Recovery of metal cations from aqueous solutions by the nanocelluloses

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Abstract

Adsorption is one of the most efficient and feasible methods for the metal removal from aqueous solution. The adsorption techniques based on sustainable, efficient, low costs and biodegradable adsorbent has a growing appeal, in particular. In this study fines fraction derived from wheat straw pulp were used as a cellulose source for the production of nanocellulose based adsorbents. The fines fractions were nanofibrillated with a homogenizer and anionized using an oxidative sulfonation as shown in Fig. 1.

Fig. 1 Modification of wheat straw pulp fines to nanocellulose adsorbents.

Production of nanocellulose based adsorbents

The fines of wheat straw pulp obtained by pressure screening were fractionated further to two fractions by density and specific volume using a hydrocyclone (Fig. 2). These two fractions, overflow (O) and underflow (U) of the hydrocyclone, were used as a raw material for the homogenization and further derivatization to adsorbent material.

Fig. 2 Obtaining fines fractions from the wheat straw pulp.

Adsorption of Pb (II) from aqueous solutions

Pb (II) was adsorbed from aqueous model solution by unmodified and anionized nanocelluloses (Fig. 3). The unmodified nanocelluloses showed a poor adsorption capacity, while the anionized nanocelluloses removed efficiently Pb (II) from the solution.

Fig. 3 Adsorption isotherms for Pb(II) removal by nanocelluloses.

The maximum adsorption capacity of modified nanocelluloses was obtained at pH of 5 as shown in the Fig. 4.

Fig. 4 The effect of pH in on adsorption of Pb(II) on sulfonated nanocelluloses.

Conclusions

- Functionalized nanocelluloses offer promising green alternatives for recovery of metals from aqueous solutions.
- Pb (II) was adsorbed efficiently from model solution by anionized nanocelluloses.