NITROGEN-GRAFTED ACTIVATED CARBON FOR REMOVING NITRATE FROM WATER

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Introduction. Nitrate (NO_3~) and nitrite (NO_2~) ions are ubiquitous in the environment and considered hazardous to humans. The primary health hazard from drinking water containing NO_3~ occurs when it is transformed to NO_2~ in the digestive system (Robillard et al., 2006). Currently nitrate is removed from water using polymer anion exchangers. However, this process is expensive and requires a lot of brine (NaCl) for the exchanger regeneration. Alternative physicochemical methods such as reverse osmosis are expensive and inefficient.

The proposed research aims to develop anion-selective nitrogen-containing activated carbon, NGAC that can be regenerated electrochemically and does not require concentrated brine for regeneration. The key to the selectivity of the NGAC is achieved by the deposition of N-bearing conductive polymers or other species such as polypyrrole, polyaniline, pyridinium, quaternary ammonium, etc. onto the AC surface. Our preliminary results indicate that the polypyrrole charge can remain stable through multiple redox cycles (at least 50).

Materials and methods. The original carbon obtained from rice husk carbonized at 700°C, CRH-700 and modified by carbonization with urea CRH-700-U or in the atmosphere of ammonia, CRH-700-N were washed with hot distilled water until neutral pH was reached. The pore size distribution, pore volume and surface area of the carbons were analysed using low temperature nitrogen adsorption (Autosorb-1, Quantachrome). Adsorption of vitamin B_{12} from liquid phase was used to model adsorption kinetics of organic matter.

Results and discussion. The results of the porosimetry show the presence of micropores and mesopores in all three samples (Table 1).

Table 1. *Porosity of the carbon samples. Micropore volume (Vmicro), average mesopore diameter (Dmeso), mesopore volume (Vmeso) and specific surface area S were calculated using Density Functional Theory (DFT) and Brunauer-Emmett-Teller equation (BET).*

Sample	DFT Vmicro (cc/g)	Dmeso (nm)	Vmeso (cc/g)	SDFT (m2/g)	BET SBET (m2/g)
CRH-700	0.336	5.3	0.375	1410	1270
CRH-700-U	0.174	3.9	0.320	910	930
CRH-700-N	0.330	4,9	0.438	1370	1270

The results of adsorption kinetics study showed that within 120 min CRH-700 carbon adsorbed significant amount of vitamin B_{12} (8.35 mg/g), which indicates its ability to remove the accompanying organic contaminants from water.

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References.

1. Robillard PD, Sharpe WE, Swistock BR (2006). Nitrates in Drinking Water. US Department of Agriculture and Pennsylvania Counties Cooperating. resources.cas.psu.edu/WaterResources/pdfs/nitrate.pdf