

EUROPE'S THIRST FOR ACTIVATED CARBON AND A POTENTIAL ANSWER? DUAL-USE ADSORBENTS FROM DRINKING WATER TREATMENT SLUDGE

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Abstract

Due to increasingly stringent environmental regulations combined with strong anthropogenic impacts on water bodies, the demand for activated carbon in Europe is continuously increasing. At the same time, activated carbon used in Germany is still almost exclusively imported. Although activated carbons based on renewable resources are in principle available, competition for these raw materials in Europe is high, resulting in elevated production costs. Sludge from water treatment processes represents a locally available and abundant feedstock; however, the production of adsorbents from this material is often hindered by its high content of inorganic clay minerals. While these minerals are commonly regarded as a disadvantage in activated carbon manufacturing, they may also provide adsorption capacity for cationic heavy metals. This could enable the development of dual-use adsorbents capable of simultaneously removing heavy metals and organic micropollutants. In this study, the production of clay-carbon composite adsorbents from drinking water treatment sludge was investigated using a specially developed laboratory-scale rotary furnace. To optimize the thermal activation process, statistical design of experiments was applied, enabling a systematic evaluation of the most relevant process parameters. Depending on the activation conditions, thermal treatment substantially increased the specific surface area of the produced materials, reaching values between 112 and 201 m²/g. Response surface analysis identified heating rate and ramp duration as significant factors influencing adsorption performance for various organic micropollutants. In addition to organic micropollutant removal, the produced materials exhibited a substantially higher adsorption capacity for chromium compared to a conventional activated carbon.

Keywords: Activated carbon, sustainable adsorbents, activation, drinking water treatment residues, adsorption.

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