

工程热物理

改性壳聚糖性能表征及脱除烟气中HgO的实验研究

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摘要: 采用VM3000在线测汞仪(CEMS)和Ontario Hydro (OH)方法作为检测手段,在固定床实验台架上,以壳聚糖(chitosan, CTS)和改性壳聚糖(modified chitosan, MCTS)为吸附剂,进行脱HgO实验研究。同时采用比表面积分析仪(ASAP2020)、热重分析仪(TG)、X射线衍射仪(XRD)和傅里叶变换红外光谱仪(FTIR)等分析仪对吸附剂进行了详细表征。发现氨基和羟基可能与HCl分子和Cu离子发生反应,形成了壳聚糖盐酸盐和铜模板壳聚糖螯合物。改性后的吸附剂上形成了C-Cl键,而且铜模板型壳聚糖(Cu-CTS)因铜离子空缺而拥有记忆功能,可吸附与铜离子半径大小相当的金属离子或分子,大大提高了其对HgO和Hg2+的吸附效率。实验结果表明:未经任何处理的CTS原粉不吸附HgO,经过改性后的CTS能够氧化Hg0并吸附Hg0和Hg2+,盐酸溶胀型铜模板CTS吸附剂脱汞效果尤为明显。

关键词: 改性壳聚糖 吸附 脱汞 铜模板 记忆功能

Characterization and Application of Modified Chitosan for Elemental Mercury Removal From Simulated Flue Gases

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Abstract: Adsorption experiments of vapor-phase elemental mercury (Hg0) were carried out using commercially available chitosan (CTS) and modified chitosan (MCTS) in a laboratory-scale fixed-bed reactor. VM3000 online mercury analyzer (CEMS) and Ontario Hydro method (OH) were applied to detect the inlet and outlet Hg0 concentrations and to determine the mercury speciation during adsorption process respectively. Simultaneously, the characterization of the sorbents was analyzed using accelerated surface area porosity (ASAP2020), thermogravimetric analysis (TG), X-ray diffraction (XRD) and Fourier transform infra-red spectroscopy (FTIR). It was observed that CTS hydrochloride and Cu-CTS chelate complex could be formed mainly through the reactions of the amino group and the hydroxyl group in the CTS polymer chain with the hydrochloric acid and copper sulfate solution. C-Cl bond was formed through modifying process. The copper-templated CTS, which has memory function for Cu2+ vacancy, can adsorb the metal ion or vapor-phase metal which has similar radius as copper ion. Theses changes greatly improve the Hg0 and Hg2+ capture efficiency. The results show that the parent CTS has no effect on Hg0 removal, while modified CTS not only can oxidize Hg0 to Hg2+ but also have ability to adsorb Hg0 and Hg2+, especially when the copper- templated CTS are swelled by Hydrochloric acid.

Keywords: modified chitosan adsorption mercury capture copper-templated memory function

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