Industrial Crops & Products

Natural fibre-nanocellulose composite filters for the removal of heavy metal ions from water

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Abstract:
Contamination of fresh water sources with heavy metal ions constitutes a serious threat to drinking water safety. Treatment of water in order to remove these contaminants, e.g. copper ions, is thus an important task, usually performed by utilizing adsorbents or continuous membrane/filter processes. In particular combinations of these processes, i.e. adsorption or ion-exchange membranes/filters, are potential solutions in this regard. Thereby, materials derived from renewable resources constitute an environmentally benign alternative to traditional adsorption membrane/filter materials. For example, anionic TEMPO-oxidized cellulose nanofibrils (TCNF) were demonstrated to have high affinity towards heavy metal ions but nanopaper membranes made thereof suffer from low permeance and hence limited performance. To achieve high permeance and efficient adsorption of metal ions utilizing pure nanopapers has still not been possible. However, decorating a porous natural fibre substrate with TCNF should allow for high adsorption capacity towards Cu2+ together with high water permeance. We here present natural fibre-nanocellulose composite filters derived from flax and agave fibres, extracted e.g. from tequila residues, decorated with TCNF. The performance of these filters was determined with respect to their permeance and adsorption capacity for copper. It was shown that this new type of filter derived from industrial crop residues is capable of adsorbing high amounts of Cu(II) ions during a continuous filtration process with very high permeances enabled by their highly porous nature.