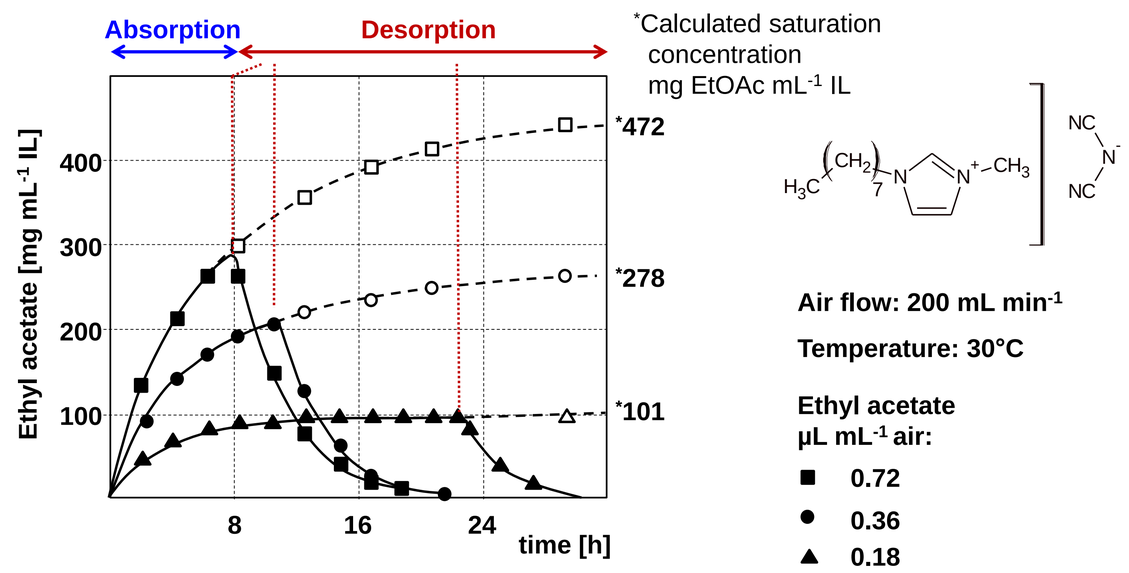


Setup for EtOAc absortion from contaminated air

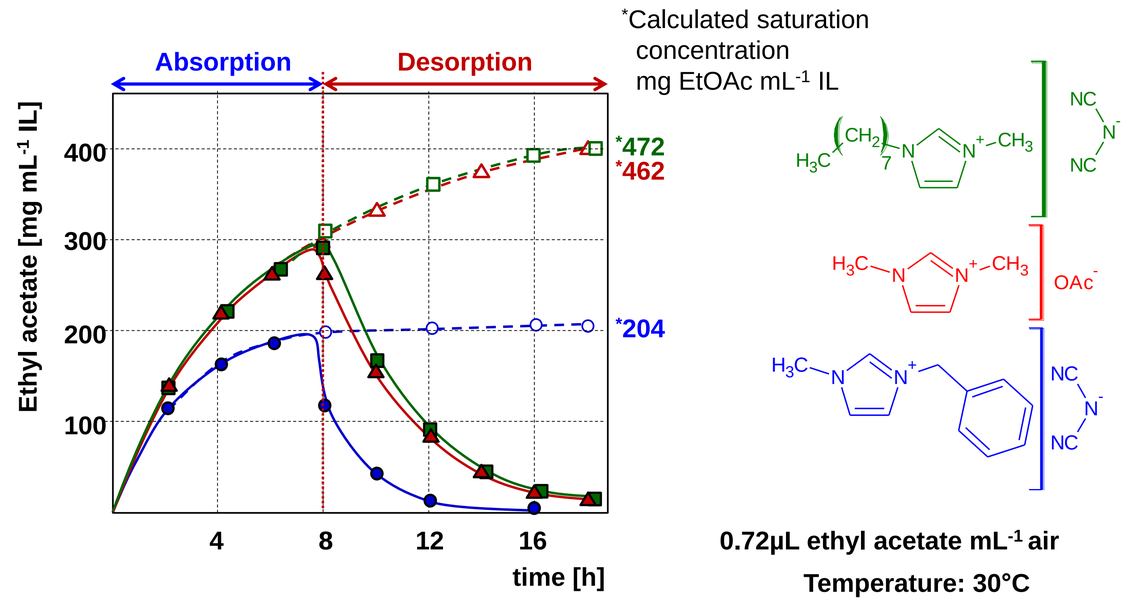


EtOAc absortion/desorption process

Absorption/desorption of EtOAc in OMIM]DCA at different EtOAc / air ratios

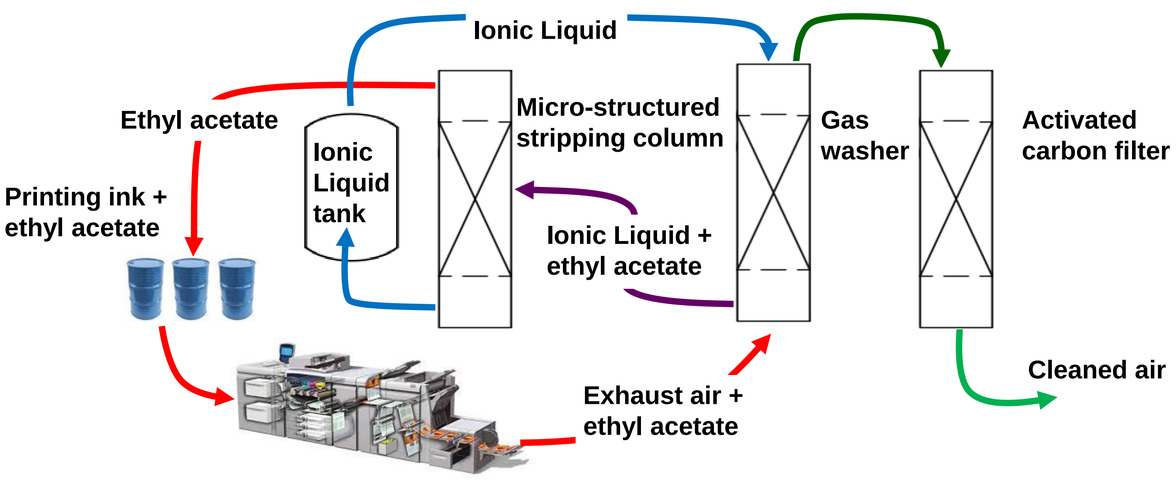


Absorption/desorption of EtOAc in BzMIM]DCA, OMIM]DCA and DMIM]OAc



* Calculated saturation concentration
Graphs are redrawn from original files

Proposed design for a technical application



Summary

- **Printing on plastics requires volatile organic solvents (VOCs) that are toxic or otherwise environmental harmful by pollution into the air.**
- **The amount of VOCs, which are released during the printing process is high and not tolerable.**
- **Special ionic liquids can be applied as absorbens for VOCs. After stripping and condensation VOCs as well as the ionic liquid can be recirculated.**
- **A remarkable loss of capacity could not be observed after several absorption/desorption cycles under lab-scale conditions.**

References

[1] McCourt, A.S., *Printing Industries Association of Australia*, in *Reducing VOC solvent use in the printing industry*; www.printnet.com.au/verve/resources/VOC Report -members.pdf.

[2] Grundemann, L., N. Fischer, and S. Scholl, *Chemical Engineering and Technology, 2009. **32(11) 1748.***