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Biobased water treatment materials for industrial wastewaters

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Abstract

The utilization of biomaterials in water treatment has been the subject of great interest during the past few decades. These natural raw materials are attractive since they can be produced from renewable and nontoxic sources. Locally available materials, industrial byproducts, and even waste materials can be utilized as raw materials. Chemical modification of these raw materials is required in most cases in order to improve their affinity towards anionic impurities. Thus the biodegradability of products is not self-evident. We investigated Finnish wood and tree bark materials as well as peat as raw materials in the preparation of anion exchangers. The anion exchangers were synthesized with epichlorohydrin, ethylenediamine, and triethylamine in the presence of N,N-dimethylformamide to produce strong anion exchangers that work in a wide pH range. Elemental analyses revealed a substantial increase in nitrogen content after modification: from 0.8–1.6% to 9.1–9.8% on average. This indicated the attachment of amine groups onto the biomaterials. The efficiency of the exchangers was tested first with synthetic nitrate solutions, as the accumulation of nitrates in groundwater is an emerging worldwide problem. Maximum sorption capacities of 24–30 mg/g were achieved for NO_3^-N. The highest capacity was achieved with modified pine sawdust. Importantly, modified pine sawdust maintained its ion exchange ability well for five ion exchange cycles, including successful desorption cycles with sodium chloride. The results of the study indicate that Nordic lignocellulose materials can be modified into anion exchangers. Further evaluations of these materials are currently underway with real industrial wastewater.

Biography

Dr. Tiina Leiviskä received her M.Sc. degree in Chemistry in 2001 and a D. Sc. (Tech.) degree in Water Engineering in 2010, both from the University of Oulu, Finland. Currently, she is working as a researcher in Chemical Process Engineering Laboratory at the University of Oulu. Her research interests include biological wastewater treatment, coagulation-flocculation, ion exchange, adsorption, and development of water treatment chemicals. She is currently serving as an editorial board member of the Journal of Bioremediation and Biodegradation.