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# Valorization of swine manure into low cost activated carbons capable of Cr(VI) removal

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**Abstract.** The valorization of swine manure samples, i.e., de-watered cake (SMc) and solid digestate (SMd), in products with beneficial value, i.e., low cost activated carbons (ACs), is studied. For this purpose slow pyrolysis and steam activation at three different duration times are applied. Additionally, the obtained ACs are characterized and tested towards removal of Cr(VI) from aqueous solutions. It is revealed that BET surface area varies in the range of 236-267 $m^2/g$ for ACs prepared from SMc sample and in the range of 411-432 $m^2/g$ for ACs prepared from SMd sample. Despite the low determined surface area of prepared ACs, a high total Cr removal capacity is observed occurring through a "coupled adsorption-reduction" mechanism. Higher Cr(VI) removal capacity is demonstrated for ACs having higher surface area ($q_m$ is 140.9 mg/g according Langmuir modelling). Cr(VI) removal is found to be pH dependent with a maximum at pH 1. However at that pH significant amounts of Cr remain in the solution as Cr(III). At pH 2 lower amount of Cr(VI) is removed compensated by a higher removal of Cr(III) resulting in a higher amount of adsorbed $Cr_{tot}$. Therefore adsorption at pH 2 is found to be appropriate. The removal capacity of the studied ACs towards Cr(VI) is almost independent of activation time.

**Keywords**: manure; activated carbon; chromium; adsorption

## 1. Introduction

The increased worldwide manure concentrations and increased environmental requirements and regulations towards emissions originating from it ($NH_3$, $NO_x$, methane and non-methane volatile organic compounds and particulate matter) (European Environment Agency 2009) have evoked an amplified interest towards its management. Currently, a number of pathways, i.e., anaerobic and aerobic digestions, composting, flocculation, etc., have been developed in order to valorize swine manure (SM) and to limit its negative environmental impact with respect to surface water, groundwater and air quality, as the lasts are being affected by odors, toxic effluents and gaseous emissions from swine production industries. Nevertheless those technologies suffer from several drawbacks and in some cases contribute to environmental pollution. An alternative option for SM

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