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The systematic study of synergistic and antagonistic effects on the adsorption of pyrene and copper onto mesoporous silica from aqueous solution

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Polycyclic aromatic hydrocarbons (PAHs) and heavy metals are mircopollutants which are persistent compounds in the environment. Both PAHs and heavy metals have toxic effect on human and wildlife in trace level. Furthermore, growing evidence suggests that the co-toxicity of PAHs and heavy metal is generally larger than their individual toxicity. Consequently, the requirement for effective removal methods for PAHs and heavy metals pollution from aqueous solution has attracted increasing concerns. In this study, the mesoporous silica adsorbent SBA15 before and after modification were used to eliminate the pyrene and Cu (II) from aqueous. The results showed that the adsorption of pyrene and Cu(II) onto the adsorbents was fast and the Langmuir model fitted the adsorption better. The increasing ionic strength enhanced the adsorption capacity of pyrene while decreased the Cu (II) adsorption onto the adsorbents. Furthermore, it was found that the modification influences the adsorption behavior greatly. There are antagonistic effects on the adsorption of pyrene and Cu (II) onto SBA15. However, after the modification of Fe(III) into the framework of mesoporous silica, the synergistic effect was observed in the adsorption process. The decreasing adsorption capacity could be attributed to the competitive effect between pyrene and Cu (II). While the increasing adsorptive capacity could be attributed to the formation of complex pyrene-Cu (II) through cation-π interactions or the stronger affinity for the complex than pyrene or Cu(II) separately. This study shows new guidelines and useful information for the removal of PAHs and heavy metals from aquatic environments.

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