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Efficient Mercury Sorbent: Activated Carbon and Metal Organic Framework Hybrid

Authors : Yongseok Hong, Kurt Louis Solis

Abstract : In the present study, a hybrid sorbent using the metal organic framework (MOF), UiO-66, and powdered activated carbon (pAC) is synthesized to remove cationic and anionic metals simultaneously. UiO-66 is an octahedron-shaped MOF with a $Zr_6O_4(OH)_4$ metal node and 1,4-benzene dicarboxylic acid (BDC) organic linker. Zr-based MOFs are attractive for trace element remediation in wastewaters, because Zr is relatively non-toxic as compared to other classes of MOF and, therefore, it will not cause secondary pollution. Most remediation studies with UiO-66 target anions such as fluoride, but trace element oxyanions such as arsenic, selenium, and antimony have also been investigated. There have also been studies involving mercury removal by UiO-66 derivatives, however these require post-synthetic modifications or have lower effective surface areas. Activated carbon is known for being a readily available, well-studied, effective adsorbent for metal contaminants. Solvothermal method was employed to prepare hybrid sorbent from UiO66 and activated carbon, which could be used to remove mercury and selenium simultaneously. The hybrid sorbent was characterized using FSEM-EDS, FT-IR, XRD, and TGA. The results showed that UiO66 and activated carbon are successfully composited. From BET studies, the hybrid sorbent has a SBET of 1051 $m^2\ g^{-1}$. Adsorption studies were performed, where the hybrid showed maximum adsorption of 204.63 mg g^{-1} and 168 mg g^{-1} for Hg (II) and selenite, respectively, and follows the Langmuir model for both species. Kinetics studies have revealed that the Hg uptake of the hybrid is pseudo-2nd order and has rate constant of 5.6E-05 g $mg^{-1}\ min^{-1}$ and the selenite uptake follows the simplified Elovich model with $\alpha = 2.99$ mg $g^{-1}\ min^{-1}$, $\beta = 0.032$ g mg^{-1}.

Keywords : adsorption, flue gas wastewater, mercury, selenite, metal organic framework
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