347b A Nanostructured Chelating Adsorbent for the Capture of Gaseous Mercury: Synthesis and Characterization

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A novel adsorbent for the capture of mercury vapor from flue gases has been developed. The adsorbent uniquely combines a chelating ligand with an ionizing surface nano-layer on a mesoporous substrate. This enables selective, multi-dentate adsorption of mercury directly from the gas phase. A prototype adsorbent has been developed to illustrate the workability of the concept material. The synthesis and performance characteristics of this material were recently published (Abu Daabes and Pinto 2005). The prototype has an operating temperature limit of 135^{o}C. This implies that some cooling (25-30^{o}C) of the flue gas will be required for a mercury adsorber placed immediately downstream of the particulate collectors. To eliminate the associated cooling cost, and widen the range of contacting options, advanced versions of the adsorbent have recently been synthesized. The structure and characteristics of these will be described. It will be shown that these newer materials can operate stably at temperatures in the range of 160- 175^{o}C in typical flue gases. Furthermore performance measurements in a fixed-bed adsorber with very short gas residence times (<0.3s) have shown very high capture efficiencies for oxidized mercury, and operating capacities as high as 86 (mg Hg^{2+}/g adsorbent). The efficient uptake is attributed to a combination of factors resulting from the engineered structure of the adsorbent. This includes an extremely high driving force for adsorption due to the use of chelation, the use of an oxidizing nanolayer with a very high affinity for Hg, careful control of the active-layer thickness, and the use of a substrate with the proper pore-size and surface-area characteristics for the application. Furthermore, it will be shown that the concept can be extend to the capture of elemental mercury by proper selection of the oxidizing nanolayer.

Reference:

Abu-Daabes, M and N.G. Pinto, Chem. Eng. Science, 60, 1901-1910 (2005)