Development, modification and application of low cost and available biochar derived from corn straw for the removal of vanadium(V) from aqueous solution and real contaminated groundwater

Ruihong Meng\textsuperscript{a,b}, Tan Chen\textsuperscript{c}, Yaxin Zhang\textsuperscript{d}, Wenjing Lu\textsuperscript{a,b,*}, Yanting Liu\textsuperscript{a,b}, Tianchu Lu\textsuperscript{e}, Yanjun Liu\textsuperscript{a,b}, Hongtao Wang\textsuperscript{a,b,*}

\textsuperscript{a} School of Environment, Tsinghua University, Beijing 100084, P. R. China
\textsuperscript{b} Key Laboratory for Solid Waste Management and Environment Safety (Tsinghua University), Ministry of Education of China, Tsinghua University, Beijing 100084, P. R. China
\textsuperscript{c} College of Life and Environmental Sciences, Minzu University of China, Beijing 100081, P. R. China
\textsuperscript{d} College of Environmental Science and Engineering, Hunan University, Changsha 410082, P. R. China
\textsuperscript{e} CECEP Clean Technology Development Co., Ltd, Beijing 100083, P. R. China

* Corresponding author at: School of Environment, Tsinghua University, Beijing 100084, China

Email addresses: htwang@tsinghua.edu.cn (Hongtao Wang)
luwenjing@tsinghua.edu.cn (Wenjing Lu)
Thermo-gravimetric analysis

The TG curves of different absorbents (Figure 1S) showed that a continuous weight loss distributed in the range of 38–1000°C. Comparison of the TG curves showed that biochars and AC had higher residual mass (> 70%). Generally, thermal decomposition of biochar could be divided into three stages [31]. In the first stage, loss of surface water occurred at temperatures ranging from 50°C to 100°C. The second stage ranged from 100°C to 350°C, where the degradation of surface functional group occurred. In the last stage, once the temperature was higher than 350°C, the carbon skeletons started to disappear. As the temperature continued to increase from 350°C to 700°C, a smooth and steady weight loss (3.06%-8.08%) of biochars was observed (Figure 1S). Biochars and AC followed nearly different degradation patterns in temperatures from 700°C to 1000°C. Zr-BC, Cs-BC, BC and AC showed better thermal stability as compared to Zn-BC. Thus, comparing the residual mass, Zr-BC (89.12%), AC (87.39%), Cs-BC (82.38%) and BC (81.91%) had better protection from thermal degradation than Zn-BC (72.67%).
Figure 1S. TG curves of modified biochars, BC and AC.
Figure 2S. pH of aqueous solution after vanadium(V) sorption. Equilibrium conditions: adsorbent dosage 1-8 g/L, 25.0 ± 1.0 °C.
**Figure S3.** SEM images of the modified biochars: (a) Cs-BC (10000× magnification), (b) Zn-BC (10000× magnification), (c) Zn-BC (50000× magnification), (d) Zr-BC (10000× magnification).
References