

Ionic Liquid Shows Promise for Membrane-Free Desalination

Researchers have discovered a new substance for use in directional solvent extraction (DSE), an approach to desalination that does not require membranes or high temperatures. Using the substance, a type of ionic liquid known as 1-ethyl-3-methylimidazolium bis(trifluoromethylsulfonyl)imide or [EMIM][Tf₂N], researchers demonstrated about 10-times-more-efficient desalination than state-of-the-art DSE solvents such as decanoic acid.

Inspired by previous research, the team investigated seven sulfonate anion-based ionic liquids and compounds to identify promising new DSE solvents, and studied how some solvents lead to more efficient desalination than others.

After synthesizing test solvents, the researchers exposed each of them to water containing up to 15,000 ppm of sodium chloride. The team mixed the solvents into each saltwater sample at temperatures of 45°, 60°, and 75° C (113°, 140°, 167° F) before performing spectrometric procedures to measure remaining sodium concentrations. The best results came from [EMIM][Tf₂N], which yielded 0.304% water per degree Celsius, compared to 0.027% per degree C achieved by decanoic acid. The newly studied substance also demonstrated sodium-ion rejection rates as high as 98.3%.

The DSE process using [EMIM][Tf₂N] entails a similar energy consumption to reverse-osmosis desalination and operates at only a fraction of the heat of thermal desalination. As a result, the researchers write that [EMIM][Tf₂N]-based DSE could potentially be viable using solar heat, or heat produced as a result of other water resource recovery facility processes.

According to a February release about the research, the team is now working to reduce the synthesis costs of [EMIM][Tf₂N] in addition to developing a continuous DSE system that uses [EMIM][Tf₂N] as a solvent.

"Now that we have found an ionic liquid that has shown to improve the productivity of directional solvent extraction as a desalination technique, there is definite potential for this technology to be applied in the real world," said University of Notre Dame (Indiana) Professor Tengfei Luo, corresponding author of the study.

Directional solvent extraction is an approach to desalination that functions without requiring membranes or exceedingly high temperatures. However, the lack of an efficient solvent that can recover suitable amounts of pure water while retaining selectivity for sodium ions has hampered its use. Researchers from the University of Notre Dame (Indiana) have reported a new solvent that performs up to 10 times better than conventional solvents.
Image courtesy of Philippe Delavie/Pixabay

WHO: University of N

WHAT: Ionic liquid c efficient directional extraction than conventional s

HIGHLIGHTS:

- Researchers synt and compounds solvent extractio
- The ionic liquid (clean water per per degree C ac conventional DS
- Desalination bas at temperatures with energy requ osmosis desalina

RESEARCH: "Ionic li low temperature de extraction." *Nature* (2021). bit.ly/DSE-so



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