

Innovative anion exchangers from microfibrillated cellulose: a sustainable solution for water purification

Researchers develop high-efficiency ion exchange materials using reactive ionic liquids

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Water pollution remains a significant global challenge, with anionic pollutants such as nitrates, sulphates, and phosphates posing serious threats to ecosystems and human health. Traditional methods for removing these pollutants often involve complex and costly processes. Now, researchers from the Technical University of Munich have developed a sustainable and efficient solution using microfibrillated cellulose (MFC) and reactive ionic liquids.

The study, published in the Journal of Bioresources and Bioproducts, describes the functionalization of MFC using glycidyltriethylammonium chloride (GTEAC). This process results in a novel cationic polyelectrolyte-grafted quaternized MFC (QMFC) with a high degree of quaternization and ion exchange capacity. The QMFC demonstrated remarkable efficiency in removing anionic pollutants, achieving removal rates of 83.2% for nitrates (NO_3^-), 98.1% for sulphates (SO_4^{2-}), and 94.9% for phosphates (PO_4^{3-}) under dynamic flow conditions.

The researchers used a combination of small-angle X-ray scattering (SAXS) and wide-angle X-ray scattering (WAXS) to confirm that the MFC retained its crystalline structure while incorporating amorphous polyelectrolytic grafts. This structural integrity, combined with the increased hydrophilicity of the QMFC, enhances its ability to interact with and remove anionic pollutants. The study also highlighted the material's stability and reusability, making it suitable for repeated use in filtration systems.

The QMFC's performance aligns with green chemistry principles, achieving a process mass efficiency of 2.79, an E-factor of 1.97, and an energy efficiency score of 66.3. These metrics indicate minimal waste production and efficient resource utilization. The low-cost preparation of QMFC (3.5 Euro dollars/kg) further underscores its potential for large-scale industrial applications.

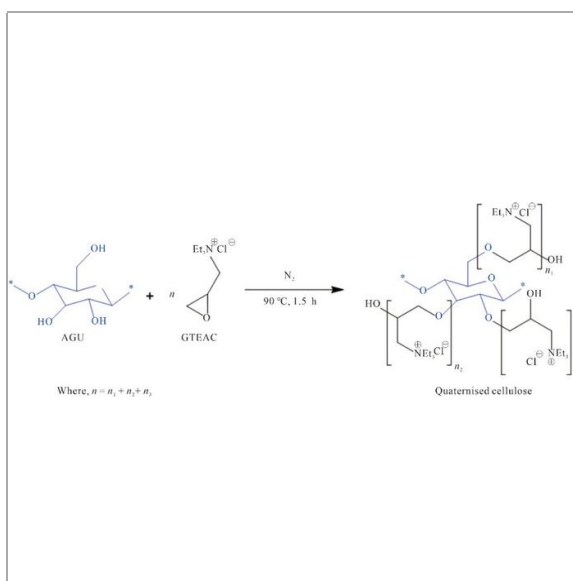


IMAGE:

RESEARCHERS DEVELOP HIGH-EFFICIENCY ION EXCHANGE MATERIALS USING REACTIVE IONIC LIQUIDS

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This innovative approach not only addresses the challenge of water pollution but also offers a sustainable alternative to traditional anion exchangers. The findings suggest that QMFC could be integrated into portable filtration devices and industrial water treatment systems, providing a cost-effective and environmentally friendly solution for removing anionic pollutants. Future research may focus on optimizing the grafting process and exploring the material's potential for removing organic pollutants.

See the article:

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METHOD OF RESEARCH

Experimental study

SUBJECT OF RESEARCH

Not applicable

ARTICLE TITLE

Anion Exchangers Prepared from Graft Polymerisation of Microfibrillated Cellulose Using the Reactive Ionic Liquid

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